

ABSTRACTS AND REVIEWS

NOTE.

1. The abstracts of British Patents are taken from the official abstracts in "Illustrated Official Journal (Patents)."
2. The fact that an abstract is given of a U.S.A. Patent Specification does not necessarily imply that there is no corresponding British Patent Specification.

I.—Glass-making Materials.

1. Potassium Salts from Blast Furnace Dust. STAFFORD COAL & IRON Co., Stoke-on-Trent, and J. R. RICHMOND. (Brit.

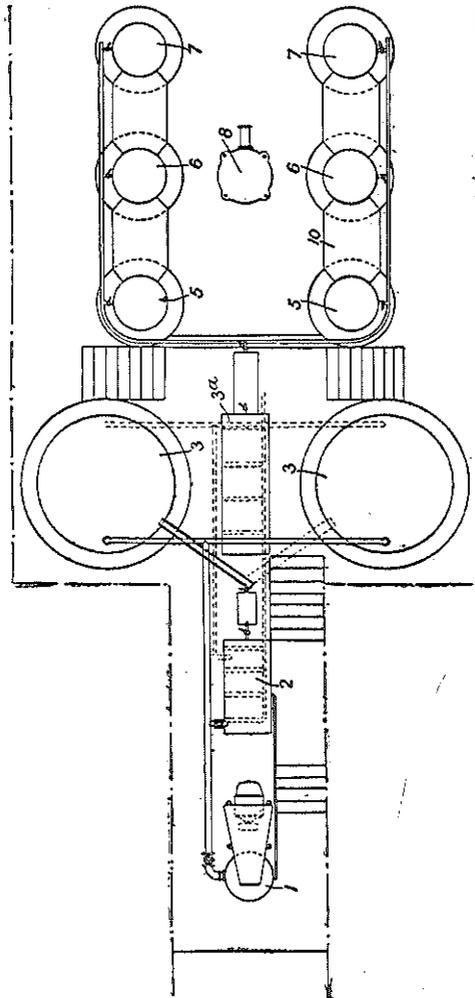


FIG. 1.

Pat. No. 117991.) (September 8th, 1917, No. 12887).—Blast furnace flue dust is dissolved in water and treated with air to render the

iron compounds insoluble. Lime or the like is then added to precipitate magnesia, and the solution is then evaporated to dryness and calcined, the residue being finally redissolved and evaporated to obtain crystals. Ammonium chloride may be obtained by giving the dust a preliminary heating, or ammonia may be recovered when the lime is added.

H. G. C.

2. Sifting Machinery. A. C. HARRISON, Stoke-on-Trent (Brit. Pat. No. 118800.) (March 5th, 1918, No. 3823).—A machine for sifting potters' slip, powdered substances, etc., consists of a frame, *a*, carrying detachable lawn frames or sieves, *b*, *c*, *d*, placed one above the other, and a collecting-box, *e*, below the lowermost sieve, rocked on a shaft, 2, arranged longitudinally and in the centre of the machine by means of a link, 7, and a crank, etc. Springs, 9, mounted on a fixed structure, engage with the frame

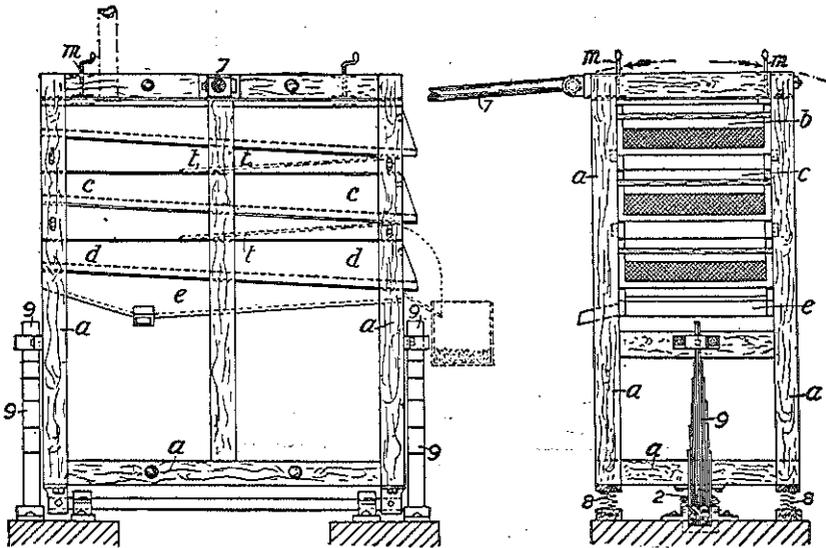


FIG. 2.

and tend to keep it in the vertical position. The detachable sieve frames are fitted with inclined sieves provided with inclined partitions, *t*, to convey the material passing through one sieve to the upper end of the next sieve, and are open at their lower ends. The sieve frames are clamped up in the frame, *a*, by clamping screws, *m*, and the tension of the sieves may be regulated by eccentric rollers bearing across their lower surfaces. Buffers, 8, may be provided below each corner of the rocking frame. In a modification, the rocking frame is suspended from an overhead shaft carried by a beam.

H. G. C.

3. A Comparison of Dolomites. A. ROTHBROCK and J. B. SHUMAKER (*Chem. News*, 1920, 120, 29).—The compositions of a

No.	Source.	Physical characteristics, etc.	Spec. Gravity.	Composition.					Total.
				SiO ₂ .	Fe ₂ O ₃ .	Al ₂ O ₃ .	CaCO ₃ .	MgCO ₃ .	
1	Ossining, N.Y.	White; crystalline; very compact.	2.93	10.61	0.20	Trace	51.97	37.40	100.18
2	Cumberland, England.	Dark grey; massive.	2.88	0.56	16.05	0.87	57.59	24.98	100.05
3	Cerro Gordo, California.	Light coloured; massive; non-crystalline.	2.57	0.06	0.09	—	87.88	11.85	99.88
4	Frankenstein, Germany.	Grey; compact; massive; hard; conchoidal fracture; neither granular nor crystalline.	2.9	0.13	3.71	0.73	27.04	67.91	99.52
5	Keeler, California.	White; very hard; compact; crystalline; resembles marble.	2.7	32.57	0.06	—	66.08	1.15	99.86
6	Binnenthal, Switzerland.	Greyish-white; contains transparent crystals; resembles marble; crumbles easily.	2.85	10.84	0.48	—	49.00	40.23	100.55
7	Gerolstein, Germany.	Hard; compact; massive.	2.82	1.23	0.80	0.22	52.93	44.33	99.51
8	Costa da Val, Tyrol.	Pearly lustre; coarse particles; light colour with yellow streaks; closely approximates to 2CaCO ₃ ·MgCO ₃ ·FeCO ₃ .	3.01	0.12	2.36	—	49.59	24.50	100.01*
9	New Almadin, California.	Greyish-white; hard; very compact; long, coarse crystals; one surface coated with brown deposit.	2.8	0.4	8.57	—	53.28	45.18	100.11†
10	Raible, California.	Light grey; fine, granular crystals; somewhat porous.	2.7	0.23	trace	0.28	54.64	45.18	100.33
11	Brewster's, N.Y.	Grey; large, rhombic crystals.	2.9	0.33	2.44	—	59.98	36.83	99.58
12	Missouri.	Outer layer: light pink crystals.	—	0.23	1.18	0.63	56.63	41.37	100.04
		Inner layer: dark grey crystals.	—	3.96	0.89	1.16	57.18	36.83	100.02
13	"The Dolomites," Austrian Tyrol.	Grey.	2.73	0.48	0.56	0.57	94.21	4.15	99.97
		Brenner, Brenner Pass.	—	0.35	—	0.50	96.25	2.98	100.08

* Includes FeCO₃, 23.44.

number of dolomites, or supposed dolomites, were given as follows, showing wide variations from the typical dolomite $\text{CaCO}_3, \text{MgCO}_3$, which contains 54.35 per cent. of CaCO_3 and 45.65 per cent. of MgCO_3 .
F. W. H.

4. Potassium Salts from Glaucosite. F. TSCHIRNER, Newark, New Jersey, U.S.A. (Brit. Pat. No. 117870.) (November 2nd, 1917, No. 16013).—A process for obtaining potassium chloride from glaucosite.
H. G. C.

5. Potassium Chloride Preparation. E. A. ASHCROFT, London. (Brit. Pat. No. 119492.) (August 28th, 1917, No. 12363).—A process for obtaining potassium chloride from potash-bearing minerals, such as felspar, mica, alunite, or leucite, or from cement-kiln dust, blast-furnace dust, wood or plant ashes, beet-sugar residues, etc., by treating the substances with chlorine gas while suspended in a fused bath of sodium or potassium chloride, or a mixture.
H. G. C.

II.—Glass: Manufacture and Properties.

6. Glass and some of its Problems. H. JACKSON (*J. Roy. Soc. Arts*, 1920, 68, 134).—Dealing with the relative plasticity of various glasses, it was pointed out that the satisfactory sealing of wires into glass did not depend solely on the coefficients of expansion of the materials concerned. Certain glasses gave successful joints with platinum and copper wires, but always cracked with iron wire, although the coefficient of expansion of copper was double that of platinum, and that of iron about midway between the two. Examination showed that in the case of the softer metals, like platinum and copper, the glass, on setting, could deform the wires, and so tend to prevent excessive strain being left in the glass. In the case of harder metals, like iron and tungsten, it was necessary to have a glass which showed considerable plasticity over a sufficient range of temperature to permit of the glass flowing and following the contraction of the wire when the joint cooled.

Plasticity was also concerned in the durability of glass vessels when subjected to sudden changes of temperature. The coefficient of expansion was again an important factor, but if the strain set up in the glass, due to change of temperature, could be rapidly

released, the tendency to crack would be diminished. It was possible to make a glass having a higher coefficient of expansion which would not crack so easily as one having a lower coefficient of expansion, owing to the greater plasticity of the glass with the higher coefficient of expansion.

The structure of glass and the phenomena of crystallisation were illustrated by reference to the behaviour of arsenic trioxide, sulphur, zinc silicate, lime-soda-silicate glass, and a number of borates. There was a certain temperature at which crystallisation proceeded readily, whilst for small ranges above and below that temperature no crystallisation occurred. With alteration of temperature there was a corresponding change of viscosity, with the consequent modification of the freedom with which the particles of the substance could move among themselves. When the viscosity was too great, rearrangement of particles to form crystals was prevented. Gases, as foreign matter in the materials, aided crystallisation, as illustrated by the behaviour of water and phenyl salicylate. Removal of the gas made it possible to cool the material many degrees below its melting point before crystallisation took place. Simple silicates and borates gave off water vapour on alternate melting and solidification, and with the progressive removal of the water vapour the vitreous state persisted more and more. Direct introduction of water subsequently, readily promoted crystallisation.

Etching with hydrofluoric acid, and also tearing the surface of glass by means of a glue film, caused markings on the glass, which had a network appearance, but examination under the microscope gave no evidence of crystalline structure, and the phenomenon was more probably due to surface tension. A study of the phosphorescence of nitreous compounds, including glasses, gave rise to the conclusion that a truly vitreous body exhibited no phosphorescence in ultra-violet light or X-rays, or under cathodic discharge. Nearly every glass showed some phosphorescence, which suggested that there was something of a crystalline nature in the glass. Boric anhydride, which had a marked effect in preventing crystallisation in glass, that is, in preserving the vitreous state, was a fatal ingredient to add to a uranium glass if strong fluorescence in ultra-violet light was desired. The question whether glass was crystalline or not had an important bearing on the production of glass for lampworking purposes. The segregation of less fusible vitreous bodies, giving a kind of crinkled skin to the glass, the separation of amorphous silicates, the formation of minute bubbles, giving a grey appearance to the glass, as well as true crystallisation, were all frequently referred to as devitrification. Concerning the last-mentioned trouble, apart from temperature, which was the most important factor, there were two problems to be considered. It was pointed out that a soda-lime silicate could be made which could scarcely be worked at all in the flame, owing to rapid devitrification, yet could be worked if heated by radiation in a muffle furnace. The problems arising were, first, whether work-

ing in the flame caused the surface of the glass to be raised to a very high temperature, and a thin layer of glass accordingly reached the requisite state of fluidity for crystallisation, or, secondly, whether the hot gases of the flame had a chemical action on the glass. Experiments directed towards the solution of these problems appeared to justify the conclusion that water and carbon dioxide did act chemically, and such action played an important part in the initial stages of devitrification. Other than boric anhydride, previously mentioned, the oxides of aluminium, titanium, zirconium, tin, thorium, arsenic, and antimony tended to prevent devitrification. The disadvantages attending the use of some of these oxides were also mentioned. Soda glasses were more liable to devitrify in the flame than potash glasses or glasses containing a fair proportion of potash with soda.

The production of various types of opal glass was briefly discussed, and the distinction between opalescence and devitrification indicated. Examination under the microscope showed that in the usual opals the opalescence was due to the scattering of light by numerous small globules evenly diffused throughout the glass with no evidence of crystallisation.

Dealing with coloured glasses, the author discussed the production and properties of glasses containing gold, copper, and selenium as representative of those glasses in which the colouring was diffused in very minute particles throughout the glass, and which could be compared with colloidal solutions. Gold gave colours varying from red through the purples to blue; copper, in the metallic state, gave a red normally, but would also give variations similar to gold, even to a definite blue, by transmitted light; selenium glasses were generally red, but various states of division would give other colours. Whilst accepting the chemical and physical evidence that, when they did give colour, the three substances mentioned were in the elementary state, the author considered that it did not necessarily preclude the possibility that there might be something akin to chemical combination in the case of the chilled and colourless glasses.

Interesting experiments were described which gave some light on the development of the pink or violet colour in window glass. Glasses containing small amounts of manganese dioxide and as little iron as possible were made, and these were practically colourless to the eye. On exposure to radium, some of the glasses were coloured, but others remained colourless. The former were made under conditions which caused as little deoxidation of the manganese as possible, whilst the latter were made under conditions which were arranged for complete reduction of the manganese. Rods drawn from one of the former glasses, which cooled practically colourless, "struck" a violet colour on re-heating. After noting the connection between this effect and the question of the chemical condition of colouring agents in glass, the author pointed out that it was possible that the colours in old window glasses were not due to manganese dioxide itself, but that the manganese might

have rendered the alkali compounds in the glass more sensitive to light of short wave-lengths.

As examples of those glasses in which the colouring agents were in a state resembling solution, and which might be compared with aqueous solutions of coloured salts, nickel and cobalt glasses were described, and also the effect of different alkalis and the effect of varying proportions of an alkali. Using equivalent proportions of the alkalis and the same amount of nickel, a potash glass gave a deep violet, a soda glass a brown with a faint violet tinge, and a lithia glass a yellowish-brown of less colour intensity than in the soda glass. Similarly, cobalt gave blue colours with potassium and sodium, and a bluish-violet, less coloured, with lithium.

The effect of alkalies on borate glasses containing nickel and cobalt was dealt with in similar fashion, and also the effect on glasses containing copper oxide. The changes of colour observed, such as from brown to violet in the case of nickel, from pink to blue in the case of cobalt, and the progressive development of the colour of copper, all brought about by increasing the proportion of alkali, appeared to point to something like a separation of the oxides of those metals, if not a definite separation. With very little alkali present, the coloured oxides might be playing a basic part, but as the proportion of alkali was increased they might be freed or caused to play an acid part.

F. W. H.

7. Production of Selenium Red Glass. F. A. KIRKPATRICK and G. R. ROBERTS (*J. Amer. Cer. Soc.*, 1919, 2, 895).—Thirty pounds of batch were melted in closed pots at 1400°. The batch was introduced in three fillings over a period of three hours, and the melting and fining occupied eight hours. Then the metal was allowed to cool during half an hour to working temperature, and the working out occupied two or three hours. To prevent the escape of volatilised selenium from the pots, the pot stoppers were covered with wet clay. Prior to working out, the metal was skimmed, the skimmings being used as cullet.

Melts were made of a soft working zinc-alkali glass and a plate glass, the formulæ and batches for which were as follows:—

Zinc-alkali glass.			Plate glass.				
Formula.	Batch.		Formula.	Batch.			
SiO ₂ ...	2.26	Sand	100.0	SiO ₂ ...	2.62	Sand	100.0
K ₂ O...	0.239	Potash.....	30.3	Na ₂ O .	0.427	Soda-ash	29.8
Na ₂ O	0.408	Soda-ash .	30.3	CaO....	0.549	Hydrated lime ...	27.7
ZnO...	0.353	Zinc oxide.	21.2	CdS ...	0.015	Cadmium sulphide	1.35
CdS ...	0.0142	Cadmium sulphide	1.51	Se ...	0.020	Selenium	1.04
Se	0.026	Selenium...	1.51	MgO...	0.024		
B ₂ O ₃ ...	0.0145	Borax	1.51				

The glass was gathered on punties and worked by pressing or blowing in a mould, or by blowing without press or mould. The

use of the three different methods determined the operations necessary for the development of the correct colour.

It was found that the method of working was a most important factor in the production of selenium red glass. Escape of selenium throughout the whole melting and fining period must be prevented, and the glass must be allowed to cool immediately after gathering for a sufficient length of time, usually from half to one minute, and from pot temperature to from 400° to 700° , in order to bring the selenium into the proper state of dispersion for the subsequent development of the red colour by re-heating. Pressed ware gave the best colour when heated, after pressing, for a period from one to five minutes at 900° . Sometimes articles blown in a mould developed colour before being placed in the lehr, and sometimes afterwards. By purely hand-working methods, decanter-shaped vases, 6 inches to 12 inches in height, were made from both kinds of glass. The plate-glass vases tended to give a sealing-wax-red colour, probably due to crystallisation. The zinc-alkali glass vases did not give this result normally, but crystallisation could be produced by heating for thirty minutes at 900° . In both cases the colour developed during working, before being placed in the lehr.

Temperatures of glory-holes and lehrs were given, and details tabulated of the time taken for each separate operation, and diagrams were given showing the effect of specimens on the prismatic solar spectrum. The following were typical tables:—

Pressing in a Mould.

Zinc Glass Lenses, 3 Inches in Diameter.

Time in seconds from instant of gathering.	Stage of process.
0 to 2	Glass gathered from pot.
2 „ 20	Glass marvered (rolled on iron plate).
20 „ 40	Lens pressed in mould.
40 „ 60	Lens allowed to cool.
60 „ 120	Lens flashed in glory-hole.
120 „ 130	Lens allowed to cool.
130	Lens placed in lehr.

Blown in a Mould.

Time in seconds from instant of gathering.	Stage of process.
0 to 2	Glass gathered.
2 „ 30	Glass blown and worked to shape in iron blocks.
30 „ 130	Glass bulb allowed to cool until dark (about 400°).
130 „ 200	Glass bulb flashed in glory hole.
200 „ 230	Salt shaker blown and held in mould.
230 „ 240	Salt shaker placed in lehr.

Making of Vases.

Time in seconds from instant of gathering.	Stage of process.
0 to 3	Glass gathered on punty.
3 ,, 8	Glass bulb blown and swung to length.
8 ,, 30	Bulb marvered.
30 ,, 40	Bulb blown to a larger size.
40 ,, 45	Bulb swung to length.
45 ,, 50	Bulb taken to work bench.
50 ,, 60	Neck cut in bulb.
60 ,, 75	Bulb swung to length.
75 ,, 90	Bottom of bulb softened in glory hole.
90 ,, 110	Vase shaped by allowing it to stretch and by pressing the bottom against an iron plate.
110 ,, 125	Bulb of vase blown to larger size.
125 ,, 140	Bottom shaped by pressure of tool.
140 ,, 150	Vase heated in glory-hole.
150 ,, 180	Bottom again shaped.
180 ,, 185	Bottom of vase stuck to another punty.
185 ,, 225	Top of vase heated in glory-hole.
225 ,, 230	Vase swung and revolved to straighten neck.
230 ,, 250	Vase rotated on punty and top of neck flared with tools.
250 ,, 270	Vase allowed to cool to just below red heat.
270 ,, 275	Vase broken off punty.
275 ,, 280	Vase placed in lehr.

F. W. H.

8. Selenium as a Colouring Agent for Soda-lime-Silicate Glasses. P. FENAROLI (*Chem. Zeit.*, 1912, 36, 1149, and 1914, 38, 177).—In order to investigate the action of selenium as a colouring agent, the author made special melts based on the formula $6\text{SiO}_2, \text{CaO}, 2\text{Na}_2\text{O}$ in porcelain crucibles. The glass took from twenty-four to thirty hours to clear at about 1400° . When each melt was clear, finely powdered selenium element was added, the proportion varying from 0.05 to 0.2 part of Se to 100 parts of sand. When the glass was once again clear, the crucible was covered and the furnace closed, in order to prevent oxidation, and the whole allowed to cool very slowly. The proofs of all the melts, taken before closing down, were almost colourless. The final products, obtained by slow cooling, were also colourless when viewed by transmitted light, but exhibited a blue fluorescence, which increased as the selenium content increased. Examination of the glasses by the ultramicroscope showed this fluorescence to be due to colloidal particles in the case of the glasses rich in selenium, but submicrons could not be distinguished in those which only contained a small quantity.

The meltings were then repeated, with the addition of 0.5 part of charcoal to 100 parts of sand in each melt, in order to ensure reducing conditions. The proofs before the addition of Se were again colourless. The addition of selenium produced a deep reddish-brown colour, which was very intense even with the smallest quantity added. The intensity of the colour increased relatively little with larger selenium content. The blue fluorescence previously observed was again present when the selenium content

was large, though not to such a great degree. Those glasses with little selenium were again optically clear, even though intensely coloured. The richer ones again contained colloidal particles.

An absorption spectrograph of the red glass showed absorption from $\lambda = 424 \mu\mu$ to $\lambda = 505 \mu\mu$. This was the same as was obtained with selenium hydrosols and aqueous solutions of sodium and potassium polyselenides. Further, all the glasses when dissolved in HF, in an atmosphere of CO_2 , gave H_2Se , metallic Se being precipitated. This supported the view that selenides were present.

In the second paper further investigations were described. In these experiments the glass was melted at a temperature of 1530° , taking six to seven hours to clear, and being cooled down after nine hours. A reducing atmosphere was obtained in the furnace, rendering the addition of charcoal unnecessary. 0.1 part of Se was added for every 100 parts of silica, and the proof was a bright salmon colour. The slowly cooled glass was feebly flesh-coloured, milky, and quite opaque, even though several melts were carried out. The transparent glass gave H_2Se and Se with HF; the milky glass gave H_2Se , but very little Se. The former was not optically clear, but the diffraction cones were reddish-violet and not sky-blue, as previously. The colour more nearly resembled that of the commercial red glasses than the previous specimens had done. The slowly cooled glass was a suspensoid with sky-blue diffraction cones.

The same amount of selenium was added to a glass of the composition of $9\text{SiO}_2, \text{CaO}, 1.66\text{Na}_2\text{O}, 0.33\text{K}_2\text{O}$, and similar colour effects were observed, but in this less basic potash glass a purer red was obtained than with the more basic soda glass. It was noted that Le Blanc had found when selenium was dissolved in a concentrated KOH solution, a mixture of selenides and selenites was formed, and when the solution was diluted, selenium element was precipitated.

The author concluded that the various glasses obtained were coloured in the following ways. The brownish-red, optically clear glasses obtained by energetic reduction contained polyselenides as pigment. The straw-coloured glasses, produced when the reduction was only partial and when the metal was slowly cooled, contained selenides and selenites. The selenites, being only slightly soluble in the glass, produced opalescence, and the selenides coloured the glass. The commercial red glasses obtained by preventing a too slow cooling contained colloidal selenium as pigment. This was formed at high temperatures by the dissociation of the sodium polyselenide formed at the beginning of the melt, and as the glass was fairly rapidly cooled, it could not change back into the selenide. This took place, with slow cooling, according to the equation $3\text{Na}_2\text{O} + (2n+1)\text{Se} = 2\text{Na}_2\text{Se}_n + \text{Na}_2\text{SeO}_3$, the change going to the left at high temperatures and to the right at relatively low ones. This explained the cloudiness of the slowly cooled glasses, which were otherwise red.

The red glasses contained submicrons less than $40 \mu\mu$ in length,

and the general properties of these colloidal solutions corresponded accurately with those of other selenium sols. The glasses also bore a marked resemblance to Hoffmann's "ultramarines." A glass was melted to the formula 3.6 grams of borax, 0.01 gram of Se, and 2.2 grams of boric acid (that is, approximately $\text{Na}_2\text{O}, \text{B}_2\text{O}_3$) to illustrate this resemblance. The proof was transparent yellow; when the glass was cooled to about 800° , it was purplish-red, and when cooled to 500° it was dirty red and cloudy. Thus the soda-lime-silicate glasses and the "ultramarines" were very much alike, and probably their constitutions similar. J. R. C.

9. Tellurium as a Colouring Agent for Soda-lime-Silicate Glasses. P. FENAROLI (*Chem. Zeit.*, 1914, 38, 873).—

The experiments followed the same course as those referred to in the preceding abstract. The preliminary melts, without the addition of charcoal, and without special precautions to ensure a reducing furnace atmosphere, yielded proofs which were almost colourless, the slowly cooled mass being also without colour. The addition of charcoal caused an uneven colouring, even with little tellurium. The greater part of the mass was brown, but in some places it was a dirty olive-green when viewed by reflected light. When the tellurium concentration was great, the irregularity of the colouring increased; in some places it was coral-red, in others sky-blue, and in others brown. None of these glasses was optically clear. Tellurium hydrosols behaved in the same way, and the absorption spectra of the glasses were similar to those of the hydrosols. An analogy with Hoffmann's "ultramarines" was again remarked. When treated with HF, the glasses yield H_2Te and precipitated tellurium, indicating the presence of polytellurides. It was concluded that the action of tellurium was to be explained in the same way as that of selenium. J. R. C.

10. The General Behaviour of the Elements Sulphur, Selenium, and Tellurium in Soda-lime-Silicate Glasses with Particular Reference to the Colour Produced. P. FENAROLI (*Kolloid Zeitsch.*, 1915, 16, 53).—

The experiments referred to in the two preceding abstracts had led to the conclusion that the elements of this group were only effective in colouring glasses when they are present either as colloidal elementary solutions or as polysulphides, polyselenides, or polytellurides of the metals in the glasses, probably of the alkali metals. As the polysulphides, selenides, and tellurides did not differ greatly from solutions of the elements in the monosulphide, selenide, and telluride, the colouring effect might be attributed to the elements themselves, the various colours obtained depending on the manner of solution, or, more accurately speaking, on the degree of dispersion of the elements in the solution.

The glasses coloured by sulphur were first considered. If the glass contained only a small amount of heavy metal, a yellow or yellowish-brown colour was produced, the glass being optically clear.

The colour was due to the sulphide, with excess of sulphur, probably also to polysulphides, as it was the same as that exhibited by an aqueous solution of the alkaline polysulphides, which contained highly dispersed sulphur. The strongly electronegative character of sulphur did not permit it to exist in any other state than that of a true solution in the sulphide when the glass was an alkali-lime glass of ordinary composition melted under reducing conditions. Hence the colour could not vary. In a soda-borate glass, which was of a more acid character, the possibility of the presence of free sulphur was greater, and blue glasses might be obtained.

Selenium was of a less electro-negative nature than sulphur, and thus it was possible for it to be present in the elementary condition even in the soda-lime-silicate glasses. With very alkaline glasses and strongly reducing conditions, in this case, also, the chestnut-brown colour obtained was due to a true solution of the selenide or polyselenides. In glasses where the alkalinity was not too pronounced and the reducing conditions during melting not too strong, the greater part, if not all, of the selenium might be dissociated and form a colloidal solution, red and other coloured glasses being obtained. As the colour depended on the size and dispersion of the submicrons, it was affected by the rate of cooling, as above described. The colourless glasses sometimes obtained were due to the presence of the selenium in a very high degree of dispersion, probably molecularly dispersed. The author considered that the purer red produced when potash was used instead of soda was due to the greater viscosity of the potash glasses. This caused an increase in the dispersion of the submicrons, and consequently the transmitted light was redder. If a selenium soda-borate glass was maintained for a long time in the molten condition at a low temperature, it changed from yellow to red, and became more red the longer it was kept in that state.

Tellurium was still less electro-negative than selenium, and therefore it was easier to get it in the elementary condition in soda-lime-silicate glasses. Its irregular behaviour had prevented any relation being established between the colour and the tellurium concentration, but it was considered not improbable that a colloid-disperse substance was formed which had no direct influence on the colour.

J. R. C.

11. The Colours of Colloids, Glasses, Glazes and Gems. W. D. BANCROFT (*J. Physical Chem.*, 1919, 23, 603, 623).

—When glasses were coloured by some metals, for example, gold, silver, and copper, examination by the ultramicroscope showed them to be colloidal and to possess the characteristics of colloidal solutions. When a gold-containing glass was quickly cooled it was colourless, a red colour being developed by re-heating, and if kept too long at a high temperature a blue colour was observed. This last appeared to be due to the coagulation of the colloidal particles. The colourless glass was difficult to explain. It was probably due to the presence of the gold in a true solution or to

its particles being too small to have an optical effect. Zsigmondy preferred the former explanation.

In the case of copper ruby glass, Seger had stated that it was not due to precipitation of metallic copper, as, in order to obtain the best red glaze, alternate oxidising and reducing conditions were necessary. Stokes had optically examined a glass coloured red by copper in a very thin stratum on one face, and concluded that a small proportion of the copper was present in a state of suboxide, or as a silicate of this base, and the rest was metallic copper. Zulkowski thought the red due to cuprous oxide, but the general consensus of opinion was against him. Zsigmondy pointed out that though copper hydrosols were red and cuprous oxide hydrosols orange, anhydrous cuprous oxide was red, and it was probable that an anhydrous colloidal solution of cuprous oxide would also be red. If the copper was present in the cuprous state it must be as oxide, because cuprous silicate, even though it might be red, would give an optically clear glass. The question arose whether or not cuprous oxide could exist in glass.

The yellow stain produced by firing a glass with silver was due to finely divided colloidal silver. It was best obtained with potash-lime glasses. With "hard" glasses, the silver tended to be deposited metallically. Platinum and iridium oxides could be used to give grey colours, and suspended carbon gave rise to yellow.

Glasses containing no heavy metals were coloured yellow by sulphur, the colour being due, apparently, to polysulphides. More acid glasses might be coloured blue by colloidal sulphur (see preceding abstracts). Glasses could be coloured yellow by colloidal cadmium sulphide. At certain concentrations of some colouring oxides, a second phase appears. Thus it was possible to make a chrome-aventurine glass in which the second phase could be seen, though it was not known whether or not it was chromium oxide or a chromium silicate.

In general, glasses coloured by silicates of iron, copper, manganese, and cobalt were optically empty, but as stannic oxide, zirconia, titania, magnetite, and probably cuprous oxide could exist as second phases under certain conditions, this might not be universally true, so the colours produced by these common colouring agents were examined. Iron usually produced a yellow or green colour in glasses and glazes, but in some cases the latter were coloured red through the iron being present as ferric oxide, and not in solution. Both cobaltic and cobaltous salts gave rise to a blue colour. Nickel, manganese, and iron turned this blue to a greyish-blue. With cobalt and chromium, all shades of bluish-green could be obtained. Manganese coloured glass in various tints from amethyst to violet. The individual effects of the various manganese oxides had not yet been ascertained, though it was probable that manganese oxide took up oxygen to form the peroxide, losing this oxygen again on fusion. Wicks and Mellor had found that nickel glazes could be blue, green, yellow, or brown, according to the composition of the glaze. Nickel oxide melted with basic

oxides only, or with silica only gave colours varying from pale brown to dark olive-green.

Granger found that copper coloured lime-soda and lime-potash glasses blue, the colour changing to green as the concentration increased. This was not the general experience, as most investigators said that the colour was green with soda glasses and blue when potash was used, the effect being analogous to that produced by iron, which, in the ferrous condition, gave a bluer tint with potash than with soda. Glasses rich in silica tended to give a green colour with copper, whilst large lime content appeared to be most favourable for the production of red copper glasses. The author pointed out that it was not known how the pink colour was caused when manganese or chromium were added to the batch, and that the nickel colours were still unexplained. He was of the opinion that the mechanism, by means of which glasses were coloured, when melted with various oxides, was in need of systematic investigation.

In the paper dealing with gems, the author showed that the position was still more uncertain. Very little was known concerning the agents which produced the colour. Probably it was frequently due to organic compounds. The most extensive investigations on the colours of gems were those of Doelter, who exposed them to the rays from radium and to ultra-violet light. No attempt was made to explain the changes observed. The author concluded from the results obtained that the effect of radium rays was the reverse of that produced by ultra-violet light. The whole subject, however, called for further research. J. R. C.

12. The Production of Opal Glass without Cryolite. (*Sprechsaal*, 1919, 52, 30, 265).—As substitutes for cryolite in the manufacture of opal glasses, tin oxide, Baker guano, fluorspar, and bone ash were mentioned. Tin oxide was expensive. Successful opal glasses could be made, using either bone-ash or felspar-fluorspar mixtures as opacifying agents. Typical batches described are as follows:

	I.	II.
Sand	100.0	100.0
Potash.....	10.0	2.5
Soda ash	24.5	27.5
Limespar	18.0	—
Bone ash.....	22.0	1.5
Borax	2.0	—
Saltpetre	2.0	—
Fluorspar	—	11.0
Felspar	—	27.5

J. H. D.

13. Light Cast Plate Glass. (*Sprechsaal*, 1919, 52, 27, 227).—Cast plate glass had the particular advantage over the so-called "three-quarter white" glass (blown) that it could be made in sheets as large as 20 sq. m., whereas it was difficult to make

plate glass on the blowing iron in sheets larger than 1 sq. m. On the other hand, cast plate glass was usually made in thickness from 9 to 10 mm., so that if glass of similar quality was required but 3—4 mm. thick, an inordinate amount of grinding was necessary. Thin plate could be made by the Fourcault process,* but apart from its inferior quality it was not sufficiently regular in thickness to allow of it being used with advantage for mirrors.

Two methods were briefly described for the production of light plate glass. At Herzogenrath, large pots were used, and sheets of 50—60 sq. m. surface and 7 mm. thick were cast and rolled in the customary manner, but using much larger casting tables and heavier rollers. Immediately after rolling out, the sheet was cut up into suitably sized pieces and taken to the annealing oven. Grinding and polishing took place after annealing in the same manner as with thick plate. Casting took place once daily in each furnace, and the quality of the product was very good.

In the second or "three-quarter white" method, much smaller pots were used. The furnace contained 20 pots yielding sheets varying from 4 to 10 sq. m. of good glass of a thickness of 7 mm. To obtain increased production and economy the melting was arranged so that two casts were made from each pot in twenty-four hours. Although a considerable proportion of the glass produced was not good enough for mirror plate, yet considerable success had attended this method of working. Comparing the various systems of producing plate glass, the author mentioned that light cast glass (as above) did not require skilled glass-blowers for production. Not only was this of importance on account of the high wages earned by skilled plate glass-blowers, but more particularly since the supply of skilled workmen in this particular branch of the industry was diminishing. Very much larger sheets could be cast than blown on the pipe. Further, for equal fuel consumption, the amount of light cast glass produced was from one and a-half times to twice as much as the amount of blown glass. There was much more inferior glass produced by the light cast method than by blowing, but this was more than balanced by the greater economy in manufacture, particularly as inferior qualities were at present in considerable demand for glazing. Heavy cast glass (12 mm.) had the one advantage over light cast glass that it could be made in larger sized sheets.

The capital outlay was stated to be greater for the Herzogenrath method, but it was a much cheaper method in operation than the three-quarter white method for the production of light cast glass.

J. H. D.

14. Note on the Borates of Lead. H. V. THOMPSON (*Trans. Eng. Cer. Soc.*, 1918—1919, ii, 510).—An investigation of the identity of the four borates which it is asserted lead forms. The author gives details of these borates, namely, (1) metaborate, $\text{Pb}(\text{BO}_2)_2 \cdot \text{H}_2\text{O}$; (2) polyborate, $2\text{PbO} \cdot 3\text{B}_2\text{O}_3 \cdot 4\text{H}_2\text{O}$; (3)



and (4) $\text{PbO} \cdot 3\text{B}_2\text{O}_3$.

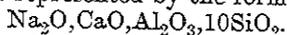
* It can be made by the Libbey-Owens (or Colburn) process.—W.E.S.T.

He confirmed the existence of $\text{Pb}(\text{BO}_2)_2 \cdot \text{H}_2\text{O}$ and $\text{PbO} \cdot 3\text{B}_2\text{O}_3$, but found no support for the formation of any definite chemical compounds having formulæ $\text{PbO} \cdot 2\text{B}_2\text{O}_3 \cdot 4\text{H}_2\text{O}$ or $2\text{PbO} \cdot 3\text{B}_2\text{O}_3 \cdot 4\text{H}_2\text{O}$.

C. M. M.

15. The Formation of Silicates, Glasses, and Glazes.

J. W. COBB (*Proc. Chem. Soc.*, 1909, 25, 165).—On the assumption that the formation of a glass was brought about by the combination and solution of the constituent oxides, the author investigated the formation of the glass represented by the formula



Lime and silica were found to combine, producing the compounds $2\text{CaO} \cdot \text{SiO}_2$ and $\text{CaO} \cdot \text{SiO}_2$.

Lime and alumina formed compounds $\text{CaO} \cdot \text{Al}_2\text{O}_3$, $\text{CaO} \cdot 2\text{Al}_2\text{O}_3$, and an insoluble calcium aluminate, presumably containing a great quantity of alumina.

Three conclusions were drawn from the study of the chemical interaction between solids. (1) The temperature of formation of a slag and its fusion point were not identical, nor apparently related, and this opposed Boudouard's generalisation. (2) The interaction between solids might proceed far, even to completion, without fusion. (3) From a temperature of 800° upwards the state of mixed solid particles was one of fairly effective molecular contact, allowing free play to selective chemical affinities.

V. D.

16. The Influence of the Composition of Glass on Pharmaceutical Preparations.

A. LESURE (*J. Pharm. Chim.*, 1910, 1, 66—71 and 119).—Solutions of easily hydrolysable substances, such as cocaine salts, should be kept in vessels made of neutral glass, which should show no sign of alkalinity with Poulenc's alizarin sulphonate reagent when heated with water in an autoclave at 120° for twenty minutes. A non-calcareous glass containing alumina, zinc, and magnesia as bases should be used for holding solutions of such salts as phosphates and arsenates, which gave precipitates with lime. More stable salts, such as sodium cacodylate, methyl arsenate, strychnine salts, and mercury salts could be kept in vessels made of glass showing faint alkalinity if this did not exceed the equivalent of 5 c.c. of $N/100\text{NaOH}$ per 100 c.c. of capacity, after thirty minutes in the autoclave at 120° . Solutions of iodides, bromides, and chlorides must not be stored in lead glass containers.

Almost all medicinal chemicals could be heated in an autoclave at 120° in containers of neutral glass, without decomposition taking place.

V. D.

17. On Devitrification.

W. GUERTLER (*Zeitsch. anorg. Chem.*, 1904, 40, 268).—The author studied the conditions for devitrification of sodium metasilicate, cobalt pyroborate, copper metaborate, and manganese diborate with the idea of illustrating and testing the views of Lammann on the theory of devitrification. The borates

of cobalt and copper were melted and quenched in a fine stream by running into water. The quenched material was powdered and packed, in a platinum crucible, round the junction of a thermocouple. The manganese borate and sodium metasilicate, being found capable of ready supercooling, were cooled rapidly to form glasses with the thermo-element in position. Subsequently, the crucible in each was slowly heated, and the temperature noted at which rapid rise of temperature began, due to crystallisation occurring, accompanied by liberation of heat, and the maximum temperature attained also recorded. The sodium metasilicate and manganese diborate glasses had to be inoculated, since they contained, apparently, no crystal nuclei like the two other borates.

The temperature at which devitrification began (t_d) and t_m , the melting point of each compound, were as follows :

	t_d .	t_m .
Na_2SiO_3	$550 \pm 20^\circ$	1055°
$\text{Co}_2\text{B}_2\text{O}_5$	$640 \pm 20^\circ$	1025°
CuB_2O_4	$675 \pm 15^\circ$	980°
MnB_4O_7	$670 \pm 20^\circ$	895°

When once the rise of temperature began at t_d , its rate increased very rapidly. The value of t_d was found to be independent of the rate of external heating.

W. E. S. T.

18. The Softening Temperatures of Lead-Silica Glasses. J. W. MELLOR, A. D. HOLDCROFT, and A. LATIMER (*Trans. Eng. Cer. Soc.*, 1909—1910, 9, 126).—From consideration of the cooling curves illustrating the behaviour of silicates cooling from the molten to the rigid state, the authors state that glasses and glazes may best be defined as undercooled solutions. If no crystallisation takes place there is no critical temperature above which it can be said that glass is a mobile fluid and below which it becomes a rigid solid. In other words, glasses have no true melting point, but their mobility increases as the temperature is raised, and their viscosity increases as the temperature is reduced.

The softening temperature of a glass is defined as the range of temperature where a substance begins to lose its shape and flow like a liquid, and the determination of this temperature resolves itself into the measurement of a certain stage in the diminishing viscosity of the glass when its temperature is increased at a given rate. Five methods of ascertaining this range of temperature were given, namely, (1) the squatting of pyramids or cones of standard composition; (2) the sinking of a rod in the softening substance; (3) the dropping of a portion of the substance from a wire heated to a known temperature; (4) the development of electrical conductivity sufficient to allow a given electric current to pass through the substance; (5) observation of the rounding of corners or melting of fragments under the microscope under steadily rising temperatures.

The authors discussed the molecular theory of softening at ele-

vated temperatures, and arrived, on theoretical grounds, at the following deductions, which were supported by practical observations: (a) The softening temperature measures the temperature at which the inward surface pressure of the substance becomes greater than those intermolecular forces which hinder the molecules taking up the position of stable equilibrium, that is, of minimum surface area. (b) The softening or melting of the surface of different substances takes place at a lower temperature than the softening or melting of the substance in lump. (c) With particles having a relatively large surface area in proportion to their mass, the finer the grain the lower the softening temperature. (d) Two "solid" substances may react at temperatures considerably below the melting point or softening temperature of either alone.

Numerous determinations of the softening point of many lead-silica glasses were made, using the fifth method mentioned above. Details of the method employed and the apparatus used were given. The results were plotted as a curve showing that (1) the melting point of pure PbO is 877°; (2) the addition of gradually increasing quantities of silica rapidly lowers the melting point of the corresponding glasses to a minimum of about 526°, corresponding with a glass of the composition PbO : 0.21SiO₂ (about 95 per cent. PbO); (3) beyond this minimum the softening temperature of the glasses gradually increases with increasing silica, reaching 661° with a glass of the composition PbO : 2.4SiO₂ (60.6 per cent. PbO); (4) the determination of the softening temperatures of glasses very rich in lead (92—95 per cent. PbO) is disturbed by crystallisation. By comparison with results obtained by other investigators, it was noted that the melting point of the lead-silica glasses is considerably below that of the same silicates in the crystalline condition (generally about 200°).

Curves were given showing the effect on the softening point of lead monosilicate glasses of gradually increasing amounts of copper oxide, ferric oxide, and cobalt oxide. In each case a gradual rise in the softening temperature of the glass was observed as the amounts of the colouring oxide were increased until a maximum was attained. Further additions reduced the softening temperature again. With copper oxide, the softening point of the lead silicate was increased from 535° to 560°, corresponding with the addition of 3 per cent. CuO. The addition of more CuO reduced the softening point of the glass again until with 6.9 per cent. of CuO it was again 535°. In the case of ferric oxide the maximum (560°) was attained with the addition of 1.0 per cent. Fe₂O₃. With 7 and 14 per cent. of Fe₂O₃ the softening point of the glass was reduced to 538°. The addition of 4 per cent. of cobalt oxide raised the softening point of the glass from 535° to 602°. Further additions lowered this again to 567° with 6.6 per cent. CoO.

The authors noted that these figures had no known relation to the subsequent behaviour of the softened mass, and it was known that the addition of some oxides made more mobile fluids than others.

J. H. D.

19. On the Density of Silicate Mixtures. E. WARD TILLOTSON (*J. Ind. Eng. Chem.*, 1911, 3, 897).—The paper gives the results of the examination of the accuracy of Winkelmann and Schott's density factors for the calculation of the density of glasses, and sets out new factors which appear to lead to closer agreement between calculated and observed results. The experimental data used by the author were those previously derived by Larsen during a study of calcium and magnesium metasilicates, by Wallace for lithium-barium and lithium-calcium silicates, and by Day and Allen for some mixed felspars.

TABLE I.

CaSiO ₂ .	Percentage.				Density.		
	CaO.	MgO.	SiO ₂ .	Obs.	Calc. ¹	Calc. ²	
100.0	48.20	0.00	51.80	2.904	2.698	2.920	
95.0	45.80	2.01	52.19	2.899	2.700	2.910	
85.26	41.09	5.91	53.00	2.891	2.701	2.897	
74.0	35.70	10.43	53.87	2.881	2.706	2.879	
64.0	30.84	14.43	54.73	2.872	2.709	2.863	
60.0	28.92	16.04	55.04	2.859	2.711	2.855	
53.64	25.85	18.59	55.56	2.854	2.713	2.848	
40.0	19.28	24.06	56.66	2.834	2.718	2.829	
30.0	14.46	28.07	57.47	2.821	2.722	2.815	
10.0	4.82	36.09	59.09	2.780	2.730	2.787	
5.0	2.41	38.10	59.49	2.777	2.733	2.780	
0.0	0.00	40.10	59.90	2.758	2.735	2.773	

The densities tabulated under Calc.¹ were calculated from Winkelmann and Schott's factors, namely, SiO₂, 2.3; CaO, 3.3; and MgO, 3.8; those under Calc.² from the author's new factors, namely, SiO₂, 2.3; CaO, 4.1; MgO, 4.0.

As tabulated in table I and also when plotted on curves, the observed results and those under Calc.¹ are at one end of the series widely divergent.

Tables II, III, and IV contain the results for other glasses examined.

TABLE II.

Lithium-Barium Glasses.

BaSiO ₂ .	Percentage.				Density.	
	Li ₂ O.	BaO.	SiO ₂ .	Obs.	Calc. ²	
0	33.30	0.00	66.70	2.61	2.63	
10	29.97	7.18	62.85	2.70	2.74	
20	26.64	14.36	59.00	2.80	2.87	
30	23.31	21.53	55.16	2.91	3.00	
40	19.98	28.71	51.31	3.17	3.14	
50	16.65	35.89	47.46	3.38	3.31	
60	13.32	43.06	43.62	3.50	3.48	
70	9.99	50.24	39.77	3.77	3.69	
80	6.66	57.42	35.92	4.02	3.91	
90	3.33	64.60	32.07	4.19	4.16	
100	0.0	71.78	28.22	4.44	4.44	

TABLE III.

Lithium-Calcium Silicate Glasses.

CaSiO ₃ .	Percentage.			Density.		
	Li ₂ O.	CaO.	SiO ₂ .	Obs.	Calc. ¹	Calc. ²
0	33.30	0.00	66.70	2.61	2.63	2.63
10	29.97	4.82	65.21	2.64	2.63	2.65
20	26.64	9.64	63.72	2.69	2.64	2.69
30	23.31	14.46	62.23	2.72	2.65	2.71
40	19.98	19.28	60.74	2.76	2.66	2.74
50	16.65	24.10	59.25	2.80	2.66	2.77
60	13.32	28.92	57.76	2.80	2.67	2.80
70	9.99	33.74	56.27	2.84	2.68	2.83
80	6.66	38.56	54.78	2.85	2.69	2.85
90	3.33	43.38	53.29	2.88	2.69	2.88
100	0.0	48.20	51.80	2.91	2.70	2.92

In the above calculations of density, Winkelmann and Schott's factors were used for SiO₂ and BaO in both sets of calculations, namely, SiO₂, 2.3, and BaO 7.0. The author's modified value for CaO was employed in the results in the last column, and his value for Li₂O, namely, 3.7.

TABLE IV.

Percentage.				Density.		
SiO ₂ .	Al ₂ O ₃ .	CaO.	Na ₂ O.	Obs.	Calc. ¹	Calc. ²
43.33	36.60	20.06	0.11	2.700	2.980	2.700
47.10	34.38	17.00	1.74	2.648	2.880	2.644
51.06	31.72	13.65	3.68	2.590	2.820	2.600
60.01	25.24	7.09	7.79	2.486	2.680	2.497

Instead of Winkelmann's factor for Al₂O₃, namely, 4.1, the new value 2.75 was derived and used.

The new factors derived by the author were further tested by application to several Jena glasses, and proved to yield much more concordant results than obtainable by Winkelmann and Schott's factors.

W. E. S. T.

20. The Relation of the Refractive Index of Soda-Lime Glasses to their Chemical Composition. E. W. TILLOSON (*J. Ind. Eng. Chem.*, 1912, 4, 246).—In order to test the nature of the relationship between the refractive index for white light and the composition of a glass, the author prepared on a small scale in clay pots a series of soda-lime glasses, of composition ranging from Na₂O, 3SiO₂ to CaO, SiO₂.

Table I contains the statement of the percentage composition of the glass, based, not on the analysis of the glasses, but on the original batch compositions, together with the values of *D*, the density calculated with an average error of 1 per cent., *N* the refractive index, and *K* (obs.) and *K* (calc.) described further below.

TABLE I.

CaSiO ₃ mol. per cent.	SiO ₂ .	CaO.	Na ₂ O.	D.	N.	K(obs.)	K(calcd.)
0.0	74.45	0.00	25.55	2.37	1.5000	0.2110	0.2110
10	73.60	2.50	23.90	2.395	1.5060	0.21127	0.2111
20	72.30	5.18	22.50	2.42	1.5115	0.21137	0.2112
30	70.85	8.25	20.90	2.45	1.5172	0.21110	0.2112
40	69.30	11.70	19.00	2.48	1.5240	0.21129	0.2113
50	67.40	15.60	17.00	2.52	1.5334	0.21166	0.2115
60	65.20	20.20	14.60	2.57	1.5432	0.21137	0.2116
70	62.75	25.35	11.90	2.63	1.5590	0.21254	0.2127
80	59.60	31.80	8.60	2.70	1.5800	0.21442	0.2142
100	51.85	48.15	—	2.92	1.628	0.21517	0.2178

The value of K (obs.) is that of the specific refraction determined from the formula of Gladstone and Dale, namely, $N - 1/D$. K (calc.) was derived by plotting the values of K (obs.) against the percentage by weight of CaSiO₃ present; in other words, K (calc.) represented smoothed values.

The specific refractions were also calculated by the Lorenz and Laurentz formula, namely, $\frac{N^2 - 1}{N^2 + 2} \times \frac{1}{D}$. In both methods of calculation it was found that when the results were plotted graphically the curve was linear, with a sharp change of direction occurring at the composition 2Na₂O, 3CaO, 5SiO₂, and a compound of this composition was assumed to be indicated.

It was found that the specific refractivities, calculated by either formula, could be represented by the following expression :

$$K = \frac{p_1 k_1}{100} + \frac{p_2 k_2}{100} + \frac{p_3 k_3}{100}$$

where p_1 , p_2 , and p_3 are the percentage amounts of SiO₂, CaO, and Na₂O present in the glass, and k_1 , k_2 , and k_3 the specific refractivities of these oxides respectively. From the results the values of specific refraction for these oxides are: SiO₂, 0.1220; CaO, 0.1210; and Na₂O, 0.1302, the Lorenz and Laurentz formula being made the basis of the calculation.

W. E. S. T.

21. Some Aspects of Scientific Research in Relation to the Glass Industry. E. W. WASHBURN (*J. Amer. Cer. Soc.*, 1919, 2, 855).—The necessity for fundamental research in the glass industry was emphasised most particularly, and many of the pressing problems were indicated. These included the determinations of viscosity, surface tension, vapour pressure and density of molten glasses, the relation between viscosity and temperature being intimately connected with stirring, gathering, drawing, and blowing, whilst the process of fining was very closely connected with the viscosity, surface tension, and vapour pressure. The substitution of soda for potash in optical glasses was impracticable, owing to increased colour, but it was necessary to discover to what agency this increased colour was due. Scarcely anything was known concerning the gases which remained in solution in glass or

concerning the electrical conductivity of glass and its relation to composition. In addition to such problems as these, there was an almost infinite number of purely scientific problems.

There were three types of laboratories in which these researches might be carried out: research laboratories of the industry itself, Government laboratories and laboratories of research foundations, and laboratories of university ceramic departments. Though the industry was not entirely dependent on the universities for research, it was dependent upon them for the training of its technical *personnel*. Such training was the most expensive which a university gave, and if the glass industry desired this training to go on, some way of providing financial assistance must be found, for no university with a ceramic department at the present time was financially able to extend its activities.

F. W. H.

III.—Lamp-worked and General Scientific Apparatus.

22. The Construction of Silica Glass Articles. W. S. QUIMBY and F. W. ROBINSON, U.S.A. (Brit. Pat., February 5th, 1919, No. 2866).—Relates to building up articles of quartz glass by heating an initial nucleus of quartz glass to a plastic condition and causing powdered quartz to adhere to it, the powder being afterwards melted so as to coalesce with the nucleus.

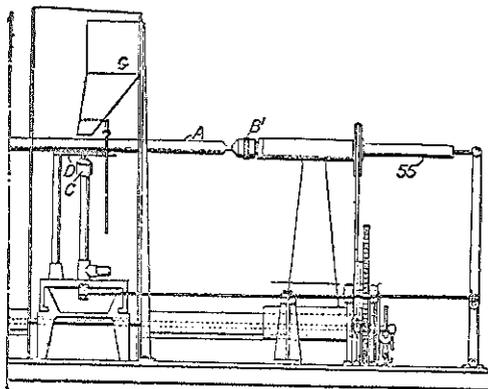


FIG. 3.

advanced so that some of the powder adheres to the nucleus, *A*. The plate, *D*, is then withdrawn, and the blowpipe, *C*, advanced to melt the adhering powder. These operations are repeated until the article is of the required size. Powder is fed automatically to the plate, *D*, from a hopper, *G*. During the process, the

Fig. 3 shows one end of the apparatus used. The tubular or solid nucleus, *A*, is held in chucks, *B'*, and rotated by the gearing shown. It is heated, meanwhile, by a blowpipe, *C*, until it is plastic, when the blowpipe, *C*, is automatically withdrawn and a plate, *D*, carrying powdered quartz,

chucks, B' , are separated slowly, so as to draw out the article and keep the diameter uniform. In the case of a tubular article, the walls are supported by internal air pressure produced by a piston inside the tubular shaft, 55. The diameter may be varied by varying the rate of drawing and internal pressure.

H. G. C.

23. Apparatus for Electrically Sealing High Temperature Mercury Thermometers under Pressure. G. LIPS (*Deut. Mech. Zeitung*, 1902, 1).—The thermometer is first evacuated and sealed, and then introduced into an air-tight chamber filled with compressed nitrogen. An iron tube is attached to the thermometer, which is vertical, in order that its height can be adjusted by means of an external magnet. This is done so that the temporary seal can be broken by a blow from a piece of steel, which is also moved by a magnetic arrangement. The thermometer is thus filled with compressed nitrogen, and is then raised so that the head is in an electrically heated tube, which melts the glass, thereby sealing the thermometer. The improvement on previous apparatus for the purpose lies in the method of breaking the temporary seal and introducing the head into the hot tube. A detailed diagram assists the explanation.

J. R. C.

IV.—Decorated Glass.

24. Luminous Paints. G. A. H. MULLER (Brit. Pat., January 7th, 1919, No. 468).—A luminous paint is manufactured by heating together sublimed sulphur and carbonates of strontium, calcium, and magnesium. The strontium carbonate is preferably the predominant constituent of the carbonates, the proportions in one example described being sulphur 26 parts, strontium carbonate 19 parts, calcium carbonate 6 parts, and magnesium carbonate 1 part. The mixture is furnaced in a crucible at a temperature of about 1500° F., then ground, and made up into a liquid paint by mixing with a colourless varnish, prepared from mastic and similar gums with turpentine, spirit, or drying oils.

H. G. C.

25. A New Method of Coating Pearl Beads. O. PARKERT (*Sprechsaal*, 1919, 52, 23 and 191).—Older methods of coating "pearl" beads were unsatisfactory on account of the ease with which the coating was rubbed off. Better results were obtained by coating the beads with hard varnish containing the "fish silver," but the surface lacked the brilliance of the fire-polished glass. The present process suggested a method for producing the coating on the inside of the beads, thus being protected from abrasion. In the new method, a solution was prepared from dry "fish silver," copal

varnish, mastic and acetone, possessing the property of rapid drying. The crystal glass beads were cleaned thoroughly with soda and dried. They were then placed in a glass bowl, so arranged and mounted that it could be rotated rapidly about an inclined axis. A portion of the solution as above was added, the container closed by a rubber cover, and then rotated. After a short period the interior of the glass "pearls" was found to be coated evenly and regularly with the pearl silver, but the excess solution was contained in the interior of the beads as drops of liquid. To remove this, the cover of the vessel was taken off and the speed of rotation doubled, the vessel being gently warmed by a small flame. In a short time the liquid was evaporated, and the coating adhered firmly to the inside of the beads.

Care should be taken that only pure fish scale "silver" (powdered fish scales) is used. If adulterated, for example, with aluminium bronze, the appearance of the resulting "pearls" is not so satisfactory. It was of the utmost importance that the coating solution should be as dense as possible with respect to the "fish silver" without becoming too viscous. Aniline colours and lustres could be applied as interior coatings to beads in a similar manner.

J. H. D.

V.—Optics and Optical Instruments.

26. The Incident Angles Corresponding to Given Deviation produced by a Prism. T. SMITH (*Trans. Optical Soc.*, 1919, 21, 49).—A mathematical discussion providing a formula giving the angle of incidence for a ray which corresponded to a given dispersion when the ray traversed a prism of known refractive index and angle.

J. R. C.

27. Spectacles for Aphakic Eyes. T. CHAUNDY (*Optician*, 1920, 58, 235).—In view of the fact that it is impossible to correct the astigmatism of a single spectacle lens when the power is greater than 7.25 D+, the author translated, with amendments and explanations, a German patent specification of an invention of Carl Zeiss, dated 1908. The invention claimed was: (1) A collective system for visual use, consisting of two lenses in contact, the power of the contiguous surfaces being positive; the posterior lens being collective and with a concave posterior surface; the system having a large field of view and being astigmatically corrected for a stop about 3 cm. from the last vertex; the anterior lens being also a collective lens. (2) A corrected spectacle system according to claim (1), in which the anterior lens was a meniscus, with its concave surface turned towards the stop.

J. R. C.

28. Progress in Manufacturing Radio-protective Glasses. W. W. COBLENTZ (*Optician*, 1920, 58, 265).—The ideal protective glass absorbed all the ultra-violet and infra-red radiations, and transmitted only visual rays by an amount sufficient to prevent irritation and injury to the eye. The great demand for colourless optical glass had brought into prominence the colouring effect of iron impurities. In addition to its visible effect, the presence of iron caused marked absorption in the infra-red, which reached a maximum at $1\ \mu$.

Transmission curves of six different types of glass were given by the author. Colourless glasses showed characteristic absorption bands at $2.9\ \mu$ and $3.6\ \mu$. Window glass gave also the iron band at $1.1\ \mu$. Red glasses were shown to afford no protection against infra-red rays, though all the ultra-violet was absorbed. Amber glass absorbed the ultra-violet and some of the visible. The iron band was also present. Green glasses were opaque to the ultra-violet, and had the absorption band at $1.1\ \mu$. In combination with other glasses they afforded suitable protection from the injurious rays. As cobalt-blue glass absorbed the infra-red, it was largely used in combination with deep amber, red or green glass for protection when working near sources of ultra-violet radiation. Transmission curves were given of combined red and blue glasses, and of a flashed red, green, and blue set, such as is used in electric welding, and their suitability for the purpose was thus demonstrated. Curves were also given for two Crookes's glasses, namely, sage-green and blue-green; these were shown to be efficient protectors. Gold leaf on glass eliminated the ultra-violet and infra-red, and with the proper density gave adequate protection from glare by visible rays. The protection afforded by black or smoked glasses was insufficient against ultra-violet rays. "Noviweld," a commercial protector, absorbed the ultra-violet and infra-red, but had 10 per cent. transmission bands at 2.5 , 3.3 , and $3.6\ \mu$.

J. R. C.

29. Description of Three German Naval Gun-sighting Telescopes. J. S. ANDERSON and A. BARBARA DALE (*Trans. Optical Soc.*, 1919, 20, 315).—The three instruments were a periscopic sight, a right angle sight, and a variable power sight, all made by Carl Zeiss. Photographs of the instruments when dissected, and drawings of the mechanical details and optical systems accompanied the minute but lucid text. The lens-holders of the first two were of hardened steel, the rest of the instruments being constructed from brass and gunmetal, whilst the third was made almost entirely of steel. The inner surfaces of such tubes as would give rise to scattered light had fine screw threads cut in them to diminish the amount of light reflected from them. Elaborate precautions were taken to ensure that the first instrument should be water-tight, but in the case of the second two reliance seems to have been placed on the excellent fit of the different parts. The periscopic sight was provided with a radio-luminous device for

illuminating the graticule lens for use in connexion with night-work. All the instruments were provided with detachable spray excluders, and all were fitted with one colourless glass and three colour filters, green, orange, and neutral, the transmission curves of which were described. An analysis of the lubricating grease employed indicated that it consisted of three constituents, namely, beeswax, vaseline, and some other fat, possibly tallow or lard.

The effective aperture of the objective of the periscopic sight was 2.8 cm.; the diameter of the emergent pencil, 0.46 cm.; the magnifying power, 6; and the percentage light transmission, 35. It was a fixed focus instrument. The radii of curvature and dimensions of the eleven lenses which formed the optical system were given. The prism was of the "roof-prism" type, designed to displace the optical axis parallel to itself through 5.5 cm., and to reverse the field. The cross lines of the graticule were engraved on the flat surface of one of the lenses; their thicknesses and separations were given, the former being very uniform.

The effective aperture, the diameter of the emergent pencil, and the magnifying power of the right-angled sight were the same as those of the periscopic sight, the percentage transmission being 38. The radii of curvature and the dimensions of the lenses were tabulated, and the optical data and type of the glass of which these lenses were made were also given. Five of the lenses were of boro-silicate crown, and two, one being part of the objective and the other the graticule lens, were of zinco-silicate crown. The remainder were flints. The light suffered two internal reflections when passing through the prism, and was deflected through 90°, the field being reversed.

The mechanism of the variable power sight was complicated and could not be described without reference to a diagram. The lowest magnifying power was 5 and the highest 15. The instrument had a variable focus. Details of the lenses were given as before, the graticule lens again being a zinco-silicate crown, and not a baryta light flint, as was usual.

J. R. C.

30. Description of Goerz Submarine Periscope. L. C. MARTIN (*Trans. Optical Soc.*, 1919, 20, 338).—The main optical system of this instrument was of the opposed telescopes type, chief interest centring in the part which comprised the eyepiece of the topmost telescope. The optical system of this was described with the aid of a diagram. By means of a lever at the base of the instrument, two additional lenses could be inserted, changing the magnifying power from 6 to 1.5. The graticule was illuminated by luminous paint for night work. The tube of the main periscope system was lined with aluminium pressed up into rings to obviate reflection from the walls of the tube.

J. R. C.

31. Description of a German Portable Range-finder. J. S. ANDERSON (*Trans. Optical Soc.*, 1919, 21, 41).—This instrument was employed for the purpose of measuring the range of an

object, of which at least one dimension was approximately known. It consisted essentially of a telescope, in front of the objective of which were two adjacent small-angle prisms cut in the form of discs. One of these was co-axial with the telescope, while the light which passes through the other was deflected by means of a step prism so as to pass into the telescopic system. Thus there were two images of the object in the field of view. The separation of these along a direction parallel to the line joining the centres of the two small-angle prisms could be varied by rotating the prisms till the two images were brought into contact. The range of the object and the angle subtended thereby were then read off scales engraved on a disc which was revolved by the mechanism rotating the prisms, provided that the length of the object was known.

A photograph of the dissected instrument and a diagram showing mechanical detail were given. The objective was a cemented doublet with the flint component leading. A Porro prism system was used to reverse the field. The magnification was 10, and the definition described as "not good," the illumination being poor. The accuracy of setting for short ranges was of the order of 1 or 2 per cent., provided that the dimensions of the object were accurately known.

J. R. C.

32. Previous Forms of Terrestrial Telescopes. M. von ROHR (*Zeitsch. Instrumentenkunde*, 1920, 40, 15).—A description of a telescope, made by "Berge, London, late Ramsden," about 1811, and used in the Peninsular War by a Prussian fighting in the British Army. The lenses were still in good condition, the objective being a two-piece lens and the ocular consisting of four lenses. The glasses of which the objective was composed were a crown glass, $\mu_D = 1.5325$, $\nu = 57.8$, corresponding nearly with Schott's zinc-silicate crown O 15, and a flint, $\mu_D = 1.5991$, $\nu = 38.0$, corresponding with the ordinary light flint 0.318. The crown lens was leading, and the separation between the two lenses was 0.16 mm. The other measurements are also given, the focal length being 500 mm. The lenses of which the ocular was composed were made of a glass with refractive index $\mu_D = 1.51$. Both objective and ocular were overcorrected for spherical aberration. The magnification of the telescope was 24.3.

An old Ramsden triple objective is described, the focal length of this being also 500 mm. It was in good condition, though the exterior crown lenses of a similar one had not weathered so well. The flint glass had a refractive index of 1.5961, $\nu = 38.3$, being very similar to that used in Berge's objective. The crown glasses were also apparently the same. The performance of the triple objective is better than that of the doublet.

Diagrams of the spherical aberration, and secondary spectra of both objectives and ocular, are given.

J. R. C.

33. A New Method of Testing Spectacle Lenses. SOLMS. (*Die Glashütte*, 1920, 50, 197).—The method described was one

originated by Tscherning. A second telescope, made up with the lens under test as the objective and an ocular of known measurements, was inserted between the collimator and telescope of a spectrometer. The objective of the latter telescope was provided with two marks, the distance between which represented the size of the image before the second telescope was inserted. By means of a micrometer screw, the new image size was ascertained, and this was directly proportional to the focal power of the tested lens. In order to ascertain the radii of curvature of the lens, if the surfaces be concave, a parallel beam of light, provided by the collimator, fell on the lens surface, and was rendered convergent on reflection. The position of the focus, and hence also the radius of curvature of the surface, were ascertained. The method of determining the refractive index of the glass of which the lens is made was the immersion method. Stress was laid on the necessity of maintaining the liquid at constant temperature. The astigmatism of the lens could be studied by placing a diaphragm, 5 mm. in diameter, at the place where the focal point of the eye in relation to the lens would be. The collimator was focussed to give an image and the lens rotated.

J. R. C.

34. Chromatic Variation of Spherical Aberration in Cemented Doublets. L. M. GILLMAN (*Trans. Optical Soc.*, 1919, 21, 53).—The determination of the form of achromatic doublets, designed to give freedom from certain aberrations, had been the subject of numerous investigations, in all of which, with the exception of the work of Steinheil and Voigt, the computation had been algebraical. The results were therefore only approximate, and it was desirable that they should be tested by ray tracing to determine the remaining aberrations. Not only should the objective in question be examined in this way, but also similar objectives differing from it by slight variations in its surfaces. This procedure was adopted in the present investigations. Three series of objectives were examined, namely:—Set I, ordinary silicate crown leading; Set II, flint leading followed by ordinary silicate crown; Set III, medium barium crown leading. The constructional data for these sets were given.

In each series the investigations showed that the results for the intersection lengths of paraxial and marginal rays could be plotted as curves which showed striking uniformity throughout the series. The shape of the curves was very nearly parabolic, and examination of their varying inclinations and curvatures showed that the angle between the paraxial and marginal curves was practically constant, while the curvature of the marginal curve was greater than that of the paraxial curve in a constant ratio. These results led to the conclusion that the curve for any lens in the series could be predicted from a knowledge of both paraxial and marginal curves of one other form. The best results corresponded closely with the objective determined by algebraic calculations, in which thickness was neglected.

J. R. C.

35. The Correction of First Order Astigmatism of a Single Lens used with a Stop. T. Y. BAKER (*Trans. Optical Soc.*, 1919, 21, 65).—In a previous paper (Vol. 3, Abs. No. 164) the range of image positions, for which the correction of first-order spherical aberration was possible, was obtained. In the present paper a similar investigation was made of the positions, for which correction of first-order astigmatism was possible when there was choice of the shape of the lens and of the position of the stop. It was shown that there were two theoretical shapes for a lens, such that, for given image and stop positions, the first-order astigmatism could be made anything desired. There were, however, complications, as these shapes might not be practically possible. A set of constant astigmatism curves was drawn for a glass of refractive index 1.518, and these were so modified that the construction of the lens was practical. These curves should be of use to computers in determining approximately the greatest flattening of field that was possible for a given image and stop positions, and the shape of the lens that would do it. The investigation was extended to a series of lenses along an axis, with special reference to the case of two thin lenses in contact, and made of the same glass. The paper concluded with an investigation into the astigmatism defects of the Ramsden and Huyghens eyepieces.

J. R. C.

36. Glass for Protection from Ultra-violet Rays. (Brit. Pat. No. 118397, April 15th, 1918, No. 6398.) R. HADDON, London (Corning Glass Works, Corning, New York, U.S.A.)—Relates to the production of glass capable of absorbing ultra-violet rays and as nearly colourless as possible, and consists in adding titanium oxide and an oxidising salt to the glass composition. The titanium compound may be used in conjunction with cerium oxide, etc., and nitre is added to prevent reduction of the oxides.

H. G. C.

VI.—Illumination and Illuminating Ware.

37. The Preparation of Filaments for Electric Incandescent Lamps. (Brit. Pat. No. 120040.) WESTINGHOUSE LAMP Co., Bloomfield, New Jersey, U.S.A. (September 24th, 1918, No. 15523).—Filaments of tungsten, molybdenum, tantalum, or the like are heated in such a way as to acquire a granular structure adapted to restrain structural alterations in use. A texture of medium fineness, containing, say, 12,000—18,000 grains per sq. mm., is found to be most resistant. A coarse structure is

obtained by maintaining the filaments for some time at the critical temperature, namely, 1800°, at which grain-formation begins, and a fine structure by heating rapidly to a temperature above the critical point. Successive heating to both temperatures gives a texture of medium fineness. A 40-watt, 110-volt, drawn-wire filament, if heated in the otherwise finished lamp first for five minutes by a current at 80 volts, and then for a like period at 130 volts, acquires a fineness of 12,000 grains per sq. mm. Heating for fifteen minutes by a current of 110 volts gives a fineness of 18,000 grains per sq. mm.

H. G. C.

38. The Preparation of Tungsten. O. BERTOYA, London

(Brit. Pat. No. 119117.) October 15th, 1917, No. 14915).—Tungsten trioxide is reduced to metal by the action of hydrogen or gas containing more than 50 per cent. of hydrogen while passing through a series of externally heated inclined retorts, down which the material slides. The apparatus shown comprises two sets of retorts, *C*, mounted in combustion chambers, *Z*, to which gas is supplied through nozzles, *Z*³, the combustion products passing out through a downtake flue, *L*; or the retorts may be heated by solid fuel, the lowest chamber, *Z*, being then connected through a flue, *J*, with a coke or like furnace. The separate retorts in each set are connected by bends, *D*, having covers, *E*, and with sampling attachments, *Y*, each comprising tubes, *Y*¹, *Y*⁴, and a plunger, *Y*², which is lowered when required and given half a turn to direct the sample of material into the tube, *Y*⁴. The material is charged and discharged through hoppers, *A*, *M*, each fitted with valves, 1, 2, which may be operated for continuous feed and discharge. The gaseous reducing agent is supplied by valved pipes, *P*², passing through the covers, *E*.

H. G. C.

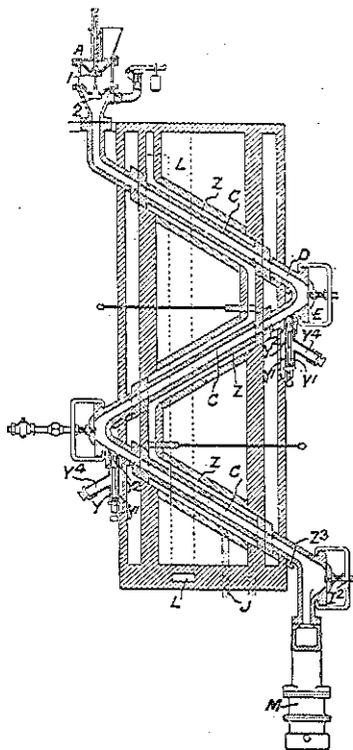


FIG. 4.

pipes, *P*², passing through the covers, *E*.

39. Vapour Electric Lamps. H. GEORGE, Paris (Brit. Pat., March 28th, 1919, No. 7841. Convention date, August 8th, 1918).—A mercury-vapour lamp contains an inert gas, such as nitrogen, argon, or, preferably, neon, at a pressure of the order

of atmospheric. In a quartz lamp, a U-tube, 6, carrying vessels, 7, 8, is fitted to the side of the anode reservoir, 3; the vessel, 8, contains a tube, 11, through which passes a tungsten wire, 12, connected to the positive terminal, and is connected to the lighting tube by a tube, 9, of at least 4 mm. internal diameter. The tube, 10, is provided with a hole, 11, and the vessel, 7, has a constricted neck, 13, of 0.8 mm. diameter. Mercury normally occupies the tube to the level, 14; on making the current, the gas in tube 8 is heated by the wire, 12, and forces the mercury into the vessel, 7, the arc being struck as soon as the mercury column is broken by the bridge of the lighting-tube, 1. The vessel, 8, acts as a condensing chamber, and the passage of vapour through the tube, 9, keeps the lighting tube free from gas.

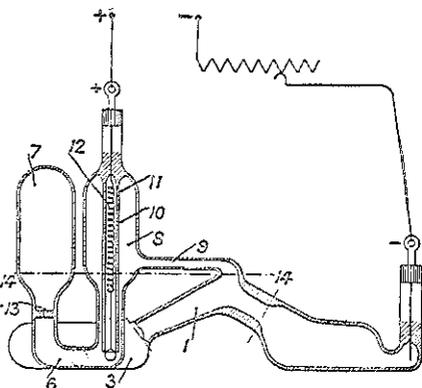


FIG. 5.

H. G. C.

VII.—Fuels, Refractories, and Furnaces.

40. Refractory Substances. H. E. MASON and A. COUPER, Horwich, Lancashire. (Brit. Pat. No. 119101.) (September 27th, 1917, No. 13906).—Relates to the manufacture of refractory magnesite bricks. H. G. C.

41. Alumina for Refractories. NORTON Co., Worcester, Massachusetts, U.S.A. (Brit. Pat. No. 118605.) (July 11th, 1918, No. 11378. Convention date, August 18th, 1917).—Alumina is prepared in fused condition from crude materials, such as bauxite and clay, by fusing the material with an excess of carbon in an electric furnace, separating the reduction products of the impurities, and then adding a solid oxidising compound to oxidise the partial reduction products of the alumina. As oxidising agents, iron oxide, silica, or titanium oxide may be used, or crude bauxite or volatile materials, such as zinc oxide or sodium carbonate. An excess of the oxidising substance may be employed, with or without some carbon, to reduce a part of the excess. H. G. C.

42. Alumina for Refractories. NORTON Co., Worcester, Massachusetts, U.S.A. (Brit. Pat. No. 118606.) (July 11th, 1918, No. 11379. Convention date, August 18th, 1917).—A method for preventing the partial reduction of the lower layer of the charge during the electric fusion of alumina. H. G. C.

43. Silica Brick Manufacture. SOC. ANON. DES PRODUITS REFRACTAIRES DE L'OUEST, Paris. (Brit. Pat. No. 118116.) (August 6th, 1918, No. 12788).—Silica bricks are made from any quartz or quartzite containing an average of 95 per cent. of silica. After disintegrating or after cooling, the material is subjected to a first crushing, and part then reduced to a fine flour by a further crushing. Suitable proportions of the two crushings are mixed together with a binder, such as lime, moulded, and burnt.

H. G. C.

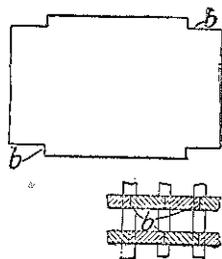


FIG. 6.

44. Regenerator Bricks. T. WILLIAMS (Brit. Pat., August 9th, 1918, No. 12978).—Chequer bricks are provided with four recesses, *b* (Fig. 6), each approximately equal in length to half the thickness of the brick. The bricks are laid end to end in parallel rows, the bricks in each course running at right angles to those in the courses above and below, so that the recesses, *b*, interlock, as shown in plan view in Fig. 6, to form vertical and longitudinal and transverse horizontal channels. H. G. C.

45. Zirconia. H. E. COLBY (*Chem. News*, 1920, 120, 7).—The possibility of the use of zirconia as a refractory material on a large scale depended on the cost. Up to the present, no sufficiently cheap process had been devised to allow of the use of pure zirconia in refractory bricks. The problem of plasticity had been largely solved, and the shrinkage could be influenced, as in other refractories, by the addition of grog, and the grog in this case consisted of previously fired and ground zirconia. The firing temperature was governed by the temperature at which the refractory was to be used, and it was essential that the grog should be fired to the same temperature. If vitrified grog were added, it was a source of weakness, and produced a "hackly" fracture, whereas, under proper conditions, a thoroughly plain and homogeneous structure was obtained, the grog uniting completely with the raw material. Fired in a reducing atmosphere, black bricks could be obtained, owing to the capacity of zirconia to absorb carbon, but the colour could be completely removed by firing in an oxidising atmosphere, and there was no evidence of the formation of carbide below the fusion point.

At present, zirconia bricks of suitable shapes could be produced and fired having a melting point of not less than 2300°, a low

coefficient of expansion, a low conductivity, a resistance to slags better than that of other refractories, a capacity to resist very great pressures when cold and a greater pressure than other refractories when hot, and could be heated and cooled alternately and rapidly without deterioration.

F. W. H.

46. **Muffle Furnaces and Kilns.** J. H. MARLOW (Brit. Pat., May 4th, 1918, No. 7487).—In a kiln or oven for the manufacture of pottery, tiles, etc., the lining is formed of multitubular slabs, *a*, arranged to provide continuous passages, *c*, extending over the arch of the kiln, each slab being corrugated or fluted on both faces, and being formed to make joint with the slabs above and below, and also to interlock or joint with retaining blocks, *f*, built into the walls of the kiln. The slabs may form a wall between the flues, *h*, for the heating gases and the interior of the kiln, or the passages, *c*, may themselves form the heating flues. In the former case, perforations, *n*, may be provided in the inner faces of the slabs to allow circulation of hot air through the passages, *c*, and the kiln chamber. The joint with the blocks, *f*, is formed by a rib, *d*, and groove, *c*, and recesses, *m*, are provided in the upper and lower edges of the slabs to receive strips, *l*, of fireclay binding. Instead of interlocking at the sides with the blocks, *f*, the slabs may interlock with one another, as shown in Fig. 7. The foundation blocks may be recessed to the contour of the slabs.

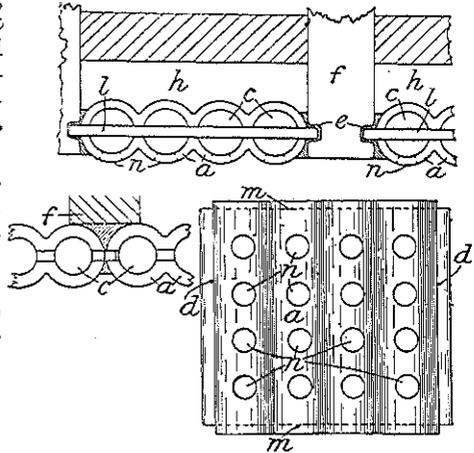


FIG. 7.

H. G. C.

47. **Tank Furnace for Drawing Sheet Glass.** HENRY DOUCHAMP (U.S.A. Pat., March 25th, 1919, No. 1298474. Filed September 20th, 1916. No. 121222).—The specification describes a tank furnace construction forming part of an apparatus by which cylinders of sheet glass are drawn directly from the metal in the tank. The furnace is provided with a number of drawing stations, 6 (Fig. 8), each consisting of a forehearth or doghouse projecting into the body of the tank, and formed by vertical blocks, 13, of refractory material suspended from girders, 27. The lower part of the blocks, 13, co-operates with front blocks, 9, to form a platform, which is pierced with a circular drawing opening, 7. The suspending rods, 23, of the blocks, 13, are screwed, and can be

adjusted vertically by means of nuts, 25, the frame, 24, carrying the rods being also adjustable vertically. Thus individual blocks may be adjusted, and the whole of the blocks may be moved to alter the level of the drawing opening, 7. Adjacent to each fore-hearth, two or more rings, 33, of refractory material, attached

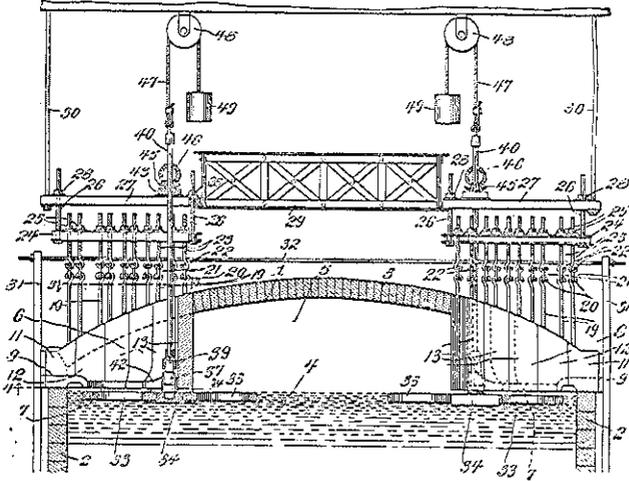


FIG. 8.

to a spider, 34, float on the surface of the metal in the tank, and the stem, 37, of the spider is connected to a shaft, 40, which can be rotated. In use, after a cylinder is drawn and detached, the shaft, 40, is rotated to bring a fresh ring, and therefore a freshly heated body of metal, beneath the opening, 7, while the ring just used, with the chilled glass attached, is turned into the body of the tank to be re-heated. G. D.

48. Wire-wound Electric Furnaces. J. A. FLEMING (Brit. Pat., April 9th, 1918, No. 6039).—A heating wire is hung in free loops from supports on the furnace wall, which has high heat-insulating power. The wire, *r*, may be of nichrome of uniform section and resistance, and without joints. It is slightly spaced from the wall. Short-circuiting may be prevented by distance-pieces of fused quartz, alundum, or diatomaceous brick.

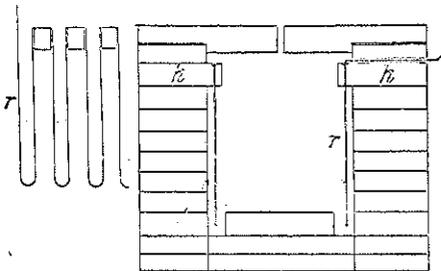


FIG. 9.

The loops may be supported by iron or copper lugs or strips, or by notched projecting bricks, *k*. They may be arranged in series or parallel, or for polyphase currents. The wall may be of fire-

clay, silica, or diatomaceous bricks, surrounded by slag wool in a brick or iron cylinder, or a very thick wall of diatomaceous brick may be surrounded by stock or fire-bricks. A door or lid is made of asbestos or diatomaceous brick, with an aperture for inspection and for a pyrometer. Current may be regulated by a choking coil with an adjustable core. The furnace is suitable for annealing iron or steel, or heating it to a welding temperature, or for melting other metals. Dimensions are given. H. G. C.

49. Electric Induction Furnaces. AJAX METAL Co., Philadelphia, Pa., U.S.A. (Brit. Pat. No. 119220.) (March 19th, 1918, No. 4868).—Induction heating is effected by the use of high-frequency currents, obtained by condenser discharge, or impressed by a high-frequency generator on an approximately tuned circuit containing the inducing coil. Frequencies of 12,600 and 25,400 have been found suitable. The power factor may be unity. No iron core is required in the heater. Fig. 10 shows an inducing coil, *O*, connected to supply conductors, *A*, *A*¹, through a condenser, *C*, in one lead,

and inductances, *L*³, *L*⁴, in both leads. A spark-gap, *G*, shunts the leads between the two pairs of inductances. Alternatively, the inducing coil may be arranged in the shunt circuit containing the discharge-gap. Instead of the inductances, *L*³, *L*⁴, a blow-out device may be provided for preventing short-circuiting by the discharge. A step-up transformer is added if the supply pressure is too low, the two inductances, *L*³, *L*⁴, being in either the primary or secondary circuits. Fig. 10 shows two-phase transformers, *D*, *D*¹, with condensers, *C*, *C*¹, in the outer conductors of the secondary circuit and discharge-gaps, *G*, *G*¹, and inducing coils, *O*, *O*¹, connecting the outer and

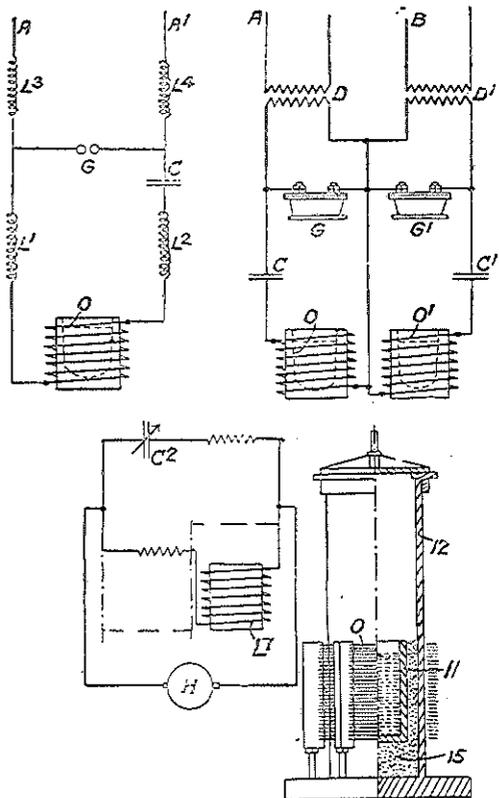


FIG. 10.

common conductors. A single inducing coil in the common conductor may, less advantageously, replace the two coils shown. Both inducing coils may surround one crucible. Variable inductances may be placed in the primary circuits, *A*, *B*, for current regulation. When a high-frequency dynamo, *H* (Fig. 10), is employed, it may be connected, directly or through a transformer, to a variable condenser, *C*², shunting and inducing coil, *L*⁷. A current much larger than that traversing the generator can then be produced in the circuit of the condenser and coil. A discharge-gap may be added to this arrangement. In a vacuum furnace, a crucible, 11 (Fig. 10), may be supported by non-conducting material, 15, in an exhausted casing, 12, surrounded by the inducing coil, *O*. Either the crucible or the charge may act as the secondary circuit. In the latter case, electro-dynamic circulation is produced. The invention is applicable to the heating of metal billets or blooms to be worked, of thin metal shells, and of liquid or pasty substances. Solid bodies may be heated locally.

H. G. C.

50. Furnace Temperature Regulator. W. P. WHITE and L. H. ADAMS (*Phys. Review*, 1919, 14, 44).—The authors described an arrangement whereby they were able to maintain the temperature of a small electric furnace constant at 0.1° for hours at various temperatures from 500° to 1400°. The heating coil of the furnace was arranged as an arm of a Wheatstone bridge, and by combining it with a galvanometer regulator, the coil resistance was kept constant, and hence also the furnace temperature. Any change in the furnace temperature with the corresponding change in the resistance of the heating coil caused a boom to connect or disconnect a contact breaker. This contact breaker controlled a relay, which in turn operated a magnet, which controlled the main current supply.

The advantages of this method of control were that it was independent of variations in the supply current; nothing had to be placed in the interior of the furnace; there was practically no lag; the power available in the regulator was very large, and it required little or no attention.

F. W. H.

VIII.—Chemical Analysis.

51. The Indirect Detection of Tin. F. FEIGL (*Chem. Zeit.*, 1919, 43, 861).—In the method described, the mixed sulphides of antimony and tin were dissolved in hydrochloric acid, and the solution divided into two portions. One portion was tested for antimony with an iron wire. By means of pure zinc, the two metals were precipitated from the second portion, and the tin dissolved out in concentrated hydrochloric acid. This solution was poured

into a hot dilute solution of ferric chloride. Then a small quantity of citric acid or sodium potassium tartrate was added, followed by an ammoniacal solution of dimethylglyoxime in alcohol. A red coloration was obtained, the intensity of which varied with the quantity of stannous chloride present. The precipitation of iron was prevented by the addition of the citric acid or sodium potassium tartrate, but the presence of ferrous iron, produced by reduction of the ferric chloride by the stannous chloride, was indicated by the production of the red coloration.

F. W. H.

52. Separations in the Arsenic Group. W. STRECKER and A. RIEDEMANN (*Ber.*, 1919, 52, [B], 1935).—The usual distillation method for the estimation of arsenic was modified by the addition of thionyl chloride or phosphorus trichloride. The flask containing the arsenic, concentrated hydrochloric acid, and 1.5 grams of potassium bromide was heated until the contents boiled, and then 10 c.c. of thionyl chloride were run in gradually through a tap funnel, the transference taking thirty minutes. The distillate was diluted to between 700 c.c. and 800 c.c., and then boiled under a reflux condenser, a current of carbon dioxide being passed through the flask to assist in the expulsion of the sulphur dioxide. The boiling was continued until the precipitated sulphur collected, and then the distillate was filtered and the arsenic estimated in the filtrate as trisulphide.

Instead of thionyl chloride, 25 c.c. of phosphorus trichloride might be used, in which case the boiling of the distillate was unnecessary, but the presence of phosphorus acid in the residue possibly introduced complications in subsequent estimations.

By this method, arsenic was accurately separated from copper, lead, mercury, antimony, tin, and also from iron. Antimony was separated from tin by rendering the tin non-volatile by the addition of phosphoric acid, whilst antimony chloride was volatile at 155—165°. When the antimony was removed, hydrobromic acid was added to the residue, the temperature slightly increased, and the tin volatilised.

Antimony and copper in hydrochloric acid solution were separated by adding this solution to a mixture of 6 c.c. of concentrated sulphuric acid and 7 c.c. of phosphoric acid (specific gravity 1.78) and distilling, the distillate being received in hydrochloric acid in this case instead of water. The distillation was carried out at a temperature of 160°, and during the operation a mixture of ten volumes of concentrated hydrochloric acid and one volume of hydrobromic acid (specific gravity 1.78) was run into the distillation flask, the rate being such that the temperature of distillation remained constant. Complete volatilisation of the antimony occurred in thirty minutes, and similarly in the case of a mixture of antimony and lead.

Tin was separated from copper and lead in a very similar manner, 12 c.c. of sulphuric acid being used, and 20 c.c. of the mixture of hydrochloric and hydrobromic acids. The tin, completely

volatilised in thirty minutes, was precipitated from the distillate as sulphide and estimated as oxide. Neither antimony nor tin could be separated in this manner from mercury, since the mercury was also volatilised. F. W. H.

53. Colorimetric Determination of Small Quantities of Uranium. E. MÜLLER (*Chem. Zeit.*, 1919, 43, 739).—The author described a method in which the dilute solution of the uranium salt containing about 0.02 per cent. of uranium was treated with sodium salicylate solution, and the red coloration so obtained compared with that given by a known amount of uranium treated in similar fashion. Iron salts, alcohol, and acetone interfered with the estimation, and free mineral acids and acetic acid should be absent. Free mineral acid being present, sodium acetate should be added, and the free acetic acid removed by evaporation. Neutral alkali salts had no effect on the reaction. F. W. H.

IX.—Machinery for the Working of Glass.

54. Bottle Blowing Machinery. S. D. OLSEN (Brit. Pat. June 17th, 1918, No. 9981).—A rotary machine in which the parison moulds are mounted on an upper, and the finishing moulds on a lower, table is provided with turnover mechanism, by which the parison is automatically transferred from one mould to the other. The rotary tables, a , a^1 , are carried on a sleeve turning on a pillar, B , and intermittently driven by a cam groove on a roller, A^2 , engaging studs, A^4 . The parison moulds, b , and the finishing moulds, b^1 , disposed as shown, open and close in the usual manner. The neck mould, v^3 , is divided, and its halves are loosely connected to spring-pressed levers, v^2 , carried by a bracket, i , pivoted on an horizontal axis, v^1 , and capable of being revolved through 180 degrees by spur gearing, v^6 , v^7 . A shaft, c , within the pillar, B , is raised and lowered, during the movement of the tables, through a double lever, U , k^3 , on a rocking shaft, l , by a cam, e , on the roller, A^2 , and carries at its upper end four arms, of which three, f , f^2 , f^3 , are shown in Fig. 11. The arm, f , carries a spring-mounted cover, g , for closing the parison moulds, the arm, f^2 , carries a blowing head, h (Fig. 11), and the remaining arms carry spring-mounted brackets, f^6 , which engage arms, v^8 , on the bracket, i , and effect the turnover action. A blowing-plug, k , mounted on a slide, k^2 , actuated from the shaft, c , is adapted to supply air to blow the parison in the parison mould. The operation of the machine takes place in six stages. (1) The parison mould is

closed for charging by a plate carried by a lever on the shaft, *l*, and is charged with molten metal. (2) The cap, *g*, is brought down on the parison mould, the plug, *k*, is inserted into the neck-ring, and the preliminary blowing is effected. (3) The parison mould, having been opened, the neck-ring carrying the parison is turned over by the bracket, *f*⁶, actuating the arm, *i*⁸, and thus the

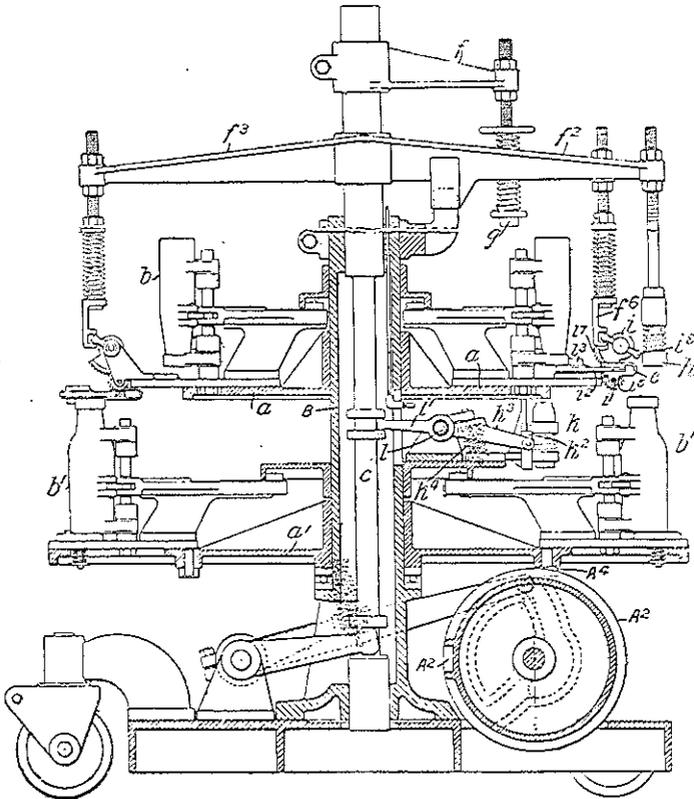


FIG. 11.

gearing, *i*⁶, *i*⁷. (4) The finishing mould is closed on the parison, the blow-cap, *h*, lowered on the mould, and the bottle blown. (5) The blow mould opens, and projections on it engage and open the neck-ring, thus freeing the bottle. (6) The neck-ring is turned back to its initial position ready for the parison mould to close upon it. The levers, *l*¹, *k*³, are connected by a spring connection, *k*², and similar spring devices are fitted to the lever, *d*¹, and the lever carrying the plate for closing the parison mould.

H. G. C.

55. An Automatic, Self-feeding, Bottle-making Machine.
 T. STENHOUSE (U.S.A. Pat., March 18th, 1919, No. 1297412.
 Filed November 12th, 1914. No. 871659).—The invention consists
 of an automatic press-and-blow machine, particularly intended for
 making bottles with externally screwed necks, and comprises a flow-

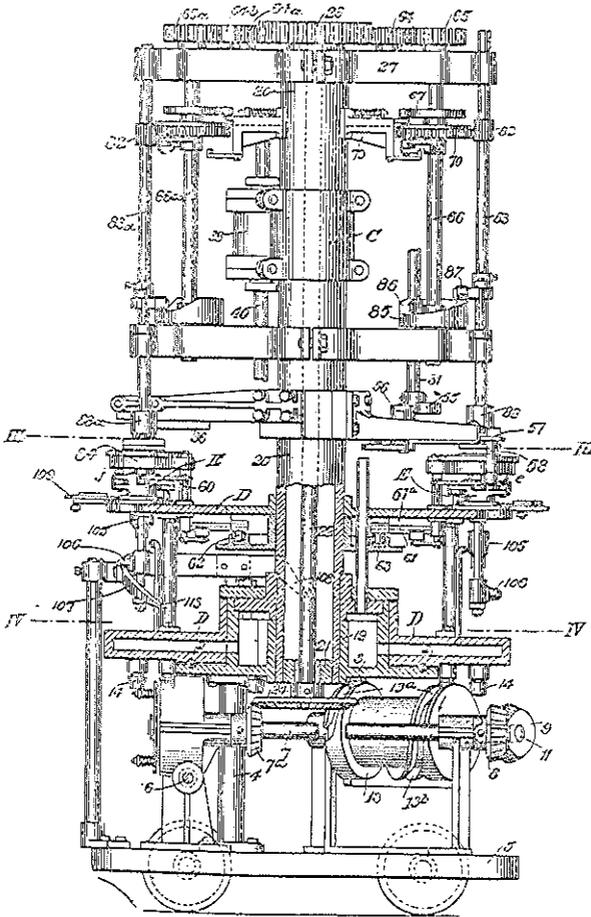


FIG. 12.

feed device. The table, *D* (Fig. 12), that carries the moulds is rotated step by step about a central column, 20, by means of a helix cam, 13, which engages rollers, 14, projecting from the underside of the table. The rollers, 14, are also engaged by spring cams, which assist in starting and stopping the table without shock. A shaft, 22, journaled in bearings in the column, 20, and driven

from the motor shaft, has a "master gear," 23, secured to its upper end, through which it drives the various mechanisms for pressing, blowing, etc.

The means for feeding the metal in regulated charges to the machine consists of a container, 37, shown in plan in Fig. 13, through which a stream of metal flows into the parison moulds from a spout projecting from the tank. The stream of metal is intermittently severed and supported by a water-cooled knife, 36, pivoted to the frame of the container, 37, and oscillated by a

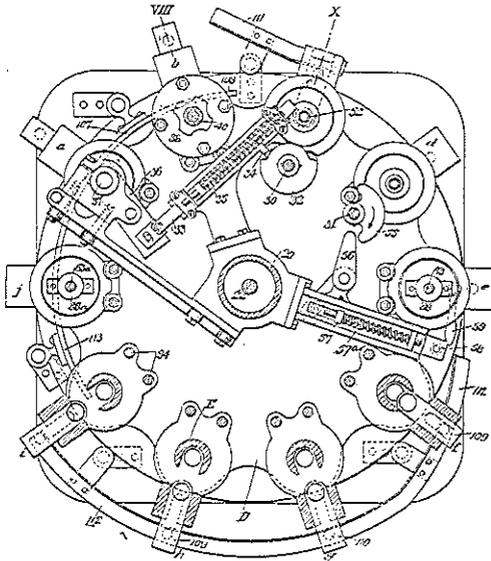


FIG. 13.

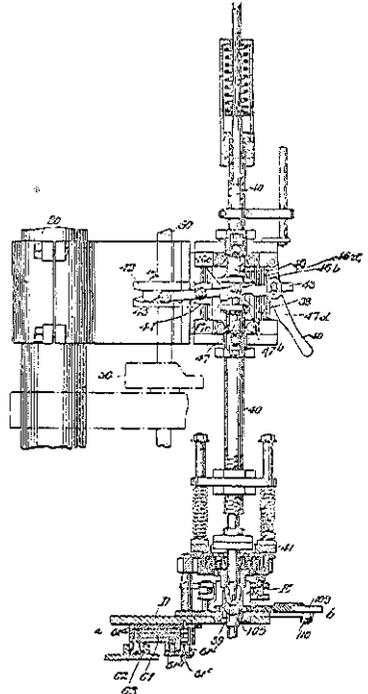


FIG. 14.

sliding bar, 33. A cam, 32, secured on a shaft, 30, engages a latch, 34, thus moving the bar and swinging the knife from under the container. When the cam releases the latch, 34, a spring, 35, returns the knife and interrupts the flow. The movement of the table carries the mould containing the charge of metal to station, *b*, where the charge is pressed into a parison by means of a plunger, 39 (Fig. 14), operated by an air cylinder, 38. The movement of the piston in the cylinder is controlled by two valves, 46, 47, which are alternately opened, to admit air to the cylinder, by means of a rocking-bar, 43, operated by a cam, 42, on the shaft, 32. A sleeve, 48, which may be moved along the bar, 43, by a

handle, 49, enables the operator so to control the valves that the plunger can be maintained either in its raised or in its lowered position.

As the table moves to carry the parison to the next station, the parison mould, 105, is lowered beneath the table, *D*, thus leaving the parison suspended from the ring mould within the blow mould, *E*. At the same time, the bottom, 109, of the blow mould is moved inwards by the engagement of its roller, 110, with a cam, 111 (Fig. 13). The parison is then blown by means of a blow-head, which is raised from, and lowered on to, the ring mould by a cam on a rotating shaft. The blowhead consists of a valve, 53 (Fig. 15), free to slide on the lower end of the air tube, 52. When the valve makes contact with the ring mould, further move-

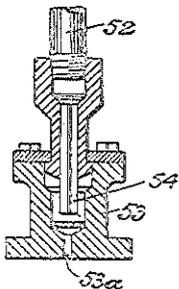


FIG. 15.

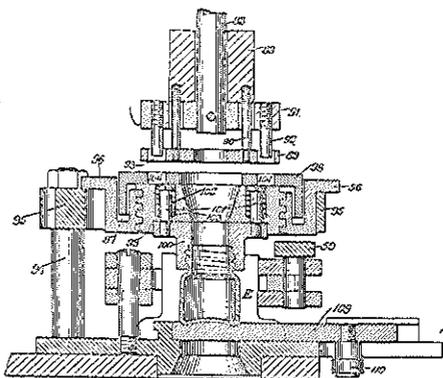


FIG. 16.

ment of the tube, 52, lifts an inner valve, 54, off its seating and releases the air. The mould is moved to the next station, where the ring mould is screwed off the neck of the bottle by mechanism shown in Fig. 16. The ring mould, 100, is carried by a support, 99, which screws into an annular member, 96, rigidly supported above the blow mould. A shaft, 83, has a collar, 91, on its lower end which has projecting pins, 92, that can engage apertures, 104, in the upper surface of the member, 96. In operation, the shaft, 83, is lowered so that the pins, 92, enter the apertures, 104, and is then rotated. The support, 99, is thus turned and screws the ring mould off the neck of the bottle. At the next stations, the mould is unlocked and opened, and the bottle is presented for removal. Finally, the mould is locked again and the ring mould screwed down by mechanism similar to the screw-off device.

G. D.

56. Glass Pressing Machines. W. J. MILLER U.S.A., (Brit. Pat., August 8th, 1918. No. 19289/19).—Relates to a press for

moulding glass articles. The plunger, *P* (Fig. 17), is mounted on a movable cross-head, *N*, connected with a fixed cross-head, 126, by toggles, 174, 176, which are operated through links, 175, by a cross-head, 172, moved up and down by fluid pressure acting in the cylinder, *J*. The capacity of the cylinder, *J*, can be varied by moving a false head or piston, 133 (Fig. 17), which is fixed to a screwed sleeve, 132, passing through the true cylinder head, 130. An extension, 134, of the piston-rod, 129, is grooved at 136 to allow fluid pressure to pass from the supply pipe, 152, through the sleeve, 132, into the space between the false head, 133, and the piston, 128, and so cause this to descend. The piston is raised by air admitted through a pipe, 149. The last part of the upward movement of the piston, 128, closes the entrance to the groove, 136, and the imprisoned air is allowed to escape slowly through a small port, 140, thus producing a cushioning effect. The height of the cylinder, *J*, and of the cross-head, 126, attached to it, is adjusted by screw collars, 146, 148.

Further devices by the same inventor are as follows:—(Brit. Pat., August 8th, 1918, No. 19290/19.)—This relates to apparatus for discharging the finished glassware from the moulds of a press. The moulds, *E*, are carried on trunnions, 20, on a frame, *D*, which is rotated step by step by a fluid-pressure cylinder, 37. The gatherer places the charge in the mould and presses the punty upon a valve, which starts the machine, after which the cycle of operations is completed automatically by fluid-pressure mechanism. Shears cut the depending charge from the punty, and the charged mould is carried round to the pressing station, where the plunger descends and compresses the charge. The further rotation of the frame, *D*, causes a rod, 27, to strike a cam, 36, and so raise the mould top, 34, which it supports. A toothed arc, 21, on the mould, *E*, engages another toothed arc, *H*, which is swung downwards by a fluid-pressure cylinder, etc., 95, and so inverts the mould and discharges the finished article into an annular trough, 87, containing sand, etc., to cushion the fall.

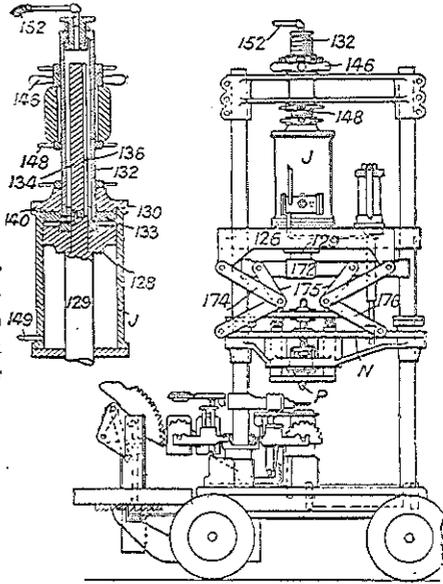


FIG. 17.

The tappets of the slide valve controlling the fluid-pressure supply to cylinder 95 are operated by a block fixed to the piston-rod, 38, of cylinder 37. The annular trough, 87, is rotated intermittently

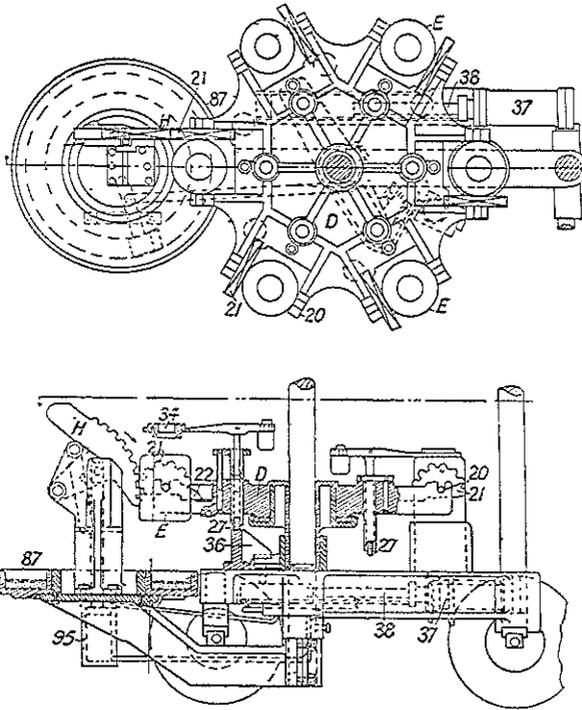


FIG. 18.

in unison with the frame, *D*, so that successive articles do not fall upon one another. The trunnions, 20, are off-set, so that the mould, *B*, turns back to its normal position by its own weight when disengaged from the arc, *H*, and a stop, 22, keeps it upright.

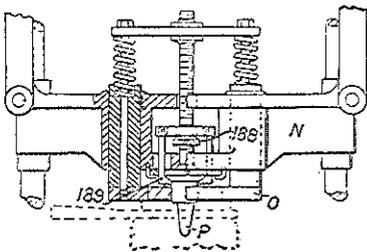


FIG. 19.

(Brit Pat., August 5th, 1918, No. 19291/19.)—In a machine for moulding glass articles, the plunger, *P*, is centred above the mould and then clamped to the cross-head, *N*, by hooks, 189, which are drawn upwards by a nut, 188. The hooks, 189, are also moved

radially by a cam ring. The plunger, *P*, passes through a spring-

pressed plate, *O*, which rests upon the top of the mould during the pressing operation.

(Brit Pat., August 8th, 1918, No. 19292/19.)—In a press of the type in which the moulds, *E*, are carried on rotating arms, 16, a cylindrical block, 113, is mounted directly below the pressing plunger and is surrounded by a sleeve, 114, having a bevelled upper edge, *T*, and is thus raised slightly, being supported during the pressing operation by the block, 113, the arms, 16, thus being relieved of strain. The sleeve, 114, is raised to the position shown by fluid pressure acting on a piston, 119, as soon as the mould, *E*, is in position above the block, 113. Accurate centring is thus insured.

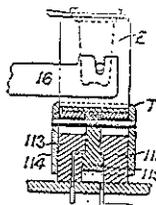


FIG. 20.

H. G. C.

57. Glass Pressing Machine. W. A. LORENZ (U.S.A. Pat., January 21st, 1919, No. 1291952. Filed December 26th, 1913. No. 808803).—The specification describes a rotary power-driven press, evidently intended for use with an automatic feeding device. The machine consists of a number of plungers and associated moulds which rotate about a central vertical column, and the construction shown in the drawings appears to be arranged for producing tumblers of the kind used for containing potted foodstuffs. The table, 3 (Fig. 21), of the machine rotates on ball bearings, 4, about the central column, 2, and has gear teeth, 5, formed on its edge, by which it is driven. A turret, 16, mounted on the table, forms with the table a support for the pressing devices, and within the turret a cylindrical casting, 17, secured to the column, 2, has cam grooves formed on its surface, by which the pressing devices, etc., are operated. The pressing plungers, 50, are carried by yokes, 31, which slide on vertical guide rods, 30, arranged in pairs at intervals around the table. Each plunger is raised and lowered by a toggle joint consisting of a connecting rod, 32, which is pivoted to the plunger yoke, 31, and to a crank arm, 33. The boss of the crank is formed with gear teeth, 42, which mesh with a rack, 43, that slides vertically, and is provided at its lower end with a roller, 45, which engages in a cam groove formed on the cylindrical casting, 17. Thus, as the table, 3, rotates, the plunger is caused to rise and fall. The arrangement of the moulds is a feature of the invention. They are mounted in pairs, 20, 21, on a Z-shaped carrier, 22, which turns on trunnions, 24, so that each mould turns over, to discharge the finished ware, about an axis that is tangential to the circle of rotation of the table. Rotation of the moulds is effected at the proper times by gearing operated by a cam roll that engages a groove, 74, in the casting, 17. In order to support the moulds during pressing, a movable abutment, 78, slides beneath the mould, and is removed when the mould is ready to rotate to discharge the finished article. The abutments,

78, are operated by springs, 82, and by cam rolls, 79, which engage a cam surface, 80, on the casting, 17. The mould rings, 90, are carried by yokes, 91, that slide on the vertical guide rods, 30, and are operated by rods, 96, having cam rolls, 94, which engage in a cam, 93, on the base of the machine. After the pressing opera-

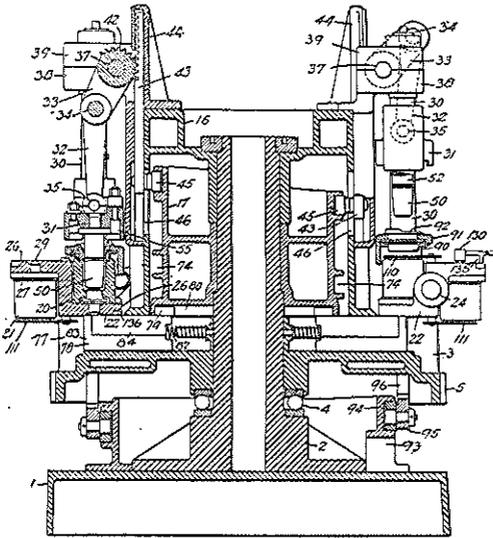


FIG. 12.

tion, the mould carrier is turned over to bring a new mould into position. The finished article is not discharged immediately, however, but is retained in the mould while setting by fingers, 111, pivoted to the mould carrier. These swing out of the way at the proper time, and the discharge of the article from the mould is ensured by small hammers, 130, which strike the movable bottom of the mould.

G. D.

58. Machinery for Moulding Glass. W. J. MILLER, Swissvale, Pennsylvania, U.S.A. (Brit. Pat. No. 118282.) (August 8th, 1918, No. 12883).—Relates to a rotary-table moulding machine actuated by fluid pressure. A series of moulds, *E*, are suspended on trunnions at the ends of radial arms on the table, *D*, connected to a boss turning on a pillar, *C*, and driven intermittently by an oscillating arm actuated by a piston in a cylinder, 37. An automatically actuated pin engaging holes in the underside of the table serves to lock the table in successive positions. The glass is fed into a mould when in the position shown at the right of Fig. 22, and the workman then actuates a valve by means

of his punty, causing shears, 83, to be pneumatically operated to sever the charge. The table then moves automatically, and the cover, 34, is brought down upon the mould, which rides up on a block, *I*, when it reaches the moulding station. The block consists of an inner fixed part and an outer sleeve, which is forced upwards by pneumatic pressure to support the mould. The die, *P* (Fig. 22), is adjustably mounted on a sliding frame, *N*, which is connected by adjustable toggle levers, 175, with a cross-head, 172, carried by the rod, 129, of a piston working in a vertical cylinder, *J*, supported by the pillars, *B*, *C*. The cylinder is fitted with an adjustable false end to regulate the movement of the piston, and air is first admitted slowly to give a slow initial movement, and then more rapidly, the final pressing being effected by the toggle levers. The time during which the die remains in the glass is determined by timing mechanism, *M*, of the kind described in the U.S. Specification 941935. After the moulding has been completed, the table moves forward, and when it reaches the discharging position the mould is turned over by a toothed segment, *H*, engaging a segment, 21, and the finished article is delivered into an annular rotating sand-box. The cylinder, *J*, is supported by a screwed stem, 132, which can be adjusted vertically for moulding articles of different lengths. It is stated that the apparatus is applicable to blowing machines.

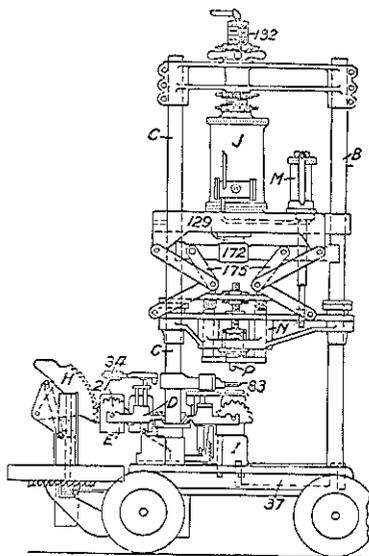


FIG. 22.

H. G. C.

59. Timing Devices for Glass Pressing Machinery. HARTFORD-FAIRMONT Co., U.S.A. (Brit. Pat., July 28th, 1919, No. 18714).—Relates to machines for moulding plastic substances, such as glass, and particularly to the mechanism for timing the movements of the plungers and tables of the rotating table type of machine, such as is described in Specification 120907*. The invention is stated to be applicable also to glass-blowing machines. The table, 23, is rotated intermittently by the engagement of a roller, 32, on a crank, 31, with passages, 28, between blocks, 27, on the under surface of the table, 23. A cam-shaft, 46 (Fig. 29), is driven by bevel-gear, 49, 50, from the crank-shaft, 30, and

* This JOURNAL, III. Abs. 201.

carries a cam, 45, which draws the crank, 31, down clear of the blocks, 27, against the action of a spring, by means of levers, 41, 43, on a rocking shaft, 42. A spring bolt, 54 (Figs. 26 and 27),

FIG. 23.

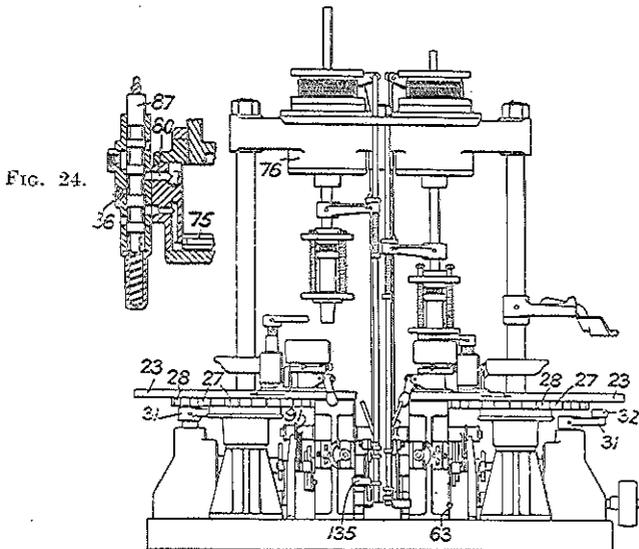


FIG. 24.

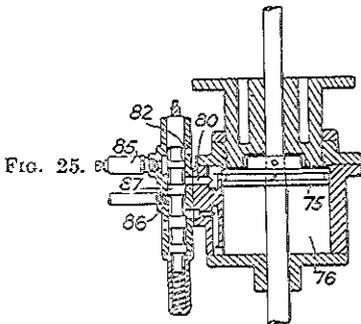
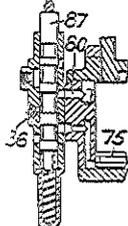


FIG. 25.

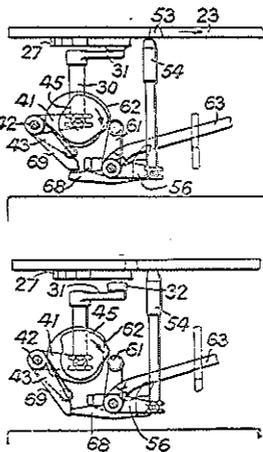


FIG. 26.

FIG. 27.

engages holes, 53, in the table, 23, to hold it at each station, and is drawn down free of the table by a cam, 62, on the rocking shaft, 42, and rocking levers, 56, 61. If the bolt, 54, is not in one of the holes, 53 (Fig. 27), a detent, 68, connected with the lever, 56, engages a lever, 69, on the rocking shaft, 42, and prevents the crank, 31, from rising and striking the blocks, 27. Normally, the

crank, 31, is allowed to rise (Fig. 26), and the bolt, 54, is then lowered to free the table, 23. The crank, 31, is also automatically held down in the event of the pressing plunger failing to rise. The piston valve, 87 (Fig. 24), which controls the fluid pressure operating the piston, 75, of the pressing plunger, is operated by a cam, 97, on the shaft, 46. The cam, 97, consists of the segments 100, 101, 104 (Figs. 28 and 29), which can be adjusted relatively to one another, while the machine is running, to alter the valve timing. In its upper position, Fig. 24, the valve, 87, admits pressure above the piston, 75, by way of the passages, 86, 80, to press the ware. As the valve, 87, descends it cuts off the passage, 80, from the pressure inlet, 86, and places it in communication with a relief valve, 85 (Fig. 25), which allows some of the pressure to escape from the cylinder, 76, and so reduces the pressure on the glass, etc., in the mould. The further descent of the valve, 87 (Fig. 25), admits pressure below the piston, 75, and exhausts it from above through a port, 82. The locking-bolt, 54, can be held down by a hand-lever, 63, and the valve, 87, can be raised, and hence also the pressing-plunger, by a hand-lever, 91. The crank, 31, can be held down by a treadle, 135 (Fig. 29).

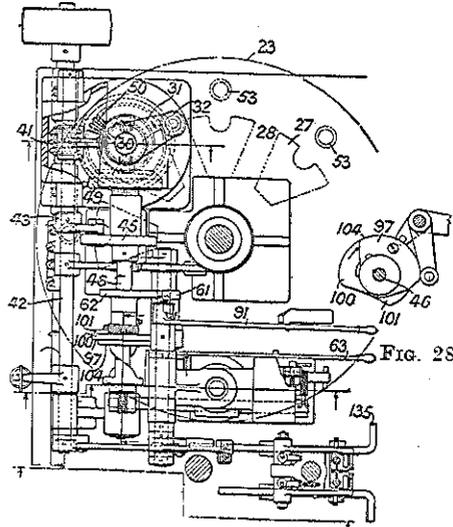


FIG. 29.

H. G. C.

60. Feeding Glass-making Machines. R. E. McCauley, London. (Brit. Pat. No. 118585.) (May 31st, 1918, No. 9030).—Relates to means for conveying molten metal from the melting tank to machines, and consists of an arrangement by which separate machines may be supplied in succession. In the arrangement shown, shoots, *c, c'*, mounted on pivots, are actuated by compressed-air cylinders, *e*, so that they are alternately brought under the outlet, *d'*, of the melting tank, *d*.

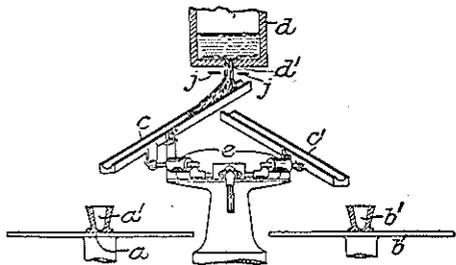


FIG. 30.

The shoots respectively deliver the charge to the moulds, a' , b' , on the rotary tables, a , b . In another arrangement, one of the shoots is stationary and the other is moved so as to intercept the discharged glass at intervals. The shoots may have a sliding instead of a swinging movement, and may be driven by any suitable mechanism. To prevent overheating, the shoots are formed hollow, and cooling fluid is circulated through them. The metal is severed by the usual shears, j .

H. G. C.

61. Glass-tumbler Press. KARL E. PEILER (U.S.A. Pat., January 21st, 1919, No. 1292033. Filed August 11th, 1913, No. 784194).—The invention consists of a tumbler-pressing machine that is a more elaborate form of the machine which forms the subject of U.S.A. Pat. 1291952 (see abstract No. 57). In the present invention, the rack, 34, that raises and lowers the plunger, 121, only actuates the plunger during its free, or non-pressing, movements, the cam groove, 123, 124, which operates

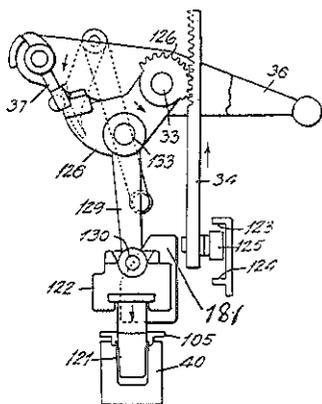


FIG. 31.

the roller, 125, of the rack being open, as shown, when the plunger is in position to press the glass. The pressure for shaping the metal in the mould, 40, is obtained from a pressing-lever, 36, which rocks on the shaft, 33, and has at its outer end a pawl, 37. This pawl engages a shoulder on the crank, 128, when the plunger is in the pressing position, and thus tends to straighten the toggle joint. The inner ends of the levers, 36, engage in slots in a collar surrounding the central column of the machine. A shaft, which reciprocates within the central column, carries an electromagnet that picks up the collar, and thus rocks the levers, 36. A pivoted guard, shown in dotted lines, is

G. D.

62. Device for Promoting Uniformity of Flow in Glass Feeder. R. E. McCAULEY, London. (Brit. Pat. No. 118581.) (May 21st, 1918, No. 8472).—Delivering molten metal. Relates to arrangements in connection with glass-melting tanks to secure that the

metal delivered is of uniform character by preventing its being unequally chilled at the cooler end of the tank. In the arrangement shown in Fig. 32, the tank is fitted with a transverse dam, 11, formed in one with an horizontal part, 11^a, which rests on the top of a cylinder, 12, forming the conduit to the outlet, 8^a. The arrangement causes the metal to pass round the cylinder, 12, and then upwards at the wall, 9, of the tank, as shown by the arrows. The invention is shown as applied to apparatus of the type

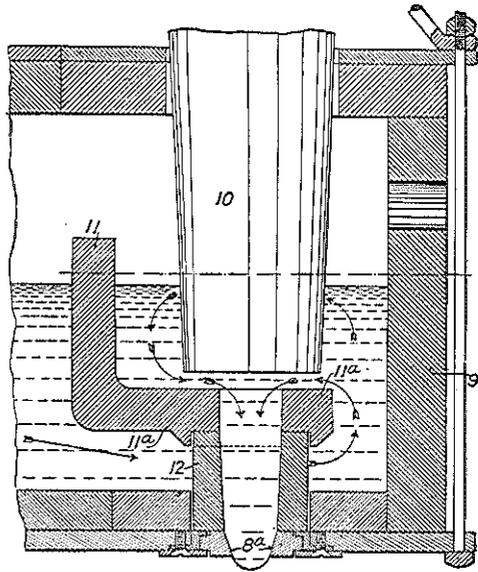


FIG. 32.

described in Specification 113665, in which the discharge is pneumatically controlled through a cylinder, 10. In a modification, the dam is formed as an open cylinder with the opening towards the wall, 9, and extends to the bottom of the tank.

H. G. C.

63. Apparatus for Drawing Glass Cylinders. WILLIAM WESTBURY (U.S.A. Pat., February 18th, 1919, No. 1294581. Filed June 26th, 1917, No. 176955).—Relates to apparatus for drawing glass cylinders, in which a tank furnace is provided with one or more forehearth or doghouses from which the metal is drawn. Such a doghouse, as shown in Fig. 33, consists of a horizontal top wall, 6, resting on a front wall, 3, and having a drawing opening, 9, and a wall, 7, filling the space between the topstone, 6, and the furnace crown, 1. According to the present invention, the vertical wall, 7, is made up of a series of vertical blocks, 10, which are tongued and grooved on their meeting faces, and the topstone, 6, is also composed of a series of blocks, 13, fitted together. Thus the walls can be repaired by the replacement of one or more damaged blocks. The topstone, 6, is supported by rods, 20, depending from the usual trussing, 23, and screwed at their lower ends into an iron pipe, 18, which passes through channels, 17, in the blocks, 13. The rods, 20, are housed in recesses, 21, in the blocks, 10, in order to protect them from temperature variations.

The pipe, 18, may also be used for the circulation of a cooling

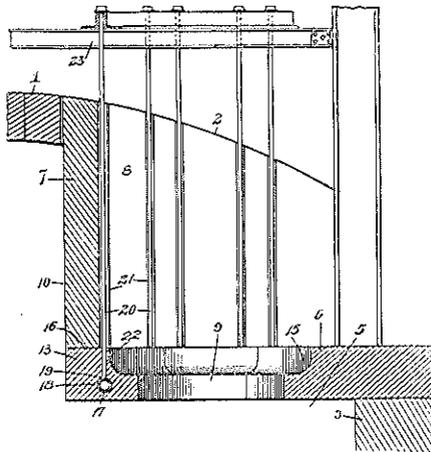


FIG. 33.

fluid, such as water, air, or steam. U.S.A. Pat. No. 1187025 is referred to in the specification. G. D.

64. Drawing Glass Cylinders. WILLIAM E. STANDLEY (U.S.A. Pat., June 24th, 1919, No. 1307381. Filed November 17th, 1915, No. 61974).—A blowhead used in drawing cylinders is provided with means for regulating the pressure of air within the cylinder in order to avoid the defects produced by air pulsations.

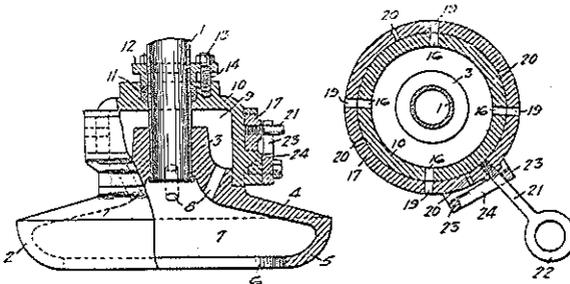


FIG. 34.

The blowhead consists of a bait, 2 (Fig. 34), a pipe, 1, through which air is supplied to the bait, and air ports, 8, in the bait, adjacent to the lower end of the pipe, 1, through which the excess air is allowed to escape. In order to regulate this escape of air, the ports, 8, instead of communicating directly with the atmosphere, open into a hollow casing, 9, from which the air escapes

through ports, 16 (Fig. 34), into the atmosphere. A collar, 17, surrounding the casing, 9, is pierced with two or more sets of holes, 19, 20, of different sizes, and these may be brought into coincidence with the ports, 16. Thus, by moving the collar, 17, the area of the ports, 16, and therefore the amount of air allowed to escape, can be regulated.

G. D.

65. Drawing Glass Cylinders. WILLIAM WESTBURY (U.S.A. Pat., June 24th, 1919, Nos. 1307943 and 1307946. Filed October 3rd, 1917, Nos. 194495 and 194497).—The inventor explains that, in drawing glass cylinders, two different methods are employed. In one, the cylinder is drawn directly from the body of metal in the tank through an opening in the topstone of a forehearth or dog-house.

In the other method, the metal is ladled from the tank into a pot heated by a separate furnace. In order to combine the advantages and to avoid the disadvantages of both methods, it is proposed to employ a pot, 3 (Fig. 35), mounted on trunnions which can be

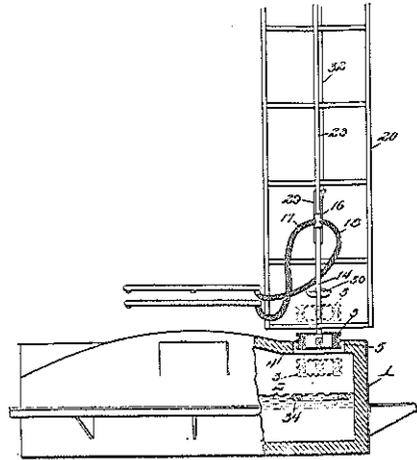


FIG. 35.

dipped, through an opening, 5, in the topstone of the tank, into the metal, 2. It is then raised to fill the opening, 5, and the drawing proceeds. The pot, 3, preferably consists of two pots placed base to base, and is reversed before filling. Thus, while a cylinder is being drawn from one pot, the "aftermath," or chilled glass, which remains in the pot after drawing is being melted out of the other pot.

G. D.

66. Drawing Glass Cylinders. OTIS A. WELLS (U.S.A. Pat., April 22nd, 1919, No. 1301771. Filed October 7th, 1914. No. 865490).—The invention relates to the method of making glass cylinders by drawing, and the specification discusses at length the relative advantages and disadvantages of the "hot bait" method, in which the bait is preheated to the point at which it will weld to the glass, and the "cold bait" method, in which the bait is used at a temperature much below the welding point. The inventor has discovered that the best results can be obtained by using the bait at a temperature intermediate between those employed in the two processes mentioned. Accordingly, the

present invention consists in using a heated bait having a temperature below that at which the glass will fuse thereto, but high enough to have the same radial contraction during the drawing process as that which occurs in the novel or rim of glass which is anchored in the flange of the bait. G. D.

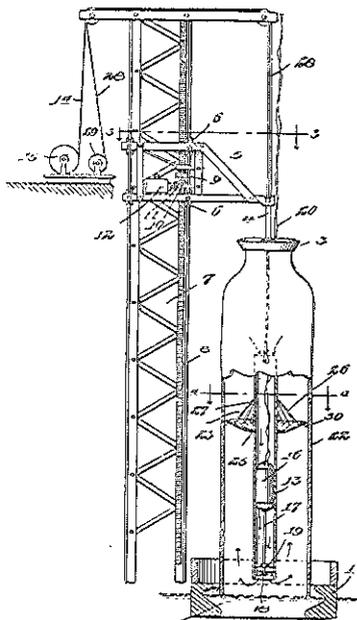


FIG. 36.

67. Drawing Glass Cylinders. WILLIAM WESTBURY. (U.S.A. Pat., June 10th, 1919, No. 1306651. Filed January 26th, 1916, No. 74473).—The invention consists of a process of drawing which is designed to avoid the defects that occur when it is attempted to draw cylinders of large diameter. An open bait, 3 (Fig. 36), is used, and the cylinder is drawn around a tube, 13, which is suspended with its lower end a few inches above the surface of the metal, 2. Within the tube, 13, a fan, 19, operated by a motor, 16, sucks air downwards, so that there is a complete air circuit within the cylinder being drawn. A centring device, 23, which opens and closes like an umbrella, bears lightly against the inner surface, 22, and thus prevents the tube, 13, from swinging. G. D.

68. Drawing Glass Cylinders. W. L. MONRO (U.S.A. Pat. February 25th, 1919, No. 1295348. Filed July 24th, 1915. No.

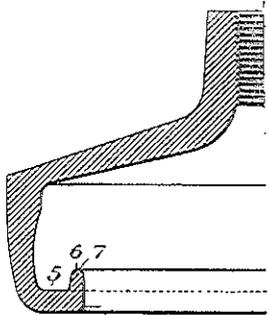


FIG. 37.

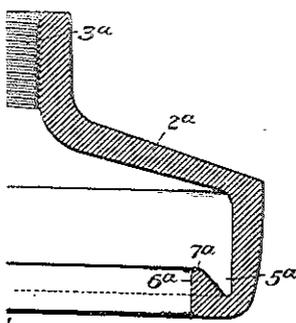


FIG. 38.

41686).—Relates to the method of drawing glass cylinders by the "cold bait" process, that is, the process in which the bait, when

inserted in the metal, is at a temperature considerably below that at which the glass fuses on to the metal of the bait. The specification explains that hitherto it has been considered that the flange, 5 (Fig. 37), of the bait, which anchors the glass, should have an inner wall with little or no inclination to the horizontal. According to the present invention, the inner surface of the flange, 6a (Fig. 38), is inclined at an angle of at least 45° to the horizontal, and may be at an angle of 90° , as shown in Fig. 37. G. D.

69. Splitting Glass

Cylinders. JOHN MURPHY (U.S.A. Pat., June 17th, 1919, No. 1307209. Filed May 10th, 1918. No. 233687).—A stand for supporting cylinders during splitting consists of side members, 2 (Fig. 39), connected by strips, 3, of flexible material which carry the cylinder, and anti-friction rollers, 4, which can be raised or lowered by means of a treadle. When the rollers are raised, they lift the cylinder off the strips, thus enabling it to be turned easily for selecting the line of splitting. G. D.

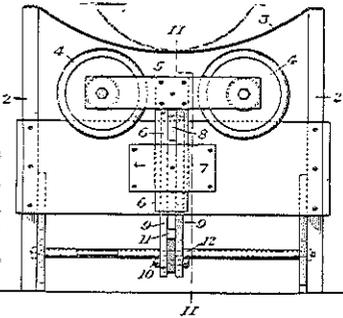


FIG. 39.

70. Perforating Glass. BRITISH THOMSON-HOUSTON CO., London (GENERAL ELECTRIC Co., Schenectady, New York, U.S.A.) (Brit. Pat. No. 119589.) (January 4th, 1918, No. 238).—Glass whilst in a plastic condition is perforated by pressing through it one or more pins made of a metal which is not wetted by the glass, such as tungsten or molybdenum. In the arrangement shown, a

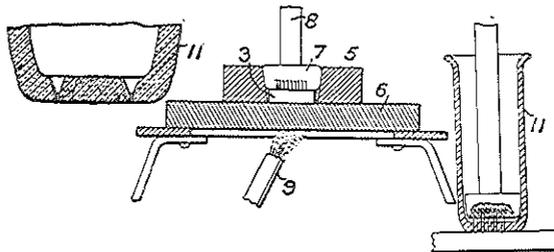


FIG. 40.

series of pins are placed in apertures in a refractory block, 3, and a bead of glass, 7, carried by a stem, 8, is pressed on to the bent upper ends of the pins in a mould, 5, supported on a refractory plate, 6, heated by a burner, 9. Fig. 40 shows the device thus.

formed used for forming perforations in a die, 11. If the perforation is effected when the glass is at the right temperature, coned perforations are produced. H. G. C.

71. Device for Splitting Glass. H. F. HITNER (U.S.A. Pat., March 11th, 1919, No. 1296661. Filed June 26th, 1916. No. 105926).—The invention consists of a device for splitting glass,

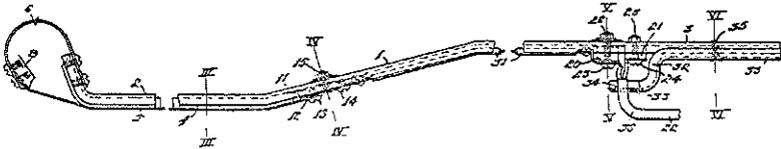


FIG. 41.

particularly glass cylinders, by electricity. The frame 1 (Fig. 41), of the device consists of channel iron shaped as shown, a strip, 4, of refractory insulating material, such as asbestos, being fitted into the channel. A block, 11, is secured to, but insulated from, the frame, and another block, 8, is attached to a spring, 6, secured to the end of the frame. A strip, 5, of nichrome is secured to the blocks, 8 and 11, and is thus tensioned by the spring, 6. In order to prevent the strip from burning off at its ends, it is fastened to the blocks in the manner shown in Fig. 42. The turned-up end, 7, of the spring, 6, forces the strip into a groove in the block, 8, when the screws are tightened. The wires of the cable, 22, are connected to the frame, 1, and

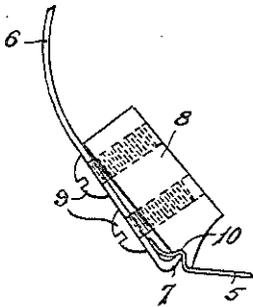


FIG. 42.

to the block, 11, respectively, and a guard, 38, secured to the handle part of the frame prevents the wires from being broken off from their terminals. G. D.

72. Handling Sheet Glass. JOHN A. BECHTEL (U.S.A. Pat., June 17th, 1919, No. 1306993. Filed June 21st, 1918. No. 241278).—A stowing tool, shown in cross-section in Fig.

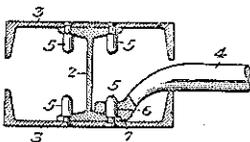


FIG. 43.

in use to prevent warping.

G. D.

73. Apparatus for Moulding Plate and Sheet Glass. EMIL G. JOHANSON (U.S.A. Pat., March 18th, 1919, No. 1297566. Filed July 26th, 1917. No. 182975).—Relates to an

apparatus for impressing a design on a flat plate or sheet of glass. A mould plate, 28 (Fig. 44), impressed with a suitable design, is supported on a stand, 10, and is heated from beneath by gas jets, 12. A hollow roller, 19, heated internally by gas jets, 20, is journaled at one end in a carriage, 18, which can be traversed along guiding rods, 15, 16, by a leading screw. In use, a plate of glass in a softened condition is laid on the mould plate, and the roller, 19, is lowered by a screw device actuated by a hand-wheel, 30, to press the glass.

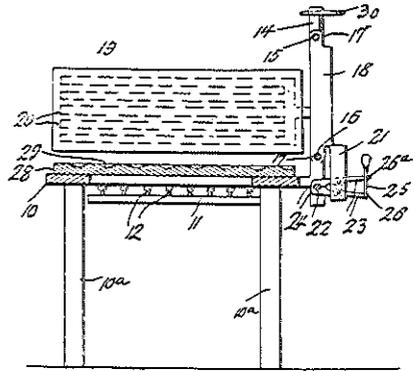


FIG. 44.

The roller is then traversed along the glass plate, which thus receives the design on the mould plate. The use of the device for the production of a plurality of headlight lenses in one operation is suggested.

G. D.

74. Casting Plate Glass. W. L. CLAUSE (U.S.A. Pat., April 1st, 1919, No. 1298893. Filed January 12th, 1912. No. 670740).—Relates to a means of casting plate glass from a tank. The tank comprises a melting chamber, 7 (Fig. 45), and a refining chamber, 8, and the chamber, 8, is provided with a spout, 10, beneath which a casting table, 11, with the usual roller, 12, is

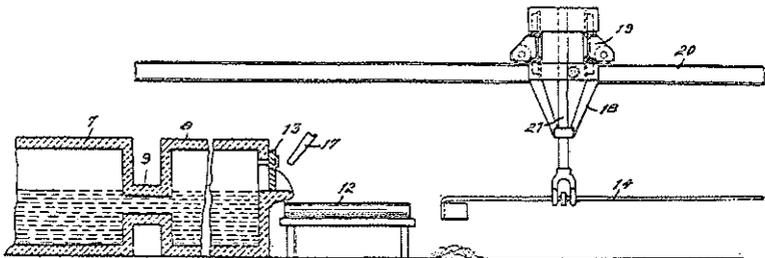


FIG. 45.

placed. The spout is closed by a gate, 13, and both spout and gate are heated by gas jets, 7. A crane, 19, running on tracks, 20, supports a hoe-like implement, 14, which has a U-shaped end, 22. In use, the rake, 22, is immersed in the metal in the tank and then withdrawn, so as to carry with it a charge of metal, which is spread on the table and is then rolled in the usual manner.

G. D.

75. Drawing Sheet Glass. R. L. FRINK and F. J. FRINK (U.S.A. Pat., April 29th, 1919, No. 1302149. Filed February 27th, 1914. No. 821396).—Relates to means for melting off the congealed glass which remains in the drawing-pot after a cylinder has been drawn. The apparatus consists of two drawing-pots carried by a frame, 5 (Fig. 46), which is secured to a rotatable shaft, 2. The pots, which are of the type described in U.S.A. Pat. 941512, consist of inner and outer layers, 11, 10, respectively, separated by a layer, 12, of heat-insulating material, and are provided with a central tube, 13, for the admission of air to the

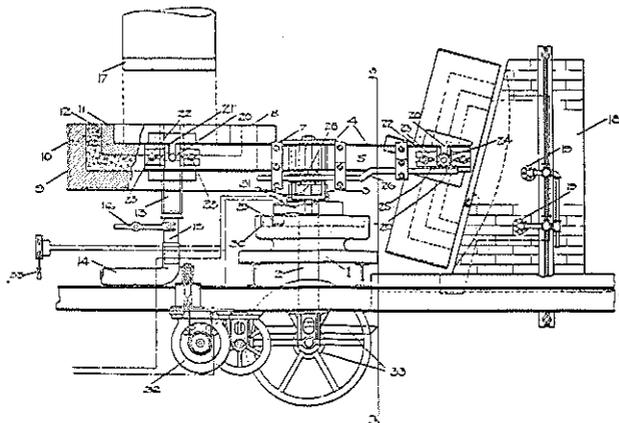


FIG. 46.

draw. A stationary air pipe, 14, positioned beneath the drawing station, has a movable extension, 15, which enables a ready connection to be made with the pipe, 13. Diametrically opposite the drawing station is the draining station, consisting of a chamber, 18, of brick having one side open and provided with burners, 19. Thus, when the pot is positioned in front of the chamber, as shown, gas flames will be directed into its interior, and the glass will melt and run down into a trough. A cam, 30, and a crank, 31, actuate racks, 26, which tilt the pots as the latter are moved to and from the chamber, 18.

G. D.

76. Drawing Sheet Glass. ROGER S. PEASE (U.S.A. Pat., April 1st, 1919, No. 1299019. Filed June 5th, 1915, No. 32364).—The invention consists of an apparatus for drawing "cylinders" having flat sides, which may be cut up, therefore, without having to be flattened. Metal from a tank, 1 (Fig. 47), passes into an annular chamber, 6, in a forehearth, 3, whence it passes by means of passages, 7, into a drawing-basin, 5, formed by a conical drawing-ring, 8. This forehearth is described more fully in a co-pending application. The apparatus which forms the present invention consists of four arms, 15, pivoted on a metal plate, 16, which

is mounted on a pedestal, 13, extending upwards from the bottom of the drawing-basin. The arms carry rollers, 17, on their outer ends, and may be raised or lowered by means of cables, 18, passing through a central channel in the pedestal, 13. In use, the arms are raised, as shown in dotted lines, and the bait, 22, lowered into the metal. The bait is then raised to draw a cylinder, as usual, but as soon as it clears the top of the forehearth, the arms, 15, are

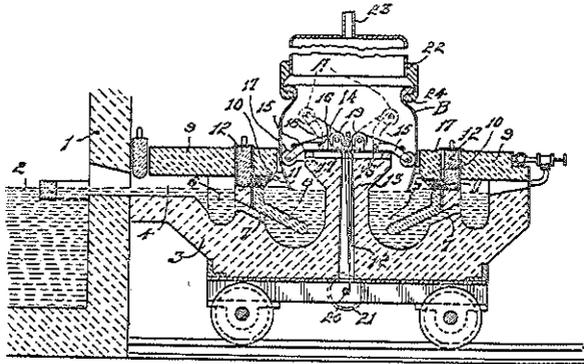


FIG. 47.

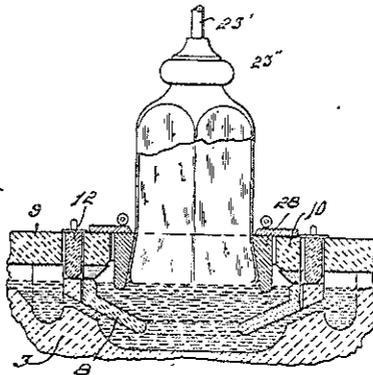


FIG. 48.

lowered, so that the rollers, 17, press the cylinder outwards. The cylinder, being pressed outwards at four points only, is stretched so that its walls between the rollers become flat, and the result is a "cylinder" which is square in cross-section. In a modification, the rollers and arms are replaced by bars of basswood, soapstone, or copper. In a further modification, shown in Fig. 48, the glass is drawn through a forming-member, 28, square in cross-section, consisting of an undercut frame of basswood, soapstone, or other

suitable material. This frame flattens the "cylinder" as it is being drawn, the glass being pressed against the inner face of the frame by air pressure supplied to the interior of the "cylinder" by means of a pipe attached to the bait. G. D.

77. Automatic Take-in. RICHARD LA FRANCE (U.S.A. Pat. No. 1296818, March 11th, 1919. Filed September 15th, 1913.

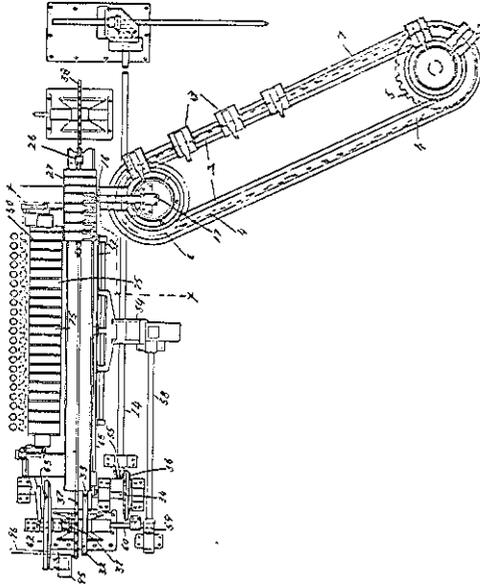


FIG. 49.

No. 789779).—Relates to a device for automatically taking-in bottles and stacking them in rows in the lehr, the device being designed particularly for use with the Owens machine. The device is shown in plan in Fig. 49. The bottles as they fall from the machine slide on to concave holders, 3, which are mounted on a horizontal travelling sprocket chain, 7. The holders are carried in front of a reciprocating member, 16, which pushes the bottles on to similar holders, 27, carried by a sprocket chain, 26, which travels across the front

of the lehr, so that the bottles will be arranged in a row across the front of the lehr. When a sufficient number of bottles are arranged on the holders, 27, they are pushed on to a rocking frame, 50, called an "uprighter," which turns through a right angle and deposits the bottles in an upright position on the travelling lehr belt. If desired, the holders, 3, and the chain, 7, may be dispensed with and the bottles delivered direct from the machine on to the holders, 27. G. D.

78. Glass Stoppering Machine. F. TWEEDDALE (Brit. Pat. No. 114543, July 4th, 1917, No. 9615).—The necks of bottles, *f* (Fig. 50), are ground by a mandrel, *d*, fed with emery or other abrasive material. The mandrel, *d*, is secured in a chuck, *b*, on a spindle, *b'*, mounted in a headstock, *a*. The stopper, *e*, is carried in a chuck, *c*, on a second parallel spindle, *c'*, mounted in the same headstock but at a slightly higher level. The stopper is ground by a pair of jaws which encircle it, and are

fed with emery, etc. The neck of the bottle which has previously

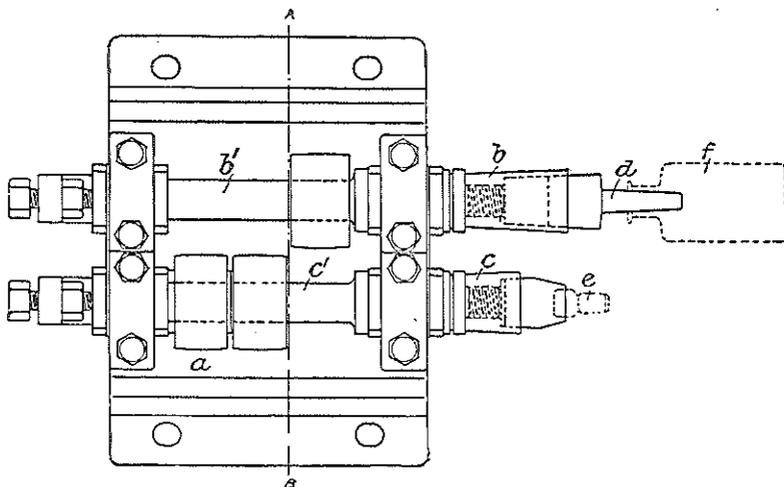


FIG. 50.

been ground by the mandrel, *d*, is then finished off upon the ground stopper.

H. G. C.

X.—Glassware Accessories.

79. Fire Extinguishment Bottles. G. J. MONEY (Brit. Pat. September 26th, 1918, No. 15696).—Relates to cast-glass bottles or tubes such as are used in chemical fire-extinguishers, and which are formed with thin parts adapted to be broken. The bottles are made of coloured glass, so that the thick and thin parts can be easily gauged by holding the bottle up to a strong light.

H. G. C.

80. A Machine for Washing Bottles, Jars, etc. M. S. CRAVEN, Kingston-upon-Hull (Brit. Pat. No. 119597.) (January 17th, 1918, No. 948).—A rotary soaking-wheel is formed with composite compartments to take two tiers of jars, *J*. Each compartment holds three rows of jars when all are arranged radially, and two rows when the upper tier is arranged tangentially. The compartments are formed by double V-shaped ribs covered with slats, *e'*. The ribs are carried by rotary end frames, *D'*, with intermediate rotary supports. The frame is rotated in the tank, *A*, by toothed gearing, *G'*, operated by a hand-wheel provided with

locking apparatus, *g'*. A perforated frame, *F*, which covers all compartments except one or two exposed for filling and emptying.

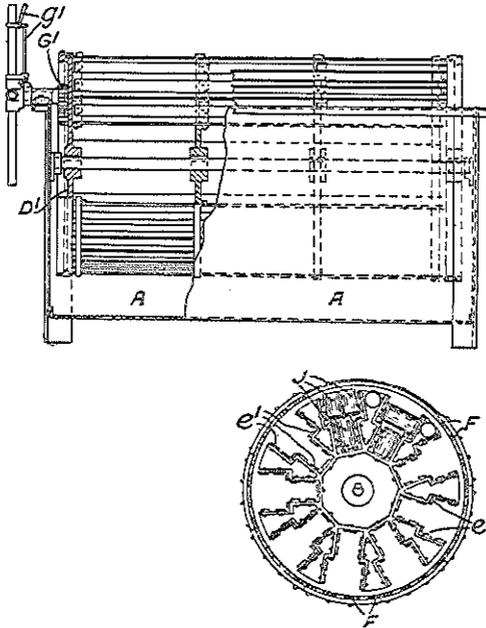


FIG. 51.

can be rotated in the end frames to expose any selected compartments.
H. G. C.

I.—Glass-making Materials.

81. **The Importance of Analysis in Purchasing Raw Materials for the Glass Industry.** A. SILVERMAN (*J. Amer. Cer. Soc.*, 1920, 3, 26).—The author desired to direct attention to the variations in composition of raw materials, and the necessity for care as to the composition, form, and size of raw materials and cullet, if uniform products were to be obtained. The chemist should decide whether any new material was suitable before it was substituted for one already used in the batch and giving satisfaction. Cheaper material might be used in certain cases, but the composition of the new material should be known in order that corrections could be made in the batch, so as to give a glass of the original composition. Tables of analyses of various materials were given, both chemical and mechanical analyses being included in the case of sand. The sand to be used should be analysed chemically and mechanically, and the form of the sand grains also taken into account. The density of soda-ash was an important factor, and special note should be made of the sulphate and chloride content of both soda-ash and potash, since the presence of sulphate and chloride might prove objectionable in certain glasses. In the case of salt-cake, knowledge of the iron content was extremely necessary. Alumina and potash, which affected the colour in white glasses, were the important constituents to consider in the case of felspar. The samples of manganese dioxide dealt with showed variations of MnO_2 content between 70 per cent. and 86.25 per cent., and of iron between 0.25 per cent. and 4.0 per cent. The decolorising effect of manganese dioxide did not depend on composition alone, but also on size and form. Analyses of nitres, limestones, limes, and talc were also given.

The author concluded by emphasising the necessity for the purchase of materials on analysis and examination of a sample, and also for the periodical checking of the composition of raw materials.

F. W. H.

II.—Glass: Manufacture and Properties.

82. **The Cooling of Optical Glass Melts.** HOWARD S. ROBERTS (*J. Amer. Cer. Soc.*, 1919, 2, 543).—The paper dealt with the cooling of the glass in the pot in which it was melted; the method involved a greater amount of labour and waste than rolling into a sheet, but it could be made to yield glass of the highest quality.

When the melt was cooled in the pot, the conditions to be sought were (1) that the cooled melt should break into large, reasonably rectangular blocks having smooth faces, and (2) that not much glass should be spoiled by inhomogeneity, that is, by striae, bubbles, crystals, or devitrification. The author divided the range of cooling into three stages, namely, the stage of fluidity, the "annealing range," and the final stage.

During the stage of fluidity, the glass was apt to be spoiled by striae, due to convection; by the formation of vacuum bubbles, caused by the premature "setting" of the top surface of the melt; and in certain glasses by the formation of one or more crystalline phases in the glass itself.

Convection might be reduced by insulating the upper portion of the melt with a layer of kieselguhr or other light insulator as soon as the pot was removed from the furnace, and cooling rapidly from the bottom.

Convection could be further reduced by intensive chilling of the bottom of the pot by means of a current of compressed air or a fine stream of water during the last hour before it was removed from the melting furnace. The cooling should be made rapid down to a temperature below that at which there was no further danger of crystallisation or devitrification.

Annealing Range.—The rate of cooling through the second stage determined the size and shape of the pieces into which the melt would break. When cold, the melt was usually found to be cut by cracks of two types; curved cracks, roughly spherical and concentric with the centre of the melt, and plane cracks, which divided the melt into large blocks. The spherical cracks were due to decrease of temperature difference, and first appeared below the temperature at which the drop was a maximum; these cracks formed one after another until the temperature gradient had disappeared. The plane cracks seemed to be the result of a difference in rate of contraction between the glass and the pot; the temperature at which they first appeared in a given melt seemed to be nearly independent of the cooling rate. The presence of either type of crack in the melt reduced the tendency of the other type of crack to form. As the fracture due to spherical cracks was rough and the pieces formed were irregular, while that due to plane cracks was entirely satisfactory, it was desirable (1) to maintain the temperature gradient at a low value by slow cooling, and (2) to prevent its decreasing much below its maximum until after the formation of plane cracks had begun by increasing the cooling rate at the proper time.

The cooling rate could be reduced (1) by placing the pot in an enclosed space and heating the air round it, or (2) by surrounding the pot with an envelope of some insulating material, such as sand or kieselguhr.

Variations of these two methods were described, and time-temperature data given.

A. M. J.

83. Applications of the Polarising Microscope in Ceramics. ALBERT B. PECK (*J. Amer. Cer. Soc.*, 1919, 2, 695).—The paper gave some account of the methods which were in general use for observations with the polarising microscope. Details were given for the determination of the refractive index of a crushed material, and also for the finding of the proportion of orthoclase, microcline, albite, and quartz in felspar.

The analysis of felspar by the microscope might be done in a comparatively few minutes, whilst the chemical analysis was a matter of days.

The microscope had been used to try to determine the mineral constitution of Portland cement, and the processes taking place in the hydration and setting of it; the presence of free lime in the cement might be detected by the microscope, whereas even its presence could not be detected for a certainty by chemical means alone.

The polarising microscope might be used to study the changes which took place during the burning of porcelain, as well as to follow the progress of vitrification and the solution of the clay and quartz.

The effect on the microstructure of different temperatures of burning had been studied extensively, and also the effect of varying lengths of burn.

The relation of the *sillimanite* which was formed during firing to the quality of the ware had also been the object of investigations. The introduction of small amounts of oxides as additional fluxes had been found to have a very marked effect on the microstructure, which was reflected directly in the transparency of the body.

Comparatively little work had been done in the microscopic study of glazes. In the case of non-crystalline glazes, its use was mainly to detect impurities, such as quartz and albite, in the ground felspar, leading to crazing. In the production of crystalline glazes, it was very useful in determining what mineral formed the crystals. The zinc orthosilicate, *willemite*, was the one most commonly formed, although *crystalite*, one of the many crystalline forms of SiO_2 , had also been identified. Manganese silicates and oxides have been partly identified, and zinc titanate or titanium dioxide crystals were also thought to have been present in some glazes containing those oxides. This field had been investigated so little, however, that it should present possibilities of excellent results.

In glass manufacture, the polarising microscope would show: (1) the solution effects of the glass on the pot walls, (2) during the melting of optical glass, the variation in the refractive index, (3) the efficient mixing of a batch, (4) the mineral composition of stones.

Detailed studies had been made of all types of refractory brick. All steps from the raw material through burning to the finished product, and even on to the product after it had been in use for some time, had been considered.

The field was almost entirely new, and capable of important results in the future.

A. M. J.

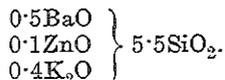
84. Devitrification of Glass. S. F. Cox (*J. Amer. Cer. Soc.*, 1919, **2**, 576. Contribution to Discussion on an article by N. L. Bowen in *J. Amer. Cer. Soc.*, 1919, **2**, 261, and *Abs.*, *J. Soc. Glass Tech.*, 1919, **3**, 172A).—In a study, by the author and A. E. Williams (*Trans. Amer. Cer. Soc.*, 1916, **18**, 315), of the effect of barium salts on the physical properties of glasses, the effect of increasing barium content on the devitrification tendency was

noted. Starting with a glass of the formula

$$\left. \begin{array}{l} 0.5\text{Na}_2\text{O} \\ 0.1\text{ZnO} \\ 0.4\text{K}_2\text{O} \end{array} \right\} 2.5\text{SiO}_2,$$

barium oxide was used to replace progressively soda, 0.1 molecule BaO replacing an equivalent amount of Na₂O until all the latter had been eliminated; the zinc and potash were maintained constant throughout. A series would hence consist of six glasses of the same silica content. Seven such series of glasses were made, the silica content increasing by 0.5 molecule in each successive series.

The last glass of the series would hence have the following composition:



In the study of devitrification tendency, the method employed was similar to that used by Bowen. Definite heating curves were followed, the temperature being raised on successive heatings until a point well past the deformation point of most of the glasses had been attained. Fifteen of the forty-two glasses, those in the high-silica, low-barium corner of the diagram, showed at 700° surface devitrification, which was increased upon further heating at 800°. All other glasses were entirely free from devitrification—those glasses which showed it did so only on the surface.

The author stated that he was inclined to accept Brockbank's explanation of the surface devitrification—that there was a volatilisation of alkali oxides from the surface, leaving a surface layer higher in silica. The author also attributed the fact that there was so little devitrification to the high potash content and the absence of arsenic from the batches.

In reply, Mr. Bowen stated that none of the glasses mentioned by Mr. Cox had a content of barium disilicate as great as that of the corrected light barium mentioned in his original paper.

The observance of devitrification in the high-silica members was probably due to the separation of silica, not to barium disilicate. The simple explanation of surface devitrification offered by Brockbank could be accepted as more than a possible contributory circumstance in some glasses. Devitrification had been observed to begin at the surface of glasses entirely free from alkalis or any significantly volatile constituents. A crucible full of a glass con-

taining only CaO, MgO, and SiO₂ frequently showed a surface skin of crystals of *forsterite*, Mg₂SiO₄. A. M. J.

85. A Note on Blue Glass. J. W. MELLOR (*Trans. Eng. Cer. Soc.*, 1918—1919, **2**, 478).—An investigation into blue glass for lamp bulbs. When a few per cent. of cobalt oxide were added as colouring agent, it was found that the incandescent filament viewed through this glass appeared to be red. It was therefore decided to attempt to cut out the red rays. Copper oxide was first introduced to mask the complementary red, but was not found very satisfactory. A small proportion of chromic oxide with the cobalt oxide proved perfectly satisfactory, and gave a glass which transmitted only blue rays.

A few glasses (lead-lime-soda) were made up with the proportions of the two oxides as indicated:—

No.		Cobalt oxide.	Chromium oxide.	Copper oxide.	Percentage of mixture for stain.
1	Unstained glass	—	—	—	—
2	Copper-Cobalt series ...	—	—	20	4.0
3	" " " " ...	5	—	20	5.0
4	" " " " ...	10	—	20	3.0
5	" " " " ...	20	—	20	4.0
6	" " " " ...	40	—	20	3.0
7	" " " " ...	80	—	20	2.5
8	" " " " ...	100	—	—	2.0
9	Chromium-Cobalt series	—	20	—	0.4
10	" " " " "	10	20	—	0.6
11	" " " " "	25	20	—	0.9
12	" " " " "	60	20	—	1.2
13	" " " " "	150	20	—	1.7
14	" " " " "	200	20	—	2.2

The glasses were annealed, and thin plates ground from them 0.5 mm. thick, and the absorption spectrum of each glass was photographed by means of a Hilger quartz spectrophotometer, the spark spectrum of nickel being used as a standard. Photographs of these spectra were included in the paper, which showed that mixtures of copper and cobalt oxides cut out the green to red portion of the spectrum, while mixtures of cobalt oxide and chromium oxide cut out the violet and yellow to red portion, until, finally, No. 14, little more than the blue rays were transmitted.

It was noticed that in Nos. 11—14 a tint approaching ruby-red was sometimes developed. C. M. M.

86. The Expansion of Solid Bodies at Low Temperatures.

F. HENNING (*Ann. Physik*, 1907, **22**, 631).—Many different substances were examined, among them being quartz glass and the Jena glass 59^{III}. Liquid air was used as the cooling agent, and a temperature of -191° attained. A rod of glass, 1 metre long at 16°, contracted 0.877 mm. at this temperature. Quartz glass expanded 0.053 mm. J. R. C.

87. The Thermometric Properties of the Alkali-free Glass 477^{III}. H. F. WIEBE (*Zeitsch. Instrumentenkunde*, 1908, 28, 293).—A communication from the PHYS. TECH. REICHSANSTALT. The glass was found to be a very good electrical insulator and had a small thermal after-effect. Furthermore, it was good for lampworking, though somewhat refractory. Two thermometers were made of it and graduated from -2° to 102° in 0.1° , the length of 1.0° being 4.4 mm. They were calibrated by the Neumann-Thiesen method, the calibration connection in the middle being found to be -0.375° and $+0.632^{\circ}$ for the two thermometers. The depression of the zero after heating to 100° was only 0.014° , which was the least hitherto observed. The glass showed a tendency to crack in this test. The reduction formula to the hydrogen thermometer was

$$t - t_{447} = +0.00000336(100 - t_{447})t_{447} - 0.000000389(100 - t_{447})^2 t_{447},$$

the corrections being greater than for 59^{III} and the alkali-free baryta-borosilicate 122^{III}, and nearly the same as for a potash glass previously examined. The coefficient of cubical expansion between 0° and 100° was 0.00001842, that for 59^{III} being 0.00001769.

J. R. C.

88. The Linear Expansion of the Scale Glass of Thermometers at High Temperatures. H. F. WIEBE and G. MOELLER (*Zeitsch. Instrumentenkunde*, 1908, 28, 137).—A communication from the PHYS. TECH. REICHSANSTALT. The two Jena glasses 16^{III} and 59^{III} and four different scale glasses were used. The expansions of the scale glasses, those of the thermometer glasses being known, were determined at 0° , 100° , 200° , and 300° . The coefficients of expansion were found to increase with the temperature, the expression

$$\beta = 10^{-6} \left\{ 860.8 \frac{t}{100} + 40.0 \left(\frac{t}{100} \right)^2 \right\}$$

being found for the mean of the scale glasses. β was derived from the formula $\beta = \alpha + \frac{K}{nt}$, where α is the coefficient of expansion of the thermometer glass, K the observed expansion difference for t° , and n the length of the tube.

J. R. C.

89. The Straining of Large Glass Articles by their Own Weight. E. ZSCHIMMER (*Zeitsch. Instrumentenkunde*, 1913, 33, 376).—Some recent researches had shown that large pieces of glass could be sufficiently strained by their own weight as to exhibit strong double refraction when viewed between crossed Nicols. A uniformly cooled disc of flint glass, 27 cm. diameter and 3 cm. thick, was fixed vertically in front of a mirror, which reflected a beam of plane polarised light through the disc and on to an analysing prism and a photographic plate. With the plane of polarisation of the light passing through the disc vertically and the Nicols crossed, a symmetrical strain pattern was observed.

The whole apparatus was then turned through 90° , so that the mirror and disc lay horizontal. A similar, but less marked, pattern was observed. The disc was then cemented on to a block of wood with a round hole through it, and a very clearly marked pattern was observed.

From these observations, it appeared that the strain assumed by large glass bodies due to their own weight was very considerable, and must affect the performance of astronomical objectives and large prisms which were kept in fixed positions for a long time.

S. E.

90. Improvement of Glass Surfaces. H. SOAR, New Southgate, Middlesex (Brit. Pat. No. 134160, March 21st, 1919, No. 7041).—The surface pores of translucent substances, such as glass, gems, etc., are impregnated with powdered substances, such as ammonium sulphate, sulphur, realgar, etc., with the view of decreasing the amount of dispersion of light whilst increasing the degree of refrangibility. When applied to photographic and other lenses, it is stated to give greater depth of focus, to reduce absorption, to correct, more or less, for chromatic and other aberrations in unsymmetrical lenses, and to give a flatter field. The lustre of gems, mother-of-pearl, and opals is increased by the process. Fluorescent properties may be imparted to glass, etc., by impregnating the surface with a fluorescent powder, such as quinine sulphate.

H. G. C.

91. Arsenic in Glass. S. R. SCHOLLES (*J. Ind. Eng. Chem.*, 1912, 4, 16).—Opinions as to whether the arsenic used in glass-making remained in the finished glass or not were very conflicting. Samples of a soda-baryta glass of fairly high alkali content, and a lead-potash glass for cut-glass ware, were analysed, and it was found that the greater part of the arsenic introduced remained in the glass, almost all of it being in the quinquevalent state. The raw materials used for these glasses contained 0.3—0.5 and 0.45 per cent. of arsenious oxide, reckoned on the quantity of glass produced.

V. D.

92. Notes on Sheet and Plate Glass Manufacture. E. H. BOSROCK (*J. Amer. Cer. Soc.*, 1920, 3, 35).—The history of the sheet-glass industry in America was outlined from its establishment in the early part of the nineteenth century. The Belgian tank method of melting was introduced in 1888 and mechanical production in 1894, the process being a reproduction of the methods used by the hand blower. That method held sway at the present time, but many attempts had been made to produce the sheet directly from the molten metal. The most successful appeared to be the development of the Colburn process by the Owens Company. It was necessary to eliminate the "wave" in the glass introduced by lack of homogeneity, caused by strains produced during the

turning from cylinder to sheet form, and, in the Colburn process, by the strains caused during the change from the vertical to the horizontal motion. In the author's opinion, extrusion rather than drawing appeared to offer the best solution of the difficulty.

Pure materials and natural gas had enabled manufacturers to produce excellent window glass without the use of decolorising agents, though the traces of impurities caused the glass to be of various green, yellow, and blue tints. The Belgian fluted glass used in reflected lighting was flattened in kilns heated by artificial gas, and the "sulphur" film deposited reduced the reflective power when the glass was silvered. The use of natural gas enabled American producers to avoid this difficulty. The making of coloured glass sheet had introduced complicated problems relating to the batch composition, to heat treatment (especially in ruby glass), and, in the case of flashed glass, to the coefficient of expansion. The production of sheets of even thickness brought forward manual difficulties, which had not yet been overcome.

Further development was most essential in the production of small articles from sheet glass, such as duplex glass for goggles, wind-shield glass, and glass for portholes; also in machine bevelling and drilling of glass, the absolute control of colour by acid working and staining, and the production of glasses for light filtering, for the exclusion of red and ultra-violet rays, and for X-ray work. Glass for directing and diffusing light presented one of the greatest problems. For the first purpose, prismatic glasses with various angles had been unsatisfactory, owing to defects in working and glazing, and the fact that common green glass was often used.

Diffusive glasses required were of two types, one with great specular reflection and one with little reflection, but maximum transmissive and diffusive values. Good colour and lustre of the glass in each case were most essential.

F. W. H.

93. The Reactivity of Powdered Glasses. P. NICOLARDOT (*Compt. rend.*, 1919, 169, 335).—The author had carried out experiments to determine the relative value of several types of glass with regard to resistance to attack by water and by hydrochloric acid. The attack was modified by the fineness of the powdered glass and the nature of the surface. The powdered glass was sieved, the surfaces of the grains used being in the ratio 1:2·84:12·8. Equal weights of the three kinds of particles were put in platinum crucibles with 300 c.c. of water or $N/10$ -HCl and boiled for three hours, the final volume of liquid being 100 c.c. Whole glasses were treated similarly in former experiments.* As before, it was found that the action of water and of hydrochloric acid varied considerably with the chemical composition of the glass, but that it depended largely on the fineness of the particles. Water attack did not vary with the size of the particles as much as that of HCl, the attack in this case generally

* This JOURNAL, Abs., 1917, 1, 96.

increasing with the fineness of the powder. Almost all powdered glasses used were attacked more by HCl than by water, contrary to the results obtained for whole glasses. The types of glasses tested included Jena, Thuringen (R), Krasna, Kavalier, Zsolna, and several French ones. It was found that the French varieties were no more attacked by HCl ($N/10$) after autoclave treatment than before, whereas Jena lost weight considerably after treatment in the autoclave.

V. D.

94. The Relation between the Refractive Index and the Density of some Crystallised Silicates and their Glasses. ESPER S. LARSEN (*Amer. J. Sci.*, 1909, **28**, 263).—The investigation represents an attempt to apply the formulæ of Gladstone and Dale and of Lorenz and Lorentz to the specific refractions both of glasses and crystalline silicates.

The two series of glasses selected for study were the soda-lime-felspar series and the three component CaO–MgO–SiO₂ system. The glasses were prepared by melting the pure components, then grinding and remelting them several times in order to secure homogeneity. The scale of melting (presumably small) and nature of the crucible used were not stated. All the compositions recorded in the tables are those calculated from the original batch compositions and not those derived by analysis of the glasses. Glasses rich in CaO and MgO could not be prepared owing to the tendency to crystallise.

The indices of refraction of the glasses were determined by the method of minimum deviation, using lithium, sodium, and thallium lights, the measurements being made on a Goldschmidt two-circle goniometer.

The results for the measurements of the felspar glasses are given in Table I, those for the metasilicates of calcium and magnesium in Table II, and those of the other silicates of calcium and magnesium in Table III. The values N_{Li} , N_{Na} and N_{Th} are averages of two measurements of the refractive index.

The specific gravities (D) of the glasses were determined on powder of 100-mesh size in a pycnometer, with water or xylene at 25°.

TABLE I.

	Per cent. Albite.	Per cent. Anorthite.	N_{Li} .	N_{Na} .	N_{Th} .	D.
<i>Ab</i>	100.00	0.00	1.48645	1.4890	1.49165	2.382
<i>Ab</i> ₂ <i>An</i> ₁	65.37	34.63	1.5135	1.5166	1.51925	2.483
<i>Ab</i> ₁ <i>An</i> ₁	48.55	51.45	1.52785	1.53075	1.53345	2.533
<i>Ab</i> ₁ <i>An</i> ₂	32.05	67.95	1.5420	1.5452	1.5481	2.591
<i>Ab</i> ₁ <i>An</i> ₅	15.87	84.13	1.55635	1.5600	1.56285	2.648
<i>An</i>	0.00	100.00	1.5719	1.5755	1.5786	2.700

The refractive index increased uniformly with increase in percentage of anorthite, except for the highest member of the series, when the increase in refractive index became greater.

TABLE II.

Per cent. CaSiO ₃	Per cent. MgSiO ₃	N _{Li} .	N _{Na} .	N _{Th} .	D.
100-00	0-00	1-6241	1-6281	1-6317	2-904
95-00	5-00	1-6222	1-62615	1-62995	2-899
85-26	14-74	1-6185	1-62235	1-6258	2-891
74-00	26-00	1-61355	1-61745	1-6210	2-881
64-00	36-00	1-6084	1-6122	1-6155	2-872
60-00	40-00	1-60675	1-6105	1-61395	2-858
53-64	46-36	1-60365	1-6073	1-6109	2-854
40-00	60-00	1-5970	1-6007	1-60375	2-835
30-00	70-00	1-59235	1-5960	1-5992	2-821
		1-5818	1-5855	1-5887	2-879
* 10-00	90-00	1-5815	1-5851	1-58815	2-8795
5-00	95-00	1-5738	1-5822	1-5854	2-777
0-00	100-00	1-5767	1-5801	1-5833	2-7575

* These two determinations were made on glasses from separate melts.

The decrease in the refractive index with increase in MgSiO₃ content is regular for all but the extreme members of the series, when the index decreases more rapidly.

TABLE III.

Per cent. SiO ₂	Per cent. CaO.	Per cent. MgO.	N _{Li} .	N _{Na} .	N _{Th} .	D.
100-00	0-00	0-00	1-4566	1-45905	1-4612	2-213
46-50	50-00	3-50	1-6370	1-6410	1-64495	2-953
45-00	40-00	15-00	1-63505	1-6392	1-6429	2-9675
50-20	24-80	25-00	1-61835	1-6225	1-62605	2-9205

The specific refractivity of the various glasses and crystals were computed according to both the formula of Gladstone and Dale and that of Lorentz and Lorenz, and it was concluded that, using either formula, the specific refractivity was sensibly additive for the glasses, and nearly so for the isomorphous series of soda-lime feldspars. When crystals were compared with glasses of the same composition, the values differed by as much as 11 per cent., and they were usually higher for the glasses. There appeared to be no reason for the choice of one formula in preference to the other, beyond the fact that Gladstone and Dale's formula was the simpler.

V. D.

III.—Lamp-worked and General Scientific Apparatus.

95. Method of Building up Objects of Quartz Glass.
W. S. QUIMBY and F. W. ROBINSON (Hanovia Chemical & Manufacturing Co.) (U.S.A. Pat. No. 1330611, February 10th, 1920. Filed November 23rd, 1918, No. 263819).—This invention is a new

method of building up an object of quartz glass to a predetermined shape and size. The object is built up of quartz powder and an initial nucleus of quartz glass. The nucleus is heated until plastic, and is then rotated in quartz powder, so that an accretion of quartz powder adheres to the hot nucleus. The original piece and its adherent accretion are then re-heated until the powder fuses and vitrifies, thus becoming incorporated in the nucleus. During this operation the plastic work is elongated, so that the added accretion is made to add to the length of the original piece. This lengthened work now forms a new nucleus, and is heated and rotated in quartz powder just as before. The operation is repeated until the successive accretions and elongations have brought the work up to the predetermined size.

Where the nucleus is of tubular form, it is desirable to support the heated and plastic walls. This is done by admitting air under pressure through one end of the tube and sealing up the outlet at the other end.

S. E.

96. Sealing Electric Incandescent Lamps. BRITISH THOMSON-HOUSTON Co., London (Brit. Pat. No. 132638, October 1st, 1918, No. 15945).—In sealing

stems into bulbs, a downward pressure is applied to the neck, 15 (Fig. 52), during heating to cause it to contract on to the flare, 16, of the stem. In the apparatus shown, the pressure is due to the weight of a forked member, 17, pivoted at 20 on a frame holding the upper part of the lamp. The frame and stem-holder may be rotated during the heating. In a modification, there are two forked members, pivoted to opposite bars on the frame. In the apparatus shown in Fig. 52, the stem-holder, 26, has a projection,

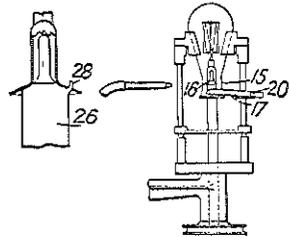


FIG. 52.

28, which preserves an aperture through the stem during jointing of the stem and bulb; an exhaust tube is afterwards sealed to register with the aperture.

H. G. C.

IV.—Decorated Glass.

97. Craftsmanship Exhibited in Fine Cut Glass. J. J. VALLELY (*J. Amer. Cer. Soc.*, 1920, 3, 149).—A brief outline was given of the evolution of a piece of artistic cut-glass ware. The essentials in cut-glass ware were a pretty design and good workmanship in cutting and polishing. Cuts should be sharp and true, crossing cuts of exactly the same depth, and all the cuts polished to

a sparkling brilliancy. A brilliant polish could be obtained by the use of acids, and the "melted" edges, produced by the fast revolving brush wheel, done away with. Composition emery wheels were superior to stone wheels for most lines of cutting. When the design was pressed into the blank in the plastic state, less cutting skill was required, but usually the ware obtained in this way lacked finish and was a discredit to the industry. The refraction produced in glass cut and polished from the plain blank was almost equal to that of a diamond, but in the case of the pressed design the prismatic effect was practically neutralised, the colour clouded, and the sparkle subdued.

F. W. H.

V.—Optics and Optical Instruments.

98. **Contributions to the Study of Lenses.** G. MALTEZOS (*Compt. rend.*, 1908, 147, 736, 850).—These two papers dealt with the equations connecting the distances from a lens of a point source and its secondary images, which are produced by one or more internal reflections; only spherical lenses were considered. In the first paper, the author dealt with thin lenses; in the second, with thick ones. He used the formulæ obtained to determine approximate values of the refractive index and of the radii of curvature when the distances of the object and image have been ascertained. It was suggested that, as the images were very large, they might be used for the observation of microscopic objects. This would necessitate a very brilliant illumination of the object.

J. R. C.

99. **The Existing Limits of Uniformity in Producing Optical Glass.** J. W. GIFFORD (*Proc. Roy. Soc.*, 1912, 87, 189).—Glasses from twenty-seven meltings by different firms were obtained, and three blocks chosen at hazard from each melting and cut into equilateral prisms. The mean refractive index for $\lambda 5270$ was determined for each of the prisms, and the results reduced to 15° . Detailed results are given, and from these it was shown that the heavy barium crown glasses were those which showed the greatest variation in homogeneity in the same melting.

J. R. C.

100. **Some Temperature Refraction Coefficients of Optical Glass.** J. W. GIFFORD (*Proc. Roy. Soc.*, 1915, 91, 319).—A continuation of the work recorded in Abs. No. 99. Seven additional glasses were examined in the same way, and, in addition, temperature refraction coefficients were given for all the thirty-four. In every case except one the refractive index in air

rose with the temperature. This exception was Schott's Fluor-Crown glass, which in this respect was like quartz and fluorite.

J. R. C.

101. A Photographic Objective which contains a Uranium Glass. M. HOUDAILLE (*Zeitsch. Instrumentenkunde*, 1907, 27, 233; Abs. from *Bull. de la Soc. Française de Photographie*, 1907, 23, 212).—As colour filters were extensively used in photography, it was desirable to combine the filter and the objective. Accordingly, the convex lens of a photographic objective was made of uranium glass, a piece of which 10 cm. thick absorbed 10 per cent. of the visible and 50 per cent. of the photographically active rays. An objective was also made of a colourless glass of similar composition. With equal exposures of plates, using the two objectives, the negative obtained with the uranium glass was much purer, and the images were equally clear at the edges.

The author stated that it was questionable whether it was advantageous so to combine the filter and the objective. The loss by reflection at the surface of the filter was eliminated, and the stronger absorption of the central portion, owing to increased thickness of the absorbing medium, compensated for the unavoidable decline of clearness towards the edges.

J. R. C.

102. Coma in Uncorrected Lens Systems. F. STAEBLE (*Zeitsch. Instrumentenkunde*, 1907, 27, 241).—A mathematical discussion of the connection between coma and the sine term.

J. R. C.

103. The Best Rays to Unite at a Common Focus when Designing an Achromatic Objective. J. WILSING (*Zeitsch. Instrumentenkunde*, 1906, 26, 41).—The author discussed the problem of a doublet, the thickness of the lenses being neglected, and obtained an expression for the radii of curvature of the lenses when two rays were united at the focus, the secondary spectrum being a minimum. Two cases were considered: (a) the objective being for visual observations; (b) when it was designed for photographic use. Examples were given of the application of the formulæ. The author considered that a tertiary spectrum could not be obtained with only two lenses.

J. R. C.

104. On the Spectrum of Elementary Silicon. W. CROOKES (*Chem. News*, 1914, 110, 113).—Great difficulty was experienced in obtaining pure silicon, and this probably explained the fact that lines measured by some observers had not been recorded by others. For the purpose of this research, samples containing 99.56, 99.86, and 99.98 per cent. of silicon were used, the impurities being titanium, iron, and aluminium. Much trouble was caused by a coating of oxide which formed almost at once when fused silicon was used as electrodes with a high-frequency current. The spark becomes much less luminous, and eventually the electrodes were changed every fifteen minutes. The wave-lengths were

measured by comparison with the iron spectrum. For two lines in the infra-red, instead of a photographic plate an instrument was used whereby eye observations could be made and recorded; this was fully described.

The wave-lengths obtained were tabulated, those of other investigators being given for comparison. J. R. C.

105. A New Microphotometer for Photographic Densities.

W. F. MEGGERS and P. D. FOOTE (*J. Optical Soc. Amer.*, 1920, 4, 24).—The purpose for which the instrument was designed was to measure the photographic densities of narrow spectral lines. It was essentially a micropyrometer, a microscope of high power being employed. The photographic plate was mounted just below the objective, on a horizontal bed, movable with a graduated screw, and was illuminated beneath by a tungsten ribbon lamp. Light transmitted by a small portion of the plate, the image of which was adjacent to that of the tip of the photometer lamp, was matched with equal brightness by adjusting the current through this lamp. It was advantageous to make the measurements with homogeneous light, so the usual monochromatic red glass screen used in optical pyrometers was employed. The instrument was calibrated as a pyrometer by sighting on a black body at a measured temperature, and the relation between the temperature of the source and the current through the photometer lamp sufficient for a match was thus obtained. The measurements of the current required to match against any spectral line and against the clear film were made and converted into "temperatures." From these the true density of the line was ascertained, using Wien's law. The tip of the filament of the pyrometer lamp might be used as a filar in the eye-piece, and the wave-length of a spectral line measured at the same time as its density. Examples were given of the application of the pyrometer to the measurement of the density of spectral lines, to the measurement of energy distribution in a broad spectral line, and to the measurement of the spectral sensitivity of a photographic plate. J. R. C.

106. The Importance of the Nodal Points in Lens Testing.

G. W. MOFFITT (*J. Optical Soc. Amer.*, 1920, 4, 1).—The paper dealt with the interpretation of lens measurements made with finite object distance on an optical bench equipped with a nodal slide turntable provided with means for holding the lens and adjusting its position relative to the axis of rotation of the nodal slide. The separation of the nodal points must be taken into account in all cases where the magnification was not zero or infinity, and a knowledge of the positions of these points was essential to the reduction of a set of bench readings. The manner in which these positions could be ascertained was explained, and the necessary corrections were applied to a determination of a focal length as an example of their importance. The formulæ for the field characteristics of a lens were derived, and with these formulæ

the reduction of a set of readings led to trustworthy values for the aberrations of the lens under the conditions of the test. J. R. C.

107. The Measurement of Diffuse Reflection Factors and a New Absolute Reflectometer. A. H. TAYLOR (*J. Optical Soc. Amer.*, 1920, 4, 9).—In the practical application of light and illumination, it was often desirable to know the reflection factors of various surfaces. No surface obeyed Lambert's cosine law perfectly, and most were very far from being perfect diffusers. No method had been described hitherto which would give accurate results and might be applied to the measurements of surfaces in place. The author described and criticised previous reflectometers, in the majority of which comparison was made with a standard surface such as magnesium carbonate, and then he described his new instrument, with the aid of which absolute measurements could be made. A hollow sphere, with a segment removed, was painted white inside and provided with holes for observation and for the entrance of an illuminating beam. The reflection factor of a surface, placed over the hole produced by the removal of the segment, was calculated from measurements of the brightness of the sphere wall with this test surface in position, of the brightness with it removed, and of the brightness when it was replaced by a surface similar to that of the rest of the sphere. The formula by which this calculation was performed was theoretically derived. The measurements could be made both with the light incident on the test surface, and with it incident on another part of the sphere wall. In order to verify the theory, a graded series of test objects was prepared. Their reflection factors were measured by another method, and then in the two ways possible with this new reflectometer. Extremely good agreement was to be observed between the standard values and those obtained with the author's instrument, using it so that the light was incident on the test-piece. The values obtained in the alternative way were slightly high in most cases, but this was shown to be due probably to experimental error. The reflection factor of magnesium carbonate was measured in four different ways and found to be 99 per cent. The previously accepted factor was 88 per cent., so measurements hitherto made with this as the standard were considerably in error. The effect of specular reflection from the test surface was discussed, and it was shown that this would not cause an error of more than 2 per cent. in the determination of the reflection factor. J. R. C.

VI.—Illumination and Illuminating Ware.

108. Glasses for Protecting the Eyes from Injurious Radiations. W. W. COBLENTZ and W. B. EMERSON (*Technologic Paper 93, Bureau of Standards, U.S.A.*).—The object of this paper was to give the general characteristics of certain newly-developed

glasses used for protecting the eyes from various radiations, especially the infra-red, or heat rays. Because of the difficulty of producing the same colour in different melts, no attempt was made to give specific data of the transmission for a given thickness of glass.

S. E.

109. The Influence of Temperature on the Transmission Factor of Coloured Glasses. M. LUCKIESH (*J. Amer. Cer. Soc.*, 1919, 2, 743).—Hyde, Cady, and Forsythe (*Astrophys. J.*, 1915, 42, 302), in studying red pyrometer glasses, noted that the transmission factor of the glass was appreciably less for various wave-lengths at temperatures near 80° than at temperatures near 20°.

The author therefore investigated the transmission factor for total visible radiation (not spectrophotometrically) for various coloured glasses at temperatures below which they become self-luminous or plastic, and found that generally the transmission factor was a function of the temperatures.

The illuminants used were gas-filled Mazda lamps operating at normal voltage. The results for ten commercial specimens were given:—

Specimen.	Principal colouring element.	Colour		Relative transmission factors at various temperatures				
		Cold.	Hot.	30° 100° 200° 300° 350°				
1	Copper	Medium red	—	100	97	92	87	84
2	Cobalt	Light blue	—	100	101	104	107	108
3	Cobalt	Deep violet	Deep blue	No appreciable change				
4	Gold.....	Pink.....	Violet.....	100	99	96	94	93
5	Copper.....	Bluish-green	Yellowish-green ...	100	98	94	87	82
6	Manganese	Purple ...	Bluish-violet ...	100	97	94	91	90
7	—	Lemon-yellow	Orange ...	100	94	84	75	71
8	—	Dull yellow	—	100	98	94	91	90
9	Copper.....	Deep red...	—	100	86	67	50	42
10	Chromium	Yellowish-green ...	Yellow.....	100	95	84	72	67

A. M. J.

VII.—Fuels, Refractories, and Furnaces.

110. Producer Gas as Fuel for the Glass Industry. F. J. DENK (*J. Amer. Cer. Soc.*, 1920, 3, 94).—In advocating the use of producer gas as fuel owing to the decrease in supply of natural gas, the author compared the relative costs of oil and producer gas. The first cost of an oil installation was cheaper than that of a producer gas plant, but the operating cost was much greater. In fact, oil could only compete with artificial gas costing a dollar

per 1000 c. ft. Where oil was very cheap and coal very dear, the case might be altered, and in the author's position this point would be reached when, with oil at 4 cents per gallon, coal was 6.25 dollars per ton.

Producer gas was, in most cases, the cheapest fuel for glass factories, whether generated in hand-poked or in automatic producers, always provided the design and handling of the plant were satisfactory. The type of producer installed would depend to a large extent on the men available for operating the plant. There was no advantage in putting down high-grade automatic producers unless a man with technical experience could take charge. Hand-poked producers, managed properly, answered to a certain extent where skilled labour was not available, but they were too much under the influence of the human element. The mechanical producer was the most satisfactory provided that skilled attention was given to it. The main factor in deciding this was that charging changed the composition, quantity, pressure, and temperature of the gas; that is, it influenced everything variable. Frequent charging was better than charging, say, every half-hour. If this latter method were adopted, the temperature of the gas dropped 500° F. in five minutes and required fifteen minutes to reach normal again. The continuous coal feed and ash removal in mechanical producers obviated this difficulty, furnished a gas more uniform in quantity and quality, temperature and pressure, besides generating gas with a higher heating value than is the case with hand-poked producers, the human factor being reduced to a minimum. Whatever type of producer was installed, the best working conditions of the coal used should be determined and the producer operated accordingly. Poor coal was gasified much better in mechanical than in hand-poked producers. In good average practice, the hand-poked, hand-fed producer of 10 feet inside diameter gasified 900 to 1000 lb. of coal per hour, a semi-automatic producer of similar size 2500 lb., and an automatic producer would use 3000 to 3300 lb. per hour.

The bottom of the fuel bed in the producer should be at a certain distance below the level of the ports in the furnace. Then the rising column of hot gases acted as a chimney, a very important fact, since the slack had no effect on the producer owing to the opening of working holes in the furnace. For increasing the efficiency of producers, the gas lines should be watched carefully and kept free from dust; at the gas outlet, the pressure should be equivalent to between 1 inch and 1.5 inches of water, and frequent analyses of the gas should be made, and the amount of carbon dioxide in the gas should not exceed from 5 to 7 per cent. The amount of steam blown in should be just sufficient to prevent the formation of clinker and no more; opening of the steam valve to increase gasification certainly gave more gas, but it was of an inferior quality and the procedure was wrong. The thickness of the fuel bed should be between 2 and 3 feet; the ash bed should be brought to 6 or 7 inches above the top of the blast hood and

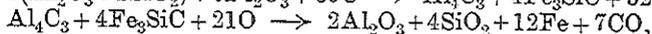
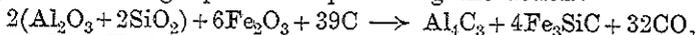
not nearer, or loss of the blast hood might follow. Cleaning out the producers whenever necessary, at least once a day, reduced the dead resistance in the ash bed, freed the air entry accordingly, and allowed the carriage of a thicker bed of incandescent fuel. Irregular charging and neglect to close up the channels formed in the fuel bed of hand-poked producers admitted air freely, caused the gas to burn in the producer, and gave poor gas to the furnaces. Too thin a fuel bed produced a similar result. Gas lines should be neither too small, so as to obstruct the passage of the gas, nor too large, so as to retard the gas velocity. At any change in direction of flow, dust catchers were necessary, and in these, if the lines were designed correctly and the gas made properly, any soot would be deposited. Frequent blowing out of the lines with air, not steam, was infinitely preferable to burning out.

The author also included a section on regenerating chambers (see Abs., this JOURNAL, 1919, 3, 263) and an appendix showing comparative calculations of first cost and operating cost for fuel oil and producer gas.

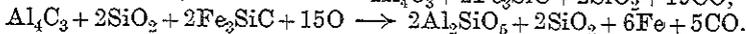
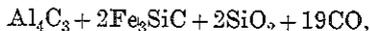
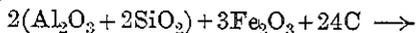
F. W. H.

111. The Malinite Process for the Production of Sillimanite Refractories. A. MALINOVSKY (*J. Amer. Cer. Soc.*, 1920, 3, 40).—A process was described in detail by which an extremely refractory, neutral body could be produced from any aluminous rock or mineral. The rock or mineral containing the aluminium silicate was smelted in a cupola furnace of special design together with a reducing agent. By varying the proportion of the reducing agent it was possible to regulate the volatilisation of the silica, so that only a portion or the whole of the charge could be converted into *sillimanite*. If only part of the charge were so converted, the remainder gave fused quartz glass or a glass having the same composition as *sillimanite*.

The crushed raw material was mixed with carbon in molecular proportion to the silica content of the rock or mineral, as indicated by the following equations representing the action:—



or



Assuming that the equations given were correct, SiC was formed, gave up its carbon, and the silicon left behind burned in the blast to SiO and finally to SiO₂, the action being strongly exothermic. The iron acted as a catalyst in that it promoted the reduction of the silica and accelerated the reaction. If iron were absent, more fuel was necessary, or from 3 to 6 per cent. of iron might be added as an ore or impure clay. The presence of titanium was beneficial, since it hindered the combination of iron with alumina, and hence the iron was left free for reaction with the silica when the mass was boiling.

The fused mass obtained was highly refractory, free from expansion and contraction at any degree of temperature, and did not warp, crack, or spall on change of temperature. Heated in an electric furnace in contact with carbon resistor plates at a temperature of approximately 1650°, the malinite brick was unaffected.

A detailed account was given of an examination of the product and of an investigation into the formation of *sillimanite* using pure kaolin, fireclays, and *halloysite*. The author failed to find *sillimanite* in these materials when fired in the kiln in the usual way. Samples of these materials were ground, made into small briquettes, dried, and heated to Orton cone 14 for ninety-six hours. Only in the St. Louis fireclay was any *sillimanite* noticed, and then only in small pockets. These samples were then heated four times to cone 16 and once to cone 18. No *sillimanite* was found in the kaolin or *halloysite*, nor in two fireclays, but the St. Louis and Ohio fireclays contained nests of fine crystals. In the author's opinion, therefore, firebricks, made of pure fireclay free from alkali, required heating above 1400° for a prolonged period and cooling slowly to form crystals of *sillimanite*, and the formation of *sillimanite* crystals in firebricks was produced only by prolonged heating at high temperature, and these were much better developed when the clay contained felspar minerals and micas. An introduction of 25 per cent. of felspar with the samples previously mentioned produced crystals in abundance.

The following analyses, among others, were given of the fused product of the malinite process:—

	From raw <i>halloysite</i> .	From St. Louis fireclays.				
		1	2	3	4	5
SiO ₂	17.16	32.60	33.10	38.10	36.30	37.50
Al ₂ O ₃	78.39	63.84	63.59	56.17	58.95	57.94
Fe ₂ O ₃	0.89	1.62	1.57	2.61	2.40	2.16
CaO	1.50	0.89	0.63	1.10	0.65	0.80
MgO	0.29	0.32	0.21	0.49	0.22	0.22
TiO ₂	—	0.67	0.82	1.12	0.95	1.10
Alkali	0.36	—	—	—	—	—

The author drew the conclusions that it would be impracticable, if not impossible, to convert fireclay into *sillimanite* by the methods employed in the manufacture of silica and magnesite bricks; the microscopic and petrographic examination of the malinite product showed the *sillimanite* produced by this process, free from any flux, to be a stable compound and in comparatively larger crystals than any *sillimanite* crystals yet produced; that no mineral particles remained unaltered, and that this latter fact produced a compound of great resistance towards chemical action and thermal changes.

The paper was illustrated by numerous photographs and photomicrographs.

F. W. H.

112. Factors Influencing the Properties of Silica Bricks. I. ALEXANDER SCOTT (*Trans. Eng. Cer. Soc.*, 1918—1919, 481).—The

investigation was undertaken to determine the effects on the inversion of the quartz to the high-temperature forms and on the properties of silica bricks generally of some of the chief non-siliceous materials which occur in the rocks used in the manufacture of silica bricks. In the present paper, in addition to the conversion, the properties considered were the apparent and the true specific gravities, porosity, after-expansion, and refractoriness. The method used consisted in bonding as pure a silica rock as possible with a small percentage of other material, firing the mixture to various temperatures, and examining the bricks so made.

The silica rock adopted was vein quartz (although usually it is unsuited for the manufacture of silica bricks) having the following percentage composition:— SiO_2 , 99.46; TiO_2 , nil; Al_2O_3 , 0.20; Fe_2O_3 , 0.24; MgO , trace; CaO , 0.13; K_2O and Na_2O , 0.08; loss on ignition, 0.10.

For the making of the bricks the percentage of material of each grade used was:—

Through 4's on	8's sieve	5.5
" 8's ..	16's	7.5
" 16's ..	40's	9.5
" 40's ..	60's	11.5
" 60's ..	80's	13.5
" 80's ..	100's	15.5
" 100's ..	120's	17.5
" 120's	19.5
		100.0

The bonding materials used were: (a) lime (CaO), (b) magnesia (MgO), (c) alumina (Al_2O_3), (d) iron oxide (Fe_2O_3), (e) iron oxide (Fe_2O_3) + carbon, (f) titanate oxide (TiO_2), (g) lime and magnesia, (h) lime and alumina, (i) lime and iron oxide (Fe_2O_3), (j) lime, iron oxide, and carbon, (k) lime and titanate oxide, (l) magnesia and alumina, (m) magnesia and iron oxide, (n) magnesia, iron oxide, and carbon, (o) alumina and iron oxide, (p) alumina, iron oxide, and carbon, (q) lime, iron oxide, and titanate oxide, (r) Glenboig fireclay, and (s) china clay. The amount used was 2.5 per cent. in the case of the simple oxides, 1.25 per cent. of each where two oxides were used, and in (q) 1 per cent. of each. Ordinary charcoal was used, the amounts being in (e) 2.5 per cent. of oxide and 0.5 per cent. of charcoal, and in j, n, p 1.25 per cent. of each oxide and 0.25 per cent. of charcoal. The approximate size of the bricks was 2 in. \times 2 in. \times 1 in., and they were made in a vertical tile press. After drying, they were fired in a pottery kiln for twenty-four hours at cone 8, and then fired for the usual period in a silica brick kiln to three different temperatures, namely, cone 14, cone 16, and cone 19. The blocks fired to cone 19 were cut into sections and examined under the microscope, full details of the examination being included in the paper.

The conversion of the quartz was influenced by the nature and amount of the non-siliceous materials present, the grain size

of the quartz, and the temperature and duration of firing. Results showed that the conversion could be increased considerably if the firing temperature were increased. The author held that the conversion would be greatest when the surface of the quartz exposed was a maximum, that is, when the grain size was a minimum, for the quartz seemed to be converted mainly through the agency of the bonding material, which dissolved the quartz and reprecipitated it as *crystalite*.

The determinations of the true and apparent specific gravities were carried out by the methods described in the Standard Specification of the Institution of Gas Engineers. In most cases the true specific gravity tended to vary directly as the firing temperature, while the apparent specific gravity followed a similar course. The true specific gravity might be assumed as giving a qualitative idea of the extent of conversion, but the quantitative relation was only approximate.

From the results of the porosity tests, the writer divided the blocks into two groups, those in which the porosity varied irregularly with the firing temperature and those in which it varied regularly.

After-expansion was determined by heating blocks of known size to cone 16 for two hours. Another set of samples was then tested by heating to cone 26 for four hours. The author pointed out that the after-expansion was mainly due to the change of volume during the conversion; hence, where the rate of conversion was rapid at the temperature of the test, the after-expansion was high, and where the rate was slow, the after-expansion was low.

For the spalling test, the author followed a method proposed by McDowell, by which the relative tendency to spalling was measured by the percentage change in the modulus of rupture after heating to 600° and cooling in air, and he obtained results which were fairly satisfactory.

The tests on refractoriness were carried out by the usual method, and the test pieces subsequently cut into sections and examined under the microscope. The author stated that the results of these refractory tests would be further discussed in the second part of the work, in connection with the refractoriness under load.

In all cases, the results of the tests were set out fully in tables.

C. M. M.

113. Refractory Substances. C. H. SANKEY, Chislehurst (Brit. Pat. No. 133842, December 19th, 1918, No. 21315).—Waste refractory articles, such as fire-bricks, tiles, saggars, retorts, or the refractory lining of furnaces, kilns, flues, retorts or coke-ovens, which have been calcined in manufacture or use, are ground and mixed with silicate of soda and water, moulded or worked by hand to the required shapes, and fired. The refractory material may be cleaned or washed before being ground.

Reference has been directed by the Comptroller to Specification 376/83.

H. G. C.

114. The Standardisation of Tests for Refractory Materials. III. The Penetrative Action of Slags. (*Trans. Eng. Cer. Soc.*, 1918—1919, 18, 516).—The action of slags on fireclays and firebricks can be examined in three ways: (1) The clay mixture can be pressed into hollow blocks of the following dimensions: outside, $2\frac{1}{2}$ in. square, $1\frac{1}{2}$ in. deep; inside, $1\frac{3}{4}$ in. square, $\frac{3}{4}$ in. deep. The blocks are then fired to the desired temperature, say, cone 10. When cold, the desired slag is placed in the receptacle and the whole again fired to the temperature of experiment for the given period of time, for example, four hours. When cold, the penetrative and corrosive action of the slag on the clay mixture can be examined by sawing the block across. This method is not applicable to firebricks because of the artificial treatment involved in making the blocks.

(2) A hole, 2 in. diameter and $\frac{1}{2}$ in. deep, is bored in the brick and filled with slag, and fired and treated as in the above case. Neither of these methods gives any idea of the peculiar resistance which the surface skin of a brick offers to the penetrative action of a slag.

(3) Nesbit and Bell's method. A ring of stoneware is cemented to a firebrick by means of a thin film of a mixture of fine grog and silicate of soda. This receptacle is filled with slag and the whole treated as before. The penetrative action of the slag can then be examined by sawing the brick across. This method can be applied generally to firebricks, and gives good results. C. M. M.

115. Notes on New Experiments on Silica Materials. A. BIGOR (*Trans. Eng. Cer. Soc.*, 1918—1919, 18, 362).—The author pointed out that the results of this work showed that silica rocks and products manufactured from them can be subjected to exact tests, which afford an excellent guide to the manufacturer in his choice of raw materials and methods of manufacture. His conclusions were that (1) raw materials which are too pure, such as chalk flints and many type of quartz, are not suitable for manufactured products, because they fall to powder after having been fired to 1450° for four hours. (2) Silica materials containing 2—5 per cent. of a mixture of clay, iron oxide, and a small proportion of lime and magnesia—some quartzitic and quartzose rocks and some dense flints—are suitable for manufacture if their expansion at 1710° is not too great. (3) Silica rocks which contain $\frac{3}{4}$ per cent. of alumina become too fusible after the addition of 2 per cent. of lime, and are not suitable for the manufacture of silica products. C. M. M.

116. Note on the Casting of Porcelain Glass Pots. J. W. WRIGHT and D. H. FULLER (*J. Amer. Cer. Soc.*, 1919, 2, 659).—The characteristics of a casting slip, as well as of the fired body, depended, first, upon the composition—the content of grog; kaolin, ball clay, and felspar; secondly, upon the sizing of the grog; thirdly, upon the peculiar physical and chemical qualities inherent in primary kaolins, as differentiated from the secondary

ones, and in ball clays against the fire clays; and, fourthly, upon the amounts and proportions of sodium silicate and carbonate of soda. The following mixtures had been used successfully in the Pittsburgh Laboratory for the casting of glass pots:—

Mixture No. 1.

	Per cent.
Whiteware-bisque grog	48
Felspar	7
Kentucky ball clay, No. 4 or No. 6	11
Tennessee ball clay, No. 5	11
Georgia, Florida, Delaware, and North Carolina kaolins, ½ of each	23

Mixture No. 2.

	Per cent.
Whiteware-bisque grog	48.0
Felspar	7.0
Kentucky ball clay, No. 4	8.5
Tennessee ball clay, No. 5	8.5
Georgia, Florida, Delaware, and North Carolina kaolins, ½ each	28.0

Mixture No. 3.

	Per cent.
Whiteware-bisque grog	48.0
Felspar	6.5
Kentucky ball clay, No. 4 or No. 6	11.0
Tennessee ball clay, No. 5	11.0
Kaolins, as before	23.5

The mechanical analysis of the grog used corresponded fairly closely with the following sizing:—

	Per cent.
Between the 10- and 20-mesh sieves	30.0
Between the 20- and 40-mesh sieves	40.0
Between the 40- and 80-mesh sieves	17.0
Through the 80-mesh sieve	13.0
	100.0

The physical and chemical qualities of the clays used were of importance with reference to their response to the effect of the alkaline electrolytes. The primary kaolins were most responsive, followed by the secondary kaolins, ball clays, and fire clays in the order given.

The use of a more plastic clay brought about higher specific gravity of the slip, shortening of the time of casting, decreased drying shrinkage, and increased strength. The use of several plastic clays was recommended, so that a slight change in the properties of one would not upset the working qualities of the mixture.

It had been found that the water content should be between

22 and 25 per cent. of the dry weight of the materials; the specific gravity of the slip, 1.90 to 1.95.

The viscosity desired was such that the pot would cast solid overnight in approximately seventeen hours. The higher the viscosity the slower was the casting of the slip, the greater the drying shrinkage, and the longer the time required for drying. With very viscous slips, but little absorption of water by the plaster mould took place, as the mass stiffened too quickly to permit of flow. With such a slip, however, the pot did not become solid for some time.

With a slip of low viscosity, considerable flow occurred, due to the absorption of water, and an undesirable structure might develop. The less viscous slips became solid in a shorter time and showed a lower drying shrinkage.

The amount of electrolyte varied from 0.20 to 0.33 per cent. of the weight of the dry materials, and the best ratio of sodium silicate to the carbonate was 4:3. An increase in sodium silicate decreased the water content, lowered the viscosity, and shortened the time of casting. An excess of it produced flow or laminated structure.

It was found best to dissolve the silicate in the water, add the dry materials, blunge, and then add the carbonate.

The introduction of a small amount (0.01 per cent.) of barium carbonate seemed desirable for the purpose of eliminating the soluble sulphates.

A. M. J.

117. A Simplified Apparatus for the Determination of Air in Clay. H. SPURRIER (*J. Amer. Cer. Soc.*, 1919, 2, 490).—A burette was cut off evenly and fused to the shortened tail-piece of a large carbon funnel, which was placed inverted in a litre beaker.

Eight hundred c.c. of water were placed in the beaker and boiled for some time. The funnel was inserted in the beaker, and the burette afterwards filled with water.

The clay blanks were of such a size that they were easily placed in the bell of the funnel. Such a blank was placed in the vessel of water and the bell rapidly lowered over it.

After a few minutes, all the air had collected in the upper portion of the burette, and the volume could be ascertained.

For convenience, charts were prepared showing the percentage of air by volume calculated on the various sizes of blanks.

A. M. J.

118. The Equipment of a Casting Plant for the Manufacture of Glass Pots. FRANK H. RIDDLE (*J. Amer. Cer. Soc.*, 1919, 2, 647).—The object of the paper was to describe the methods used and plans proposed, through co-operation between the Clay Products and Glass sections of the Bureau of Standards, for a plant

suitable for casting ten 600-lb. glass pots per day. A plan for such a plant was described. The pots might be either open or closed; closed pots were cast in two sections, (1) part of the hood and the bottom of the pot, (2) the top of the hood and cover. When properly stiffened, the top was turned over and stuck on to the bottom. The author remarked that one of these pots had been in use with lime-soda glass for a period of sixteen weeks, and had already been charged ninety-six times.

A. M. J.

119. Tank Furnace for Making Flint Glass. WILLIAM N. MATHEWS (U.S.A. Pat., December 16th, 1919, No. 1324917. Filed December 3rd, 1918, No. 265115).—The invention consists of a continuous regenerative tank especially intended for the production of lead glass. The furnace is shown in longitudinal section in Fig. 53, and in cross-section in Fig. 54. The batch is melted in "pots" or muffle chambers, which are constructed within an outer body resembling an ordinary tank surface. As shown in Fig. 54, three of such muffles, 1, 2, 3, consisting of side walls, 6, supporting arches, 8, built of tiles, are arranged beneath a crown, 4, the arches, 8, protecting the metal in the muffles from contact with the gases in the combustion chamber, 9. Each "pot" has a dog-house, 12 (Fig. 53), for the insertion of the batch, and it also communicates at its front end with a refining chamber, 13, placed at a lower level, through a spout, 14, which can be closed by a gate, 15. The chamber, 13, also communicates by a throat or dog-hole, 16, with

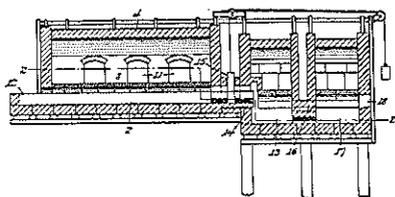


FIG. 53.

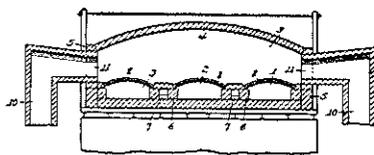


FIG. 54.

a working chamber, 17, whence the metal is taken out through a hole, 18. The three "pots" and their refining chambers are separate from one another, but the working chambers are in communication, so that the metal stands at the same level before all the working holes. In use, only one of the gates, 15, is raised, while the other two are kept closed. A "pot" is charged with batch, which is allowed to found and plain, and the gate, 15, is then lifted to let the metal flow down to the working end. By using three "pots" as shown, it is possible to obtain a continuous supply of metal at the working holes, since when one "pot" is emptied another is ready.

U.S.A. Pat., No. 1324918, granted to the same applicant,

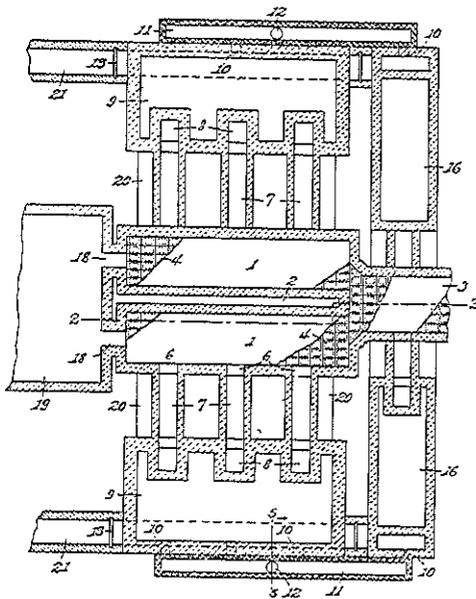


FIG. 55.

describes a tank of somewhat similar character to that described above. As shown in plan in Fig. 55, a melting chamber, 19, seemingly of the usual type, communicates by throats or dog-holes, 18, with two separate refining chambers, 1, which merge at their forward ends into a cooling chamber, 3, that leads to the working holes. The chambers 2, 3, are muffles, as described above, and are built within a combustion chamber, which is heated by gas and air admitted through ports, 6. The bottoms of the chambers, 2, slope upwards,

so that the metal in the cooling chamber, 3, being comparatively shallow, is kept at a substantially uniform temperature. G. D.

120. Furnaces for Liquid and Gaseous Fuel. H. WADE, London (FOURS ET PROCÉDÉS MATHY SOC. ANON., Liège, Belgium) (Brit. Pat. No. 134169, May 3rd, 1919, No. 11113).—To enable

different methods of heating to be employed alternatively or simultaneously, a gas-producer applied to a re-heating or other industrial furnace is provided with a space above the arch, 2 (Fig. 56), to which liquid fuel may be introduced by an injector, 16, air being supplied at 7 through passages, 5, 6, to burn at will the gas from the producer or the liquid fuel. In addition, a flameless gas burner, 10, may be provided in the bridge between the producer and the

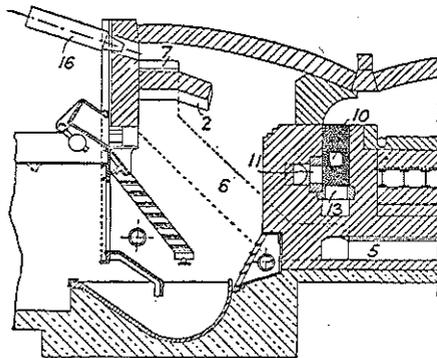


FIG. 56.

hearth of the furnace, gas from an independent source being supplied at 11 to a mass of porous, refractory material, and air from the passage, 5, being supplied at 13. H. G. C.

121. Surface Combustion Furnaces. M. MATHY, Belgium (Brit. Pat. No. 133889, February 26th, 1919, No. 4855).—In gaseous fuel furnaces in which combustion of a gaseous mixture is effected in a mass of granular, refractory material, the size of the fragments of refractory material is varied at certain parts of the furnace where it is desired to obtain a variation in the temperature, the higher the temperature required at any particular part of the furnace the smaller the size of the fragments of material used. To obtain uniform temperature throughout the furnace, the fragments of refractory material decrease in size from the entrance to the exit of the combustible mixture. Fig. 57 (d) shows a crucible furnace in which the crucible is surrounded by fragments of refractory material, which are smaller at the places where a higher temperature is required. The gaseous mixture may enter at the top or bottom of the furnace. To obtain a uniform temperature in this furnace, the refractory material decreases in size towards the top when the gaseous mixture is supplied at the bottom.

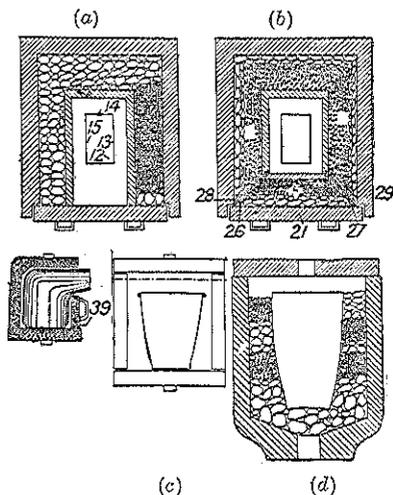


FIG. 57.

A muffle furnace is shown in Fig. 57, in which the side, 13, of the article, 12, is heated to a higher temperature than the sides 14, 15 by arranging the refractory material between the walls of the furnace and muffle, as shown. In the muffle furnace shown in Fig. 57 (b), the refractory material is arranged so that the highest temperature is at the wall of the muffle. The cover, 21, of the furnace is made hollow and packed with refractory material. The sides, 26 and 27, of the cover, and the corresponding walls, 28, 29, of the furnace, consist of porous plates or plates pierced with holes, which allow for the passage of gases. The lower and upper faces of the cover are of similar material to the sides, 26 and 27, or to the furnace walls. The walls of the muffle shown in Fig. 57 (a) and (b) may be pierced with holes to ensure more direct heating, or may be of porous material. In the crucible furnace shown in Fig. 57 (c), the sides, top, and bottom of the furnace are formed hollow and filled with refractory material in a similar manner to the cover of the muffle furnace shown in Fig. 57 (b), and the joining surfaces of the walls are made porous or pierced with holes to

permit circulation of the gases. Fig. 57 shows a crucible furnace in which the cover, 39, is similar to that shown in Fig. 57 (b).

H. G. C.

122. Electric Furnaces. GENERAL ELECTRIC CO., Schenectady, New York, U.S.A. (Assignees of E. F. COLLINS, Schenectady, New York, U.S.A.) (Brit. Pat. No. 133026, August 6th, 1919, No.

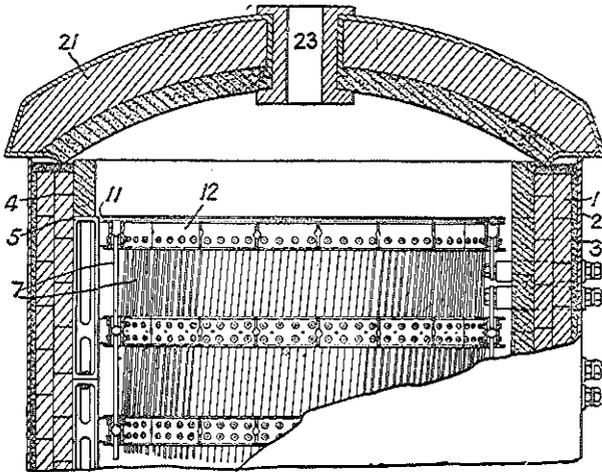


FIG. 58.

19378. Convention date, September 21st, 1918. Not yet accepted). The heating element for a furnace for heating large objects, such as guns and engine-shafts, consists of resistance strip wound around insulators carried by segmental frames mounted at different heights

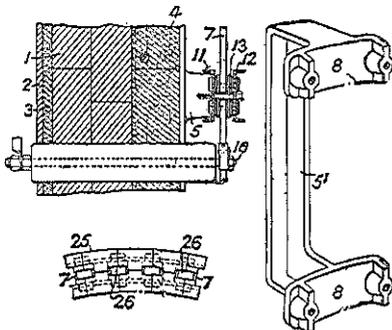


FIG. 59.

on the inner wall. As shown in Figs. 58 and 59, the strip, 7, is wound around insulating spools, 13, preferably of alundum, threaded on bolts between frames, 11, 12, which are bolted to columns, 5, built into a fire-brick lining, 4. The furnace is preferably of circular shape with an outer metal shell, 2, a brick wall, 1, and an interposed layer, 3, of pulverulent heat-insulating material. Insulated leads, 16, pass through the wall. The strip is made of an alloy containing 64 to 65 parts of nickel, 18 to 22 parts of chromium, 10 to 16 parts of iron, and 1 to 2 parts of manganese. In a modification, shown in Fig. 59, the columns, 5¹, embedded in the furnace

containing 64 to 65 parts of nickel, 18 to 22 parts of chromium, 10 to 16 parts of iron, and 1 to 2 parts of manganese. In a modification, shown in Fig. 59, the columns, 5¹, embedded in the furnace

lining, are U-shaped with bridges, 8, to which the frames are bolted. The turns of the strip, 7, may be spaced by notched insulators, 25 (Fig. 59), with rectangular blocks, 26, fitting into the notches. A cover, 21, has a central aperture, 23, for a chain supporting the work. H. G. C.

123. Tunnel Furnaces. A. BIGOT, Paris (Brit. Pat. No. 132069, September 19th, 1918, No. 15255).—In a tunnel furnace for the high-temperature treatment of metals, chemical products,

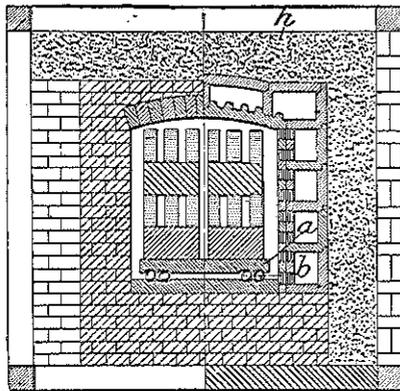


FIG. 60.

of metals, chemical products, glassware, pottery, etc., the tunnel structure is double-walled with an intermediate filling, *h* (Fig. 60), of non-conducting material, and the moving parts, such as the supporting plates, *a*, for the goods, and the balls, *b*, on which they run, are made of highly refractory substances. Fused bauxites, corundum and alumina, carborundum, compounds of chromium, magnesium, and the rare earths, such as the oxides of zirconium, cerium, and the like, are mentioned as suitable. The two walls of the tunnel structure are

connected by cross-walls of small thickness, and the filling may be powdered magnesia, silica, and the like, or material in agglomerate form. The tunnel may be heated either internally or by flues in the inner walls, as shown to the right of Fig. 60. In one form of the invention, the supporting plates for the goods co-act with projections from the walls of the tunnels to protect the balls, on which the supports move, from the action of the heat.

H. G. C.

124. Annealing Furnace for Lampworked Articles. G. R. HUGHES (Brit. Pat. No. 132852, September 21st, 1918, Nos. 15364/18 and 9960/19).—An annealing furnace is arranged close

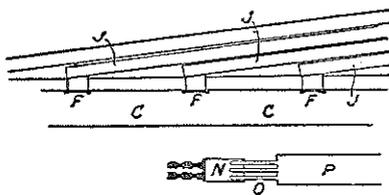


FIG. 61.

to a lamp-workers' bench, *C* (Fig. 61), and is provided with a separate door, *F*, for each worker. When the door is opened, by a pedal, etc., blowpipes are automatically turned on inside so as to heat the air which enters when the door is opened. A separate conveyer track, *J*, may be provided for each door, *F*. The bench, *P* (Fig. 61), which receives

the annealed article after its travel through the oven, is provided with projecting rods, *O*, which pass into corrugations of a plate, *N*, carrying the article, and facilitate its removal to the bench, *P*.

H. G. C.

125. Annealing Plate Glass. JAMES W. CRUIKSHANK (U.S.A. Pat., August 12th, 1919, No. 1313222. Filed December 20th, 1917, No. 208103).—The specification discusses the annealing of plate glass, and explains the difficulty that is experienced in bringing the plates out of the delivery end of the lehr at a sufficiently low temperature so that when exposed to cold-air draughts breakage will not occur, especially in winter. In order to avoid unduly lengthening the lehr, the inventor encloses it for part of its length in a chamber formed by the walls and roof of the glasshouse and dry cross-walls, and replaces the crown of this part of the lehr by a ceiling at some distance above the side walls. The glass radiates its heat to this ceiling, and is further cooled by currents of air in the chamber, the temperature of the chamber being regulated by the gases drawn down the lehr into the chamber by means of a stack having induced draught.

G. D.

126. Lehrs for Annealing Window Glass. JAMES W.

CRUIKSHANK (U.S.A. Pat., July 1st, 1919, No. 1308337. Filed April 18th, 1917, No. 163056).

—The bars for shifting sheets of window glass through a lehr consist of two sections, 5 (Fig. 62), of steel bolted together with a strip, 7, of material, such as asbestos, between them. The strip, 7, acts as a nailing strip to enable a second strip, 8, of asbestos to be secured on the upper edge of the bar. This construction enables the asbestos, 8, to be renewed easily when worn, and avoids the necessity for taking apart the entire bar.

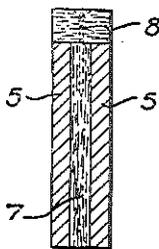


FIG. 62.

G. D.

127. Automatic Lehr. WILLIAM STENDER (U.S.A. Pat., November 25th, 1919, No. 1322735. Filed April 10th, 1918, No. 227685).—The invention consists of an automatic lehr in which the movement of the bed and of the device for stacking the ware is controlled by the entry of the ware into the lehr. The ware is carried on pans, 12 (Fig. 63), which are linked together in the usual way, and are carried through the lehr by a pinion, 14, driven by a motor, *M*, which meshes with racks secured to the undersides of the pans. The front end of the lehr is enclosed by a hood, 6, within which is a horizontal wheel, 20, situated a short distance above the pans. The wheel, 20, is furnished with curved teeth, 22 (Fig. 64), forming pockets, which receive bottles, say, and move them across the bed of the lehr. In use, the bottle, *B*, is inserted in a chute, 19, and as each is pushed inwards it opens a cock that admits com-

pressed air to a cylinder, which turns the wheel, 20, through the space of one tooth. Thus the wheel is moved step by step until a certain number of the pockets have been filled with bottles. Another cock is then opened, admitting air to a cylinder, which moves outwards a curved arm, 32, situated above the rim of the

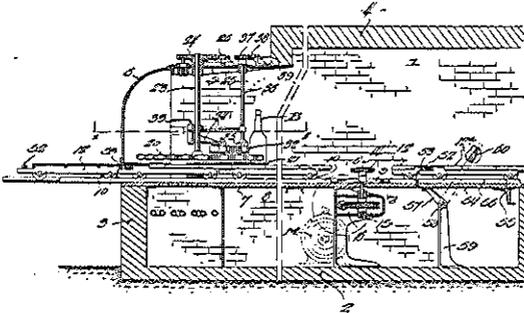


FIG. 63.

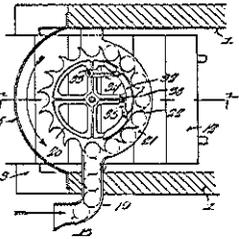


FIG. 64.

wheel, that pushes the bottles out of the pockets on to the pans. At the same time, a switch in the circuit of the motor, *M*, is closed for a short time, so that the line of pans is moved onwards a short distance. When a pan reaches the end of the lehr, it runs on to a section, 54 (Fig. 63), of the floor, which is pivoted at its outer end. This section can be swung downwards by means of a hand lever, 60, and an arm, 57, in order to disconnect the pan from the one behind it.

G. D.

128. An Improved Flattening Kiln. HARRY E. DE VAUGHN (U.S.A. Pat., July 1st, 1919, No. 1308341. Filed October 6th,

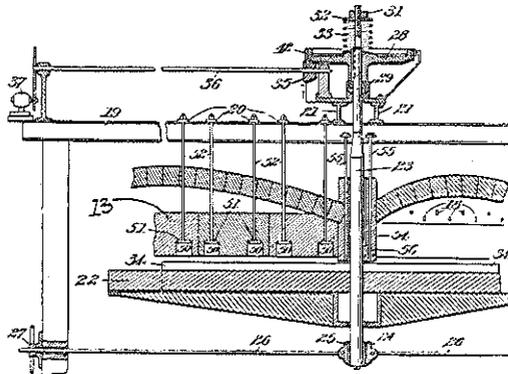


FIG. 65.

1916, No. 124093).—In flattening kilns of the type in which the stones are carried by a revolving table, the driving gear is usually

placed beneath the kiln and is inaccessible. The present invention consists chiefly in placing the driving gear above the kiln so that it is away from the heat and readily accessible for adjustment and repairs. The flattening stones, 34 (Fig. 65), are carried by a table, 22, secured to a vertical shaft, 23, on the upper end of which a gear wheel, 28, is feathered. The hub of the gear wheel rests on a bearing, 29, supported by beams, 21, and a spring, 33, is interposed between the hub and a collar, 32, secured to the end of the shaft, 33. Thus the table, 22, is resiliently supported by the wheel, 28, and the level of the table may be adjusted by means of the collar, 32, to vary the clearance between the stones, 34, and the mantel walls, 13. The table is rotated by means of a motor, 37, and hand-driving gear is also provided. In a modification, the weight of the table is supported partly by anti-friction rollers, the height of which can be adjusted from outside the kiln.

The kiln is divided into flattening, annealing, and piling chambers by mantel walls, 13, and the blocks composing these walls, and also the crown of the kiln, are supported by rods, 52, secured to beams, 19, 20, so that the walls and crown are suspended from the beam.

G. D.

129. Coke Ovens. LA SOC. DE FOURS À COKE D'ENTREPRISES INDUSTRIELLES, 94, Rue St. Lazare, Paris (Brit. Pat. July 22nd, 1919, No. 18252).—In a vertical-flued coke oven having reversible regenerators running longitudinally beneath the ovens the sets of

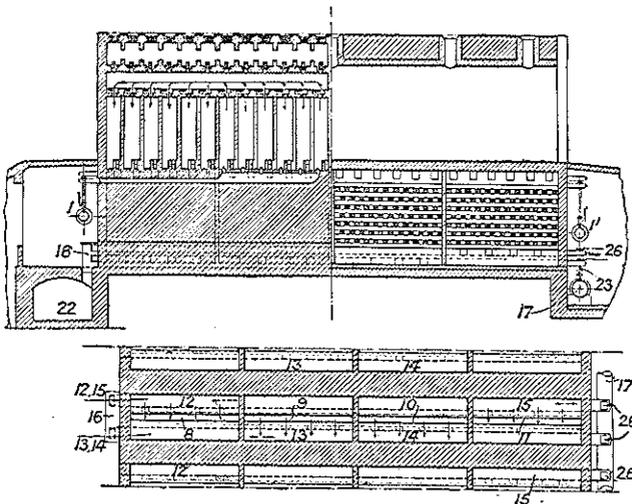


FIG. 66.

vertical flues are connected to regenerator compartments beneath the ovens on both sides of the heating-wall. In the oven shown, which is so constructed that the heating can be effected either by rich gas supplied cold from mains, 1, 1¹, or by poor gas supplied

through regenerators from the main 17, each regenerator is divided into four compartments corresponding with the four sets of heating flues. At the base of each regenerator are four conduits, 12, 13, 14, 15, opening respectively into the compartments 8, 9, 10, 11, and these conduits are connected at one end to the chimney flue, 22, through a box, 16, and at the other to the poor-gas main, 17, through valved connections, 23. Each conduit has also at this end a controllable inlet, 26, for air. When the heating is effected by rich gas, the air for combustion is heated in the compartments 9, 10 or 8, 11 along the whole bench, according to the phase of operation, while the products of combustion are exhausted through the compartments 8, 11 or 9, 10. When using poor gas, the air will be heated in the compartments 9, 10 or 8, 11 of the regenerator beneath one oven, while the gas is heated in the corresponding compartments of the regenerators beneath the two adjacent ovens.

H. G. C.

130. The Construction of Regenerators. H. HECKER and BENDER & FRAMBS GES., Hagen, Westphalia, Germany (Brit. Pat. No. 133045, September 24th, 1919, No. 23518. Convention date, May 2nd, 1918. Not yet accepted).—In a regenerator of the kind in which air ducts are arranged parallel to and on all sides of waste gas ducts, the air ducts are built up of tubular bricks, *a* (Fig. 67), of approximately hexagonal shape in cross-section, and are arranged in horizontal and vertical rows as shown, so as to form waste-gas flues, which are square in cross-

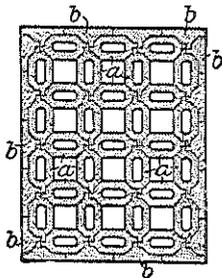


FIG. 67.

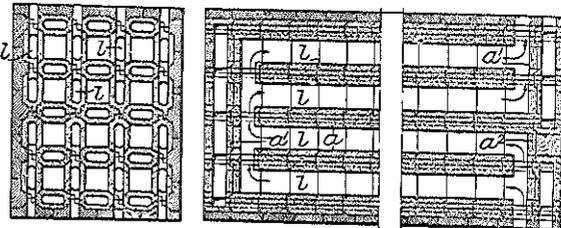


FIG. 68.

section. The bricks are provided with projections at their ends to render the joints between the bricks gas-tight. Waste-gas ducts of rectangular shape may be formed by employing two kinds of bricks of unequal height. The regenerator is enclosed by bricks, *b*.

(Brit. Pat. No. 133046, September 24th, 1919, No. 23519. Convention date, September 10th, 1918. Addition to 133045. Not yet accepted).—In a regenerator constructed as described in the parent specification, means are provided for connecting the ends of the horizontal and vertical series of air ducts with one another and with their respective inlet and outlet openings, consisting of

bricks of the same shape in cross-section as the bricks forming the ducts, but having openings on one or both of their narrow sides and one end closed. Fig. 68 shows a vertical section through one end of the regenerator, and also a vertical section through a series of vertical air ducts, l , formed of bricks, a . The connections between the ducts, l , are formed by bricks, a^1 , a^2 , closed at one end, the bricks a^1 having two openings on their narrow faces, and bricks a^2 having one opening only. The inclined joints of the bricks may be stepped as shown. H. G. C.

131. Observation Devices for Furnaces. J. G. W. HINTZE, Sweden (Brit. Pat. No. 131864, May 29th, 1919, No. 13636).—In order to observe the state of combustion in a furnace or flue with a view to admitting the necessary amount of air for perfect combustion, an air-supply nozzle, d (Fig. 69), is arranged in the

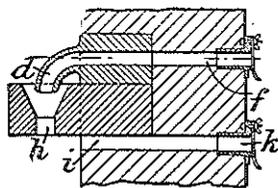


FIG. 69.

furnace wall in conjunction with a funnel, h , forming an injector-like burner, through which a small portion of the furnace gases is drawn. Any resulting flame, which indicates the proportion of unburnt gases present, is observed through a passage, i , provided with a transparent shutter, k . As shown, the nozzle, d , and passage, h , are formed in two blocks supported in the wall, but they may be formed in one block only. The device may also be supported in the wall, so that it may be readily removed through an opening therein. The air-supply passage, f , the passage, h , and the observation passage, i , may be made of tubes and in one piece, so as to form a portable piece of apparatus capable of being readily inserted. H. G. C.

VIII.—Chemical Analysis.

132. Note on an Explosion during the Separation of Potassium by the Perchlorate Method. A. F. JOSEPH and F. J. MARTIN (*J. Soc. Chem. Ind.*, 1920, **39**, 94T).—From a solution containing potassium in excess, sodium, phosphates, and silica, the phosphates and silica were removed in the usual way, the filtrate being evaporated to dryness and the residue ignited to expel ammonium salts. Potassium was separated as perchlorate and sodium estimated in the filtrate. During the process the filtrate and alcohol washings containing sodium and excess perchloric acid were evaporated nearly to dryness, and then trans-

ferred in a porcelain crucible to the hot plate for completion of the evaporation. After treating the residue with sulphuric acid, the sodium was weighed as sulphate. Although several estimations had been made safely, during the last estimation a violent explosion occurred, when only one or two cubic centimetres of liquid remained in the crucible. It was suggested that some organic matter from the alcohol had not been removed in the early part of the evaporation and that this reacted with the concentrated perchloric acid at the later stage.

F. W. H.

IX.—Machinery for the Working of Glass.

133. Machine for Making Glass Vials. W. A. WHATMOUGH, London (Brit. Pat. No. 131532, December 20th, 1918, No. 21386).—Relates to apparatus for making two vials, etc., from a length

of glass tubing. The tubing is placed on two constantly rotating rollers, *A*, *B* (Fig. 70), and two skew rollers, *J*, *K*, mounted on a pivoted frame, *L*, are brought down upon it. It is then centred by two end stops, *G*, *H*, which are moved axially by a right- and left-handed screw, *D*. A blowpipe is directed upon the middle of the tube until it is soft

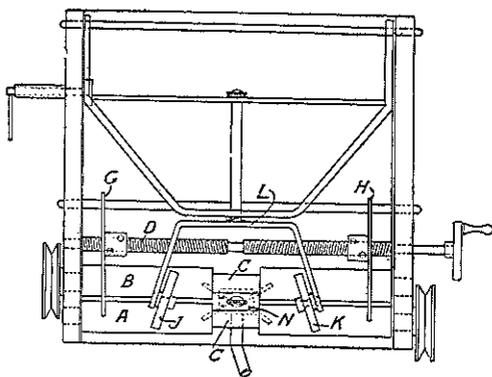


FIG. 70.

and the stops, *G*, *H*, are separated. The action of the skew rollers, *J*, *K*, draws the tube into two parts, each forming one vial. The rollers, *A*, *B*, are reduced in diameter at *C*, and a flame, *N*, plays on the rollers and tube from below to avoid too sudden heating by the blowpipe.

H. G. C.

134. Glass Blowing Machine. O. IMRAY, London (TREUHAND VEREINIGUNG AKT.-GES., Berlin) (Brit. Pat. No. 133071, June 14th, 1917, No. 8559).—In the manufacture of glass objects, such as bottles and preserve jars, a preliminary mould is first charged by dipping it in molten glass and sucking the glass into it, then a head or neck mould is applied, and a part of the glass in the

preliminary mould is raised into the head-mould either by further

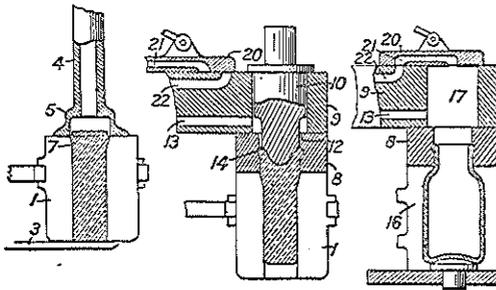


FIG. 71.

FIG. 72.

FIG. 73.

as to retain the glass in the mould after the knife, 3, has been removed. After removing the pipe, 4, the head-mould, 8 (Fig. 72), on which rests a hollow head, 9, is applied to the mould, 1, and the air is exhausted through a passage, 13, and through channels, 12, between the ring, 8, and the plunger, 10, so that the head, 14, is formed. The ring, 8, with the blank depending from it, is afterwards placed on a finishing mould, 16 (Fig. 73), the plunger, 10, removed, and air forced into the chamber, 17, of the head, 9. A slide, 20, with a duct, 21, is provided to place the chamber, 17, in communication with the pressure passage, 22.

H. G. C.

135. Glass Blowing Machines. W. McNEILAGE, Spotswood, Victoria, Australia (Brit. Pat. No. 132589, September 9th, 1918, No. 14643).—Relates to rotary-table machines and to means for forming a screw-thread in

the mouth of the blank in the parison mould. The moulds, 9 (Fig. 72), of ordinary form, are mounted on a rotary table, 8, to which a step-by-step motion is given. A spindle, 14, carrying a thread-forming plug, 53, is fitted below each mould, 9, and carries a screw, 51, engaging a nut, 12, and a driving pinion, 54. In the rotation of the table, the pinion, 54, successively engages short racks, 55, 56, on the opposite sides of a trough-shaped bracket, 56, fixed to the pedestal of the table by arms, 57. The plug is thus withdrawn at one stage, and at the next stage raised to form the thread. The racks are provided with extensions, 55', 56', which act as guides for the pinion. Air for blowing the blank is admitted through a channel, 58.

FIG. 74.

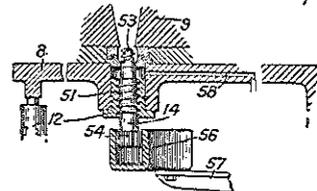
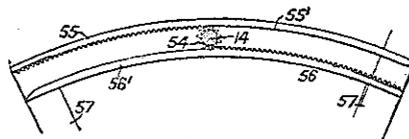


FIG. 75.

H. G. C.

136. Glass Blowing Machine. A. A. MOHN, London (Brit. Pat. No. 734252, July 31st, 1918, No. 12506).—In a machine of the turn-over rotary-table type, the usual neck, parison, and blow-

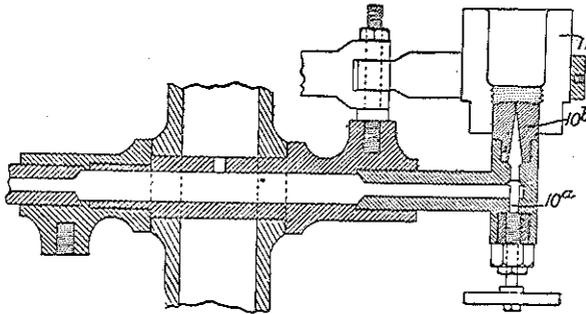


FIG. 76.

ing moulds are combined in a single divided hinged mould, 11 (Fig. 76), which is closed round the blowing nozzle, 10^b. After being charged and inverted, the mould, 11, is closed by a bottom plate, and compressed air is then admitted through the valve, 10^a, to blow the bottle, etc.

H. G. C.

137. Glass Blowing and Tempering. M. MATHY, Belgium (Brit. Pat. No. 131843, March 17th, 1919, No. 6618).—The charge is placed in a cylindrical mould, *M* (Fig. 77), a cover, *T*, is applied, and the bottom, *B*, is raised so as to bring the charge to the top of the mould. A plunger, 15, carried on a bracket, 5, is swung over the mould, *M*, and brought down by a hand-lever, 16, so as to form the initial blow opening. The plunger, 15, is then removed, and a blowing head, 26, brought into place to blow the bottle. The head, 26 (Fig. 78), is carried by a loose double valve, 27. When the head is raised, the valve, 29, prevents the escape of air. When the head is pressed down on the mould top, *T*, the valve 30 closes and the valve 29 opens and allows the blowing air to pass down through ports, *P*. The mould bottom, *B*, is raised by the action of a

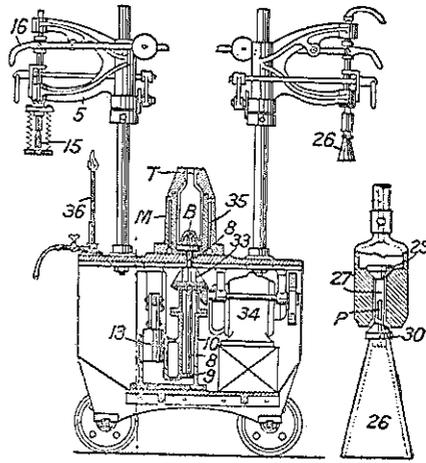


FIG. 77.

FIG. 78.

hand-operated plunger, 13, which forces oil into a cylinder, 10, and so raises a piston, 9, the rod, 8, of which carries the mould bottom, *B*. An electro-motor, 34, drives a gear, 33, feathered on the rod, 8, and so rotates the bottom, *B*, which has projections to engage and turn the blank during blowing. The plunger, 15, is heated when idle by a burner, 36. The mould is cooled by air circulating through a space, 35. This is stated to temper the bottle.

H. G. C.

138. Glass Blower. E. O. WHITLEY and E. L. KNOWLTON (U.S.A. Pat. No. 1309166, July 8th, 1919. Filed October 21th, 1918, No. 259832).—The object of the invention is to provide a

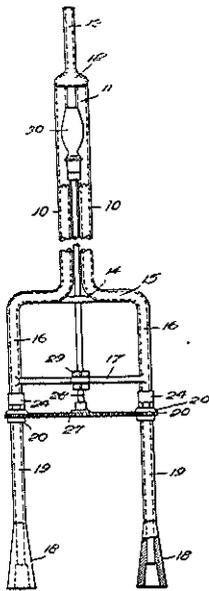


FIG. 79.

easily accomplished.

means of gathering and blowing two articles at the same time. Two pipes, 10 (Fig. 79), are arranged side by side, and at their rear end are bent into curved sections, 11, which are united in a common mouthpiece, 13. At the lower ends the pipes are bent away from each other and formed into a U-shaped member, 15 and 16. Connected to the lower ends of the two pipes, 16, are tubular stems, 19, which are rotatable and carry the glass-gathering nozzles, 18. The rotation of these stems is accomplished by turning the handle, 30, secured to the upper end of the shaft, 28. Rigidly fixed to the lower end of this shaft is a large gear wheel, 27, which meshes with gears, 20, on the two tubular stems.

In using this apparatus the nozzles, 18, are dipped into the glass and turned on their axes by operating the handle, 30. Marvering is also done simultaneously by turning the handle, 30, while the hot gathers roll on a slab of marble. The blowing moulds are arranged to suit the distance between the irons so that simultaneous blowing up and rotation of the articles in the moulds are

S. E.

139. Bottles with Re-entrant Bottoms. OWENS BOTTLE Co., Toledo, Ohio, U.S.A. (Brit. Pat. No. 132768, July 21st, 1919, No. 18143).—Relates to the manufacture of bottles having re-entrant bottoms. The parison is partly blown in the parison mould, 15 (Fig. 80), and is formed with a solid annular projection, *P*. It is then inverted, and the blowing completed in a mould having a movable projecting bottom, 34 (Fig. 81), the final shape being shown in Fig. 82. The invention is shown applied to a machine of the kind described in Specification 127995. A cam, 40 (Fig. 82), controls the tilting of the mould bottom, 33, to dis-

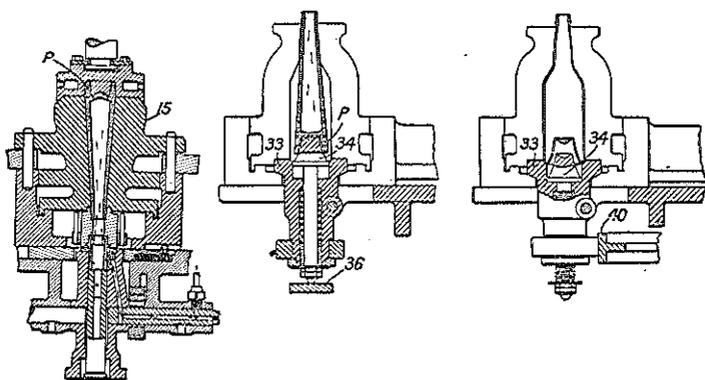


FIG. 80.

FIG. 81.

FIG. 82.

charge the finished bottle, and a separate cam, 36 (Fig. 81), operates the movable projecting bottom, 34. H. G. C.

140. Semi-automatic Bottle-blowing Machine. JAMES W. LYNCH (U.S.A. Pat., March 18th, 1919, No. 1297706. Filed September 28th, 1916, No. 122658).—The invention consists of the parison-forming mechanism of a semi-automatic machine for making narrow-necked bottles. The machine is of the hand-transfer ("one man, one boy") type, but mechanism for blowing the parison in the finishing mould is not described. The specification describes in great detail, and illustrates fully, the valves for controlling the air supply, the devices for timing the operations and regulating the speed, the driving mechanism, the devices for operating the shears, and the lubricating and cooling arrangements. G. D.

141. Automatic Glass Bottle Apparatus. E. ROIRANT St. Ouen, Seine, France (Brit. Pat. No. 134152, March 10th, 1919, No. 5868).—Relates to automatic apparatus for the manufacture of glass bottles. The movements of the apparatus are timed by adjustable cams on a shaft, 75 (Fig. 83), connected to a continuously-rotating shaft, 86, by a clutch, 104, which is engaged when a finished bottle is ready for discharge, and is disengaged as soon as the next bottle has been blown. The blown bottle remains in the mould during the period of disengagement of the clutch, 104. To allow this period of rest to be varied, a variable-speed friction disk arrangement, 93, 94, is used. The disk, 94, has a pin, 98, which trips a lever, 99, and so engages the clutch, 104, by means of a rod, 100, and bell-crank lever, 101. When the blowing is complete, the roller, *R*, on the lever, 101, enters a recess in a cam, 106, and disengages the clutch, 104, which remains out until the pin, 98, again strikes the lever, 99. By this arrangement, the period of rest in the blowing mould can be varied without altering the timing of the other operations. A ladlé, 11, is charged at the

opening, 3, and swung about the shaft, 7, to a position below the parison mould by a pinion, 12, and toothed arc, 13. The adjustment of a telescopic rod, 15, connecting the arc, 13, with a crank on a shaft, 75, determines the length of the period of rest at the opening, 3, and below the parison mould. The blowing mould, 33,

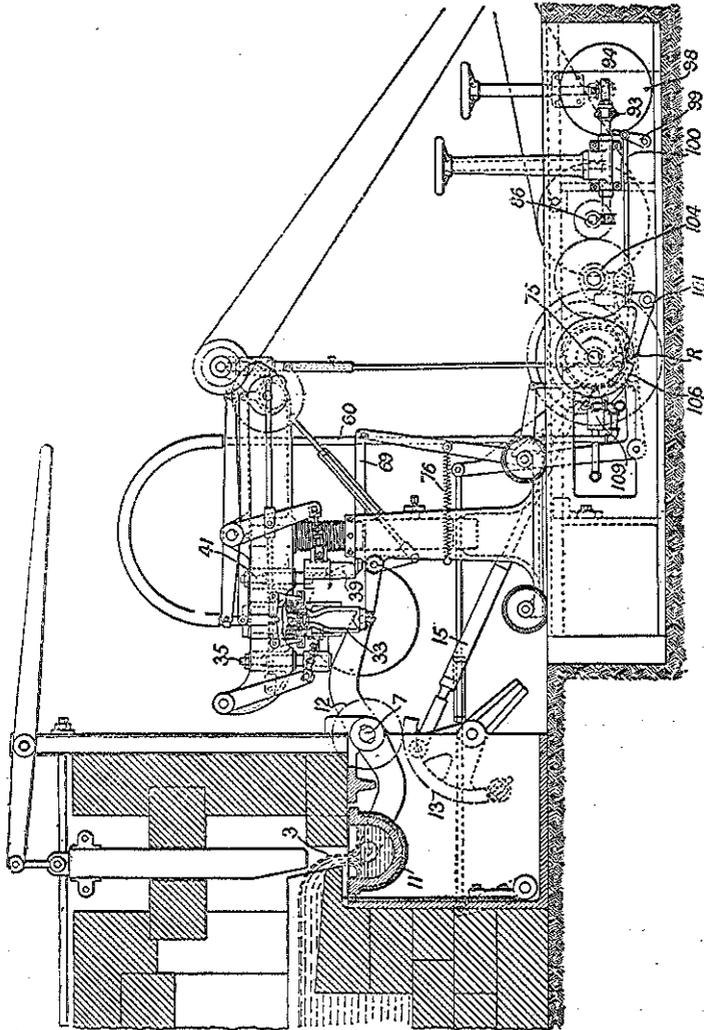


FIG. 83.

and parison mould, 39, are hinged on pins, 35, 41, respectively, and work in a manner similar to that described in Specification 112007. Cam-operated compressed air and suction valves, 109, are connected by a pipe, 60, with the neck mould. The cut-off knife, 69, is worked by a spring, 76, and cams on the shaft, 75. H. G. C.

142. Process of Making Vacuum Bottles. C. F. P. ANDERS (U.S.A. Pat. No. 1335544, March 30th, 1920. Originally filed November 23rd, 1910, No. 593891. Divided, and this application filed February 19th, 1916, No. 79393).—This invention relates to a simplification of the construction of vacuum bottles, which also secures improved heat insulation. The outer vessel is made of cylindrical form having a conical or tapering bottom, 2 (Fig. 84). The inner vessel is substantially the same shape, but has a shoulder, 4, formed by an outward bend near the top. The inner vessel is supported at its free end by a coiled spring, 5, which holds the inner vessel so accurately in position that it is not necessary to have any other supports between the walls of the two vessels, thus reducing heat conduction to a minimum. The open end of the bottle is closed by the hollow stopper, 10, which is evacuated and sealed off in the ordinary way through the projecting point, 13. The sides of the stopper are surrounded by a packing ring, 10, of suitable material. S. E.

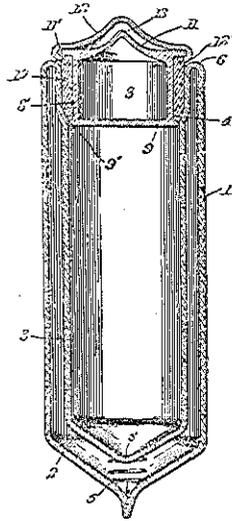


FIG. 84.

143. Drawing Glass Cylinders. JAMES A. CHAMBERS (U.S.A. Pat., July 8th, 1919, No. 1309274. Filed October 8th, 1918, No. 257405).—In drawing window-glass cylinders from a

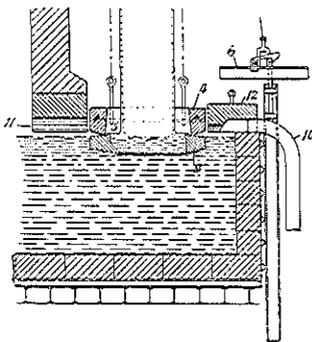


FIG. 85.

tank, it is usual to draw the glass through a ring, 9 (Fig. 85), which floats on the surface of the metal, and through an opening in the cover slab, 4, which rests on the drawing ring. When the draw is completed, the slab is raised and the cylinder melted off by gas flames from pipes, 10, but a stump of hardened glass is left in the drawing ring. This stump is re-melted by covering the opening in the slab and allowing the gas flames to continue, but the process results in loss of time and in other disadvantages. According to the invention, immediately the cylinder is detached, a charge of metal, hotter than the metal in the tank, is ladled into the drawing ring. The hardened stump is thus re-melted and forced downwards out of the ring, and the metal quickly settles down to the proper temperature for drawing another cylinder. G. D.

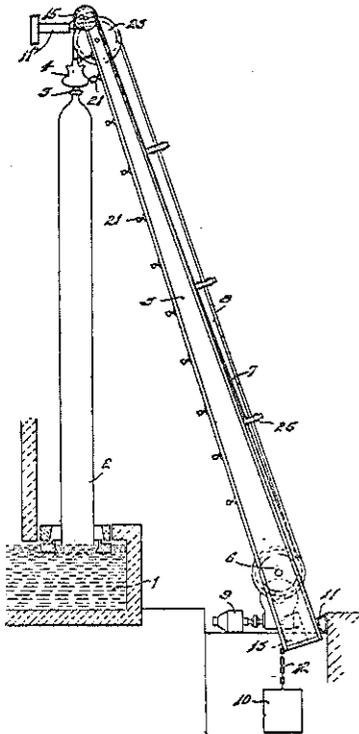


FIG. 86.

144. Drawing Glass Cylinders. HALBERT K. HITCHCOCK (U.S.A. Pat., July 15th, 1919, No. 1309942. Filed October 8th, 1917, No. 195438).—A take-down apparatus for use in drawing cylinders comprises an inclined frame, 5 (Fig. 86), very similar to the jib of a crane, turning about an horizontal axle, 6, at its lower end, and having a pulley, 23, at its upper end, over which the rope, 7, for raising the bait, 3, passes. When the draw is completed and the cylinder detached from the metal, the frame is brought into a vertical position, and is then swung over backwards, so that the cylinder is supported along its length and brought down into a horizontal position. G. D.

145. Drawing Glass Cylinders. ROBERT W. HILTON (U.S.A. Pat., July 8th, 1919, No. 1309199. Filed September 9th, 1918, No. 253305).—The

invention consists of a furnace for maintaining the temperature of the drawing-pot during the drawing operation and for

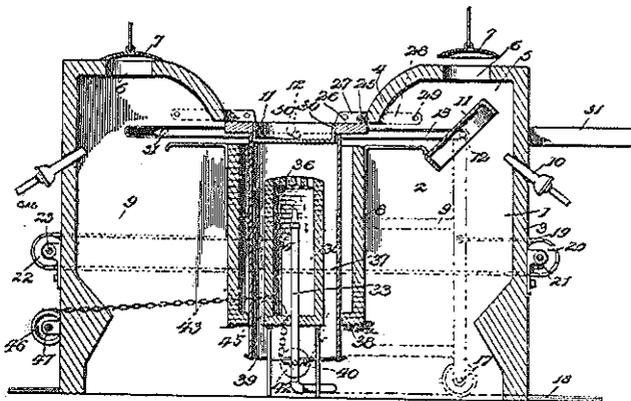


FIG. 87.

melting off the surplus glass after the draw is completed. The furnace consists of a rectangular portion, 1 (Fig. 87), having an inner cylindrical chamber, 8, below the drawing opening, 30. Two pots, 11, are mounted on a sliding framework, which can be moved horizontally to bring one of the pots below the drawing opening and the other pot into one of the end chambers, 9. While in the chamber, 9, a pot is turned about its trunnions, 12, as shown, so that gas flames from a burner, 10, can play on the pot and drain off the surplus metal remaining in the pot after the draw. The opening, 30, is formed in two hinged sections, 26, which fit snugly around the pot, but are lifted when the pot is to be moved. In this position, the pot is heated by a burner, 34, and in order to maintain the metal at a constant temperature, a cylindrical baffle, 37, is raised to fit around the pot. This baffle shields the pot from the heat of the burner 10, and at the same time retains the heat from the burner 34. G. D.

146. Cutting Glass Cylinders. CHARLES T. MOORE (U.S.A. Pat., August 5th, 1919, No. 1312341. Filed January 24th, 1919, No. 272848).—A contrivance for cutting up glass cylinders by electricity consists of a pistol-shaped device for tightening a heating wire around the cylinder and for closing the circuit that supplies the current for heating the wire. The saddles that support the cylinder can be lowered individually in order to permit the wire to be moved along the cylinder. G. D.

147. Drawing Wire Glass. IRVING W. COLBURN (U.S.A. Pat., December 2nd, 1919, No. 1323389. Filed February 28th, 1917, No. 151582).—Wire glass is made by drawing wire cloth, *T*

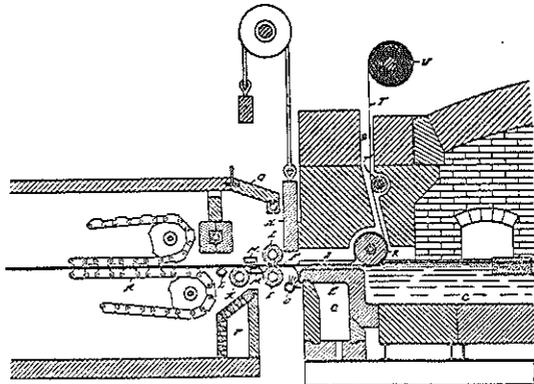


FIG. 88.

(Fig 88), through metal in a tank, the glass with embedded wire being drawn away in a sheet by conveyer chains, *A*. The wire

cloth is stored in a roll, *v*, supported above the tank, and passes through a slot, *S*, into metal in a cooling chamber, *C*, thence through a shallow layer of metal, *D*, to the conveyer. G. D.

148. Rolling Plate Glass. WALTER COX (U.S.A. Pat., August 12th, 1919, No. 1313071. Filed October 14th, 1915, No. 55824).—In order to avoid the formation of "cold spots" in rolling ribbed glass, resulting in a peacock feather appearance, the grooves of the rolling table are made as shallow, wide-angled grooves instead of the narrow-angled grooves usually employed. In the case of glass with about 20 grooves to the inch, the angle between the sides of the grooves and the plane of the sheet should be between 5° and 40° , but an angle of $12\frac{1}{2}^\circ$ has been found to give good results. G. D.

149. Machine for Making Sheet and Plate Glass. GEORGE A. SHIELDS (U.S.A. Pat., July 22nd, 1919, No. 1310451. Filed April 11th, 1918, No. 227978).—The specification described a

machine for making plate and sheet glass by flowing metal over the edge of a receptacle on to a moving conveyer, the sheet so formed being scored or marked so that it can be broken up. The metal flows out of the tank over a water-cooled sill, 15 (Fig. 89), and falls in a sheet, 4. The thickness of the sheet is regulated by the temperature of the metal and

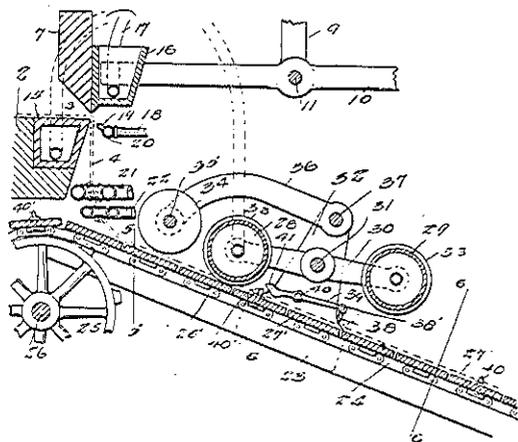


FIG. 89.

by the position of an adjustable water-cooled gate, 16, which closes the aperture over the sill. The sheet falls on to an endless conveyer, 6, formed by wooden slats, 27', attached to endless chains, 24, and is fed by this conveyer into the Lehr. On its way down the conveyer, the sheet passes under a water-cooled roller, 28, and each end of the roller is provided with a cutting disc, 33, which trims off the edges of the sheet. Other cutting discs, 34, are also caused to score the sheet longitudinally, and a reciprocating cutter-bar, 38, scores the sheet transversely, these scorings enabling the sheet to be broken up into convenient sizes. The height of the conveyer is adjustable, in order to enable the transparency of the

glass to be regulated by the length of the drop between the sill, 15, and the conveyer, a longer drop giving a better quality of glass. G. D.

150. Sheet Glass. JAMES H. CAMPBELL (U.S.A. Pat., August 5th, 1919, No. 1312306. Filed January 7th, 1919, No. 270023).—Relates to the "horses" used in window-glass factories for supporting cylinders while they are being cut up into smaller cylinders, and to that type of "horse" in which the saddles, 10 (Fig. 90), have shanks, 9, supported by springs, so that they can yield to the weight of the cylinder. According to the present invention, the saddles, instead of being independently spring-supported, are mounted in pairs on the ends of levers, 11 (Fig. 90), which are supported at their centres by springs, 14. Thus the saddles are better able to adjust themselves to variations in the diameter of the cylinder, and the weight is more evenly distributed. In a modification, each lever, 11, supports three or more saddles, and is itself supported by two or more springs. G. D.

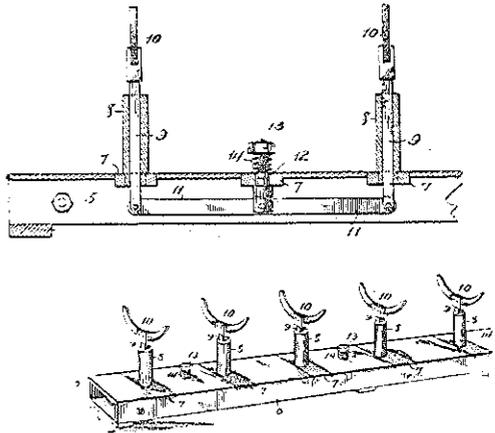


FIG. 90.

151. Drawing Sheet Glass. JAMES H. CAMPBELL (U.S.A. Pat., August 5th, 1919, No. 1312305. Filed January 3rd, 1919, No. 269524).—In drawing cylinders of glass from metal contained in a drawing pot, the cylinder is liable to move out of centre into contact with the side of the pot, owing to variations of the surface tension of the metal caused by variations of temperature. In order to avoid drawing cylinders of uneven thickness due to this cause, the pot is supported on three levelling screws, so that it may be tilted in any direction. Thus, by raising one side of the pot, the metal on this side is shielded and caused to cool more slowly, and the sidewise movement of the cylinder can be prevented.

It is suggested that a number of pots, say three, could be mounted on a turntable, so that while a cylinder is being drawn from one pot, the others can be under heating covers or furnaces for heating and drawing out the surplus glass. G. D.

152. Drawing Sheet Glass. JOHN R. SCOHY (U.S.A. Pat., July 22nd, 1919, No. 1311137. Filed October 30th, 1918, No. 260319).—

A bait for drawing window-glass cylinders consists of a bowl-shaped member, 14, attached by a cross-piece, 15, to the lower end of a tube, 13, and having an opening, 17, at the bottom. A tube, 18, slides in the tube, 13, and has screwed on its lower end a concave member, 19. In use, the bowl is lowered into the metal, which flows in between the members, 14 and 19, as shown. The metal thus locked between the two members sets at once and enables the cylinder to be drawn immediately, and is said to prevent the cylinder from

cracking and falling off the bait.

G. D.

153. Making Sheet Glass. T. J. MCCOY, U.S.A. (Brit. Pat. No. 132649, October 11th, 1918, No. 16591).—Relates to apparatus for making sheet glass by causing molten metal to flow in sheet form from the melting-tank on to a conveyer. In the arrangement shown in Fig. 92, the metal, 22, flows from the tank, 20, over a stone, 24, descends vertically, and is received on a series of tablets, 26, moved forward by an endless chain, 31. The tablets

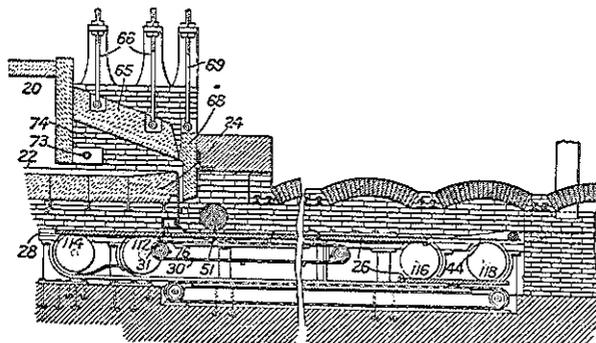


FIG. 92.

carry lateral pins which slide on guides, 28, and deliver the sheet to lifters, 44, from which it passes over a roller. After passing the lifters, the tablets are moved downwards by rotary disks, 116, 118, the pins sliding in guides, and are transferred to an endless chain, 30, which returns the tablets to the front of the tank. The tablets are raised by rotary disks, 112, 114, co-acting with guides, and are returned to the chains, 31, by which they are again carried forward. The tablets are formed with upstanding sides, and carry

transverse blades at their rear edges, so that the glass sheet is severed as it passes under a roller, 51. The tank is provided with an extension chamber, 74, fitted with a cap stone, 65, which can be adjusted vertically and angularly by screwed rods, 66, and a front stone, 68, vertically adjustable by a rod, 69. A gas burner, 73, is arranged in the chamber, 74, and a water duct, 76, is disposed behind the vertical part of the glass sheet. Pivoted guides and retaining plates are provided to ensure that the pins on the tablets take the required paths. Specification 117194 is referred to.

H. G. C.

154. Combined Metal and Glass Structure, and Method of Forming Same. W. G. HOUSEKEEPER (Western Electric Co.) (U.S.A. Pat. No. 1293441, February 4th, 1919. Filed January 4th, 1918, No. 210396).—It is difficult to seal one glass to another unless they have approximately the same coefficient of expansion, but in the present case this is done by welding one glass to a sheet-metal member, and thus forming a combined metal and glass structure, to the metal part of which the other glass may be sealed.

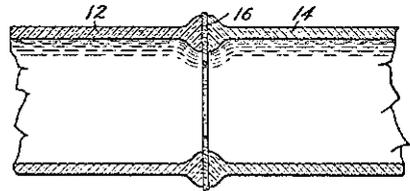


FIG. 93.

In Fig. 93 the two glass tubes, 12 and 14, are welded to the opposite sides of an annular disc, 16, of thin sheet copper or other metal. Although copper has a higher coefficient of thermal expansion than glass, the disc by reason of its thinness and the low elastic limit of the material of which it is formed, is sufficiently stretched by the force of adhesion to maintain the contacting surfaces

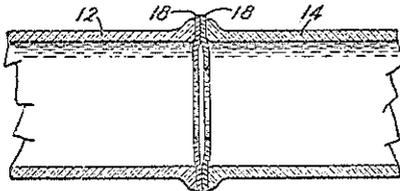


FIG. 94.

of the copper and the glass in the same relative positions when cold as when at the welding temperature. In forming such a joint it is preferable that both glass tubes be welded to the disc simultaneously in order that the strains in the disc may be at all times as evenly distributed as possible. In the modification shown in Fig. 94 the glass tubes are welded to separate copper discs (18, 18), and later the copper discs are soldered together; this permits of the ready separation of the tubes whenever it is necessary.

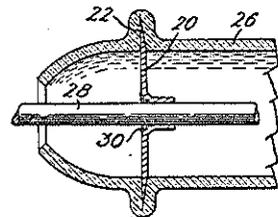


FIG. 95.

The arrangement shown in Fig. 95 shows a sheet metal disc, 20, which has its outer edge formed into a

gradually tapering knife edge, 22, around which is welded the glass wall of the container, 26. The edge of this disc is so thin that strains set up in cooling are not sufficient to overcome the adhesion between the glass and the metal of the disc. The main portion of the disc may be of considerable thickness, and may serve as the support of a leading-in conductor of considerable section, such as could not easily be sealed directly through the glass. S. E.

155. Combined Metal and Glass Structure, and Method of Making Same. W. G. HOUSKEEPER (Western Electric Co.) (U.S.A. Pat. No. 1294466, February 18th, 1919. Filed January 4th, 1918, No. 210397).—This invention relates particularly to structures consisting of glass and metal elements hermetically sealed together, in the form of tubes, and depends on the fact that if the ends of a metal tube be sufficiently thin, it may be welded to a glass tube, and will form a permanently air-tight seal.

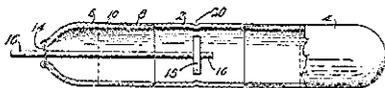


FIG. 96.

In Fig. 96 a piece of copper tube, 2, has its opposite ends surrounding and sealed to the inner ends of the glass tubes, 4 and 6. The metal tube is about $\frac{3}{4}$ in. diameter, and has its end-ports reduced to a thickness of about 0.015 inch for a length equal to at least the diameter of the tube. The end $\frac{1}{4}$ in. of the copper tube is reduced to a knife edge, 10. A section of glass tube having been fitted inside the copper tube, the latter is suitably fixed and heated to a bright yellow heat in a gas flame. When the glass softens it is rolled into contact with the inner surface of the thin portion of the copper tube by a graphite rod.

If the thin portion of the copper tube is not thicker than 0.007 inch, it is not necessary to reduce the end to a knife edge in order to form an air-tight seal.

To form a vacuum lightning arrester, another glass tube, 4, is welded on to the other end of the copper tube, and a small metal disc, 14, is sealed to the reduced end of the tube 6. The disc, 14, carries a conductor, 16, at the inner end of which is a disc, 18, which serves as an electrode. S. E.

156. Making Letter Plates for Signs. ADOLPH W. GAST (U.S.A. Pat., July 1st, 1919, No. 1308408. Filed February 23rd, 1918, No. 218626).—The invention consists of a process and apparatus for making glass letter plates, that is, plates of glass having letters, designs, or the like appearing in relief on one face and a corresponding depression on the other. The process consists in taking a glass pane or plate of the desired size, heating it to a temperature of, say, 500° F., next passing it through a furnace, by which the temperature is raised gradually until the

plate becomes softened, say, 1400° F., then pressing the plate by air pressure against a hot die, afterwards reducing the temperature gradually by passing the plate back through the furnace, and finally allowing it to cool in an annealing kiln. The furnace, 18 (Figs. 97 and 98), is very like a lehr. It is gas heated and has in its heating chamber an upper and a lower track formed by rails, 42. A plate of glass, after being raised to 500° F., is placed in a perforated carrier, 60, which is put into the cooler end of the furnace, shown in Fig. 98, and is pushed along by a bar, 72. The plates move gradually up the furnace until they reach the hotter end, shown in Fig. 97, whence they are drawn on to a

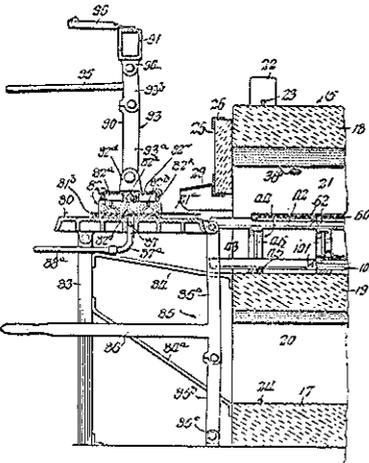


FIG. 97.

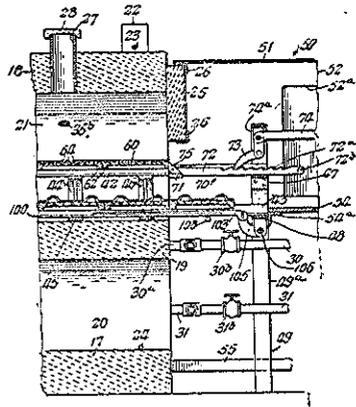


FIG. 98.

table, 80, beneath a heated die plate, 82. The die plate is then pressed firmly against the plate by toggle levers, 93, so as to clamp the plate against the carrier, 60, and also to clamp the carrier against the table, 80. Compressed air is now admitted by a pipe, 88^a, into the space between the carrier and the table, and, since the carrier is perforated, the glass plate is forced by the air to conform to the design on the die plate. The air is then cut off, the die plate is raised, and the table tilted about its pivot so as to shoot the carrier and plate on to the lower of the two tracks in the furnace. The plates are then moved gradually from the hotter to the cooler end of the furnace, whence they are removed to an annealing kiln.

G. D.

157. Shear Mechanism for Glass Working Machines.

H. A. GENEST (Hartford Fairmont Co.) (U.S.A. Pat. No. 1331847, February 24th, 1920. Filed March 28th, 1917, No. 157946).—Machines which are designed for feeding gathers of glass

from a furnace are provided with shears which are

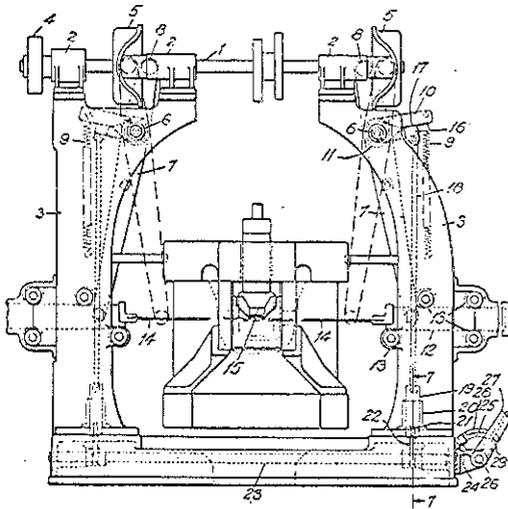


FIG. 99.

shears which are operated at intervals, cutting off pre-determined quantities of molten glass. Whenever the glass-shaping machine is stopped it is desirable that the shear movements should also be stopped, although the feeding operations should be kept going in order to prevent "freezing" of the glass round the outlet.

In the type of machine shown in Fig. 99 a horizontal shaft, 1, carries two cam-wheels, 5. In conjunction with

these are two shear levers, 7, turning on studs, 6. The upper end of each lever carries a roll, 8, which is kept in contact with the cams, 5, by means of the springs, 9, connected to the arm, 10. The lower end of each lever is connected with a horizontal movable slide, 12, to which is attached a shear blade, 14. Thus as the shaft, 1, is driven, the shear blades move towards and from each other at the proper intervals.

The levers for reciprocating the shear blades are thrown out of action by a stop arm, 16, mounted on the same stud as the lever and operated by the rod, 18, which in turn is raised by a hand lever, 27, actuating the cam, 22, through the bevel gears, 24 and 25. When the arm, 16, is raised it holds the upper ends of the levers, 7, inward, so that their rolls, 8, are kept clear of the cams, 5. When the levers are released they commence cutting operations again in synchronisation with the rest of the machine.

S. E.

158. Glass Feeding Device. O. M. TUCKER and W. A. REEVES, Columbus, Ohio, U.S.A. (Brit. Pat. No. 131586, August 5th, 1919, No. 19288).—In extruding charges from a discharge orifice, pressure is applied to the molten metal so that "the rate of extrusion is not less than the rate of downward travel of the already extruded glass."

H. G. C.

159. Glass Working. F. L. O. WADSWORTH (Ball Bros.' Glass Manufacturing Co.) (U.S.A. Pat. No. 1323507, December 2nd, 1919. Filed February 23rd, 1915, No. 9878).—This invention

relates particularly to the severing of a stream of molten glass as it flows continuously from a tank, and the provision of a temporary support for, and the shaping of the cut end during the period of mould movement.

A hole, 3 (Fig. 100), is provided in the floor of the flow block chamber, and below it is fixed a flow ring, 4. The amount of metal flowing through this ring is controlled by the movable plug, 5, the temperature of the ring itself, which can be varied by circulating water round the flow ring plate, 6, and by the temperature maintained in the flow block chamber. The shearing mechanism consists of two blades, 7 and 8, which are fixed obliquely and so shaped that when the stream of glass has been cut the upper cut end rests

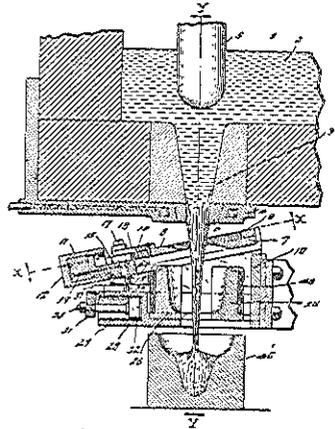


FIG. 100.

in a shallow V formed where the two blades meet. Immediately after the stream of glass has been severed the two support blocks of a bad conducting material are brought together, and the glass is allowed to accumulate in the pocket, 47. This supporting cavity can be heated electrically by heaters as indicated at 48, and thus the glass can be made to remain so soft as to obliterate any shear marks. A further advantage of collecting the glass is that by using a suitably shaped pocket the molten metal can be made to assume the shape of the mould into which it is to fall when the two halves of the support move apart.

S. E.

160. Glass Feeding Device. BRITISH THOMSON-HOUSTON CO., London, and J. GRAY (Brit. Pat. No. 131756, September 12th, 1918, No. 14862).—In a machine for manufacturing glassware, more especially bottles, lamp bulbs, etc., predetermined quantities of glass

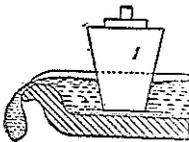


FIG. 101.

are discharged periodically from a tank or forehearth by a reciprocating displacer, 1 (Fig. 101), which is lowered into the tank to raise the level of the metal. The displacer is preferably of conical form, and is adjustably mounted so that its depth of immersion may be varied. Water may be supplied to keep the displacer moist during working. H. G. C.

161. Apparatus for Feeding Molten Glass. W. A. LORENZ, Hartford Fairmond Co. (U.S.A. Pat. No. 1300181, April 8th, 1919. Filed August 7th, 1917, No. 184875).—The gathers of glass flow

ing down a trough or conduit from a feeder are often not of a suitable shape to run direct into a mould on a machine table. If they are run in directly, they are liable to choke up the mouth of the mould, or to enclose large air bubbles which completely spoil the product. This is overcome by fixing a curved funnel, 17, over the mouth of the mould 14 (Fig. 102) in line with the conduit. The curvature of the funnel is such that the axis of the discharge end is in line with the axis of the mouth of the mould, while the axis of the open end is in line with the conduit. The delivery end of the funnel is substantially the same shape as the cross section of the mould, and always slightly less in diameter, so that the glass in passing through the funnel is

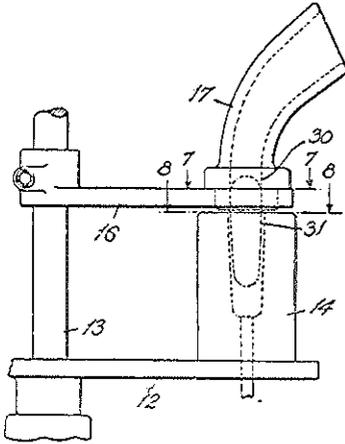


FIG. 102.

shaped, and then falls freely to the bottom of the mould. Sometimes for round moulds the delivery end of the funnel is elliptical, so that glass which is generally shot into it more or less flattened is only partially shaped. It is claimed that such an oval mass of glass falling into a mould allows of the freer displacement of the air from the mould.

S. E.

162. Gathering by Suction. EMILE ROIRANT (U.S.A. Pat., July 29th, 1919, No. 1311249. Filed November 14th, 1918, No. 262591).—In gathering metal by suction, the introduction of the lower portion of the mould into the metal has the effect of chilling the metal, so that after several successive gatherings at the same place, the glass can no longer be used. In order to avoid this disadvantage, a block, 1 (Fig. 103), having an aperture, 4, is floated on the metal, 2, beneath the mould. Thus, when the mould is lowered, it makes contact with the block and depresses it in the metal, so that the charge is sucked into the mould through the aperture, 4. As the surface of the mould does not come into contact with the mass of metal, the obstruction caused by chilling of the metal is avoided.

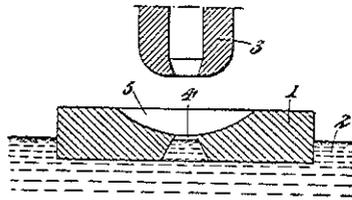


FIG. 103.

G. D.

163. Automatic Glass Feeder. S. D. OLSEN, Leeds (Brit. Pat. No. 132898, October 3rd, 1918, No. 16089).—Relates to an

automatic feed for machines for making glassware, and consists in receiving the stream of metal in a water-cooled cup, which can be turned over to deliver the charge of metal into an inverted parison mould. Thus, the hottest portion of the charge is delivered into the lower, or neck, portion of the parison mould. The cup, *a* (Fig. 104), receives the metal from the tank extension, *b*, the supply being cut off at intervals by a blade, *c*. The blade works in conjunction with a small auxiliary cup, *n*, in which the metal collects while the cup, *a*, is being inverted. The cup, *a*, is water-jacketed, the inner lining which makes contact with the glass being made of carbon, cast iron, etc. The cup is mounted on a shaft, *o*, which is turned through a half-circle by a rack, *d*, attached to a piston in a cylinder, *d'*, to bring the cup into the position shown in dotted lines, so as to deliver the charge of metal into the parison mould, *f*. The piston is operated by compressed air or steam, and is controlled by a valve, the rod, *i*, of which is connected to an arm, *k*, actuated

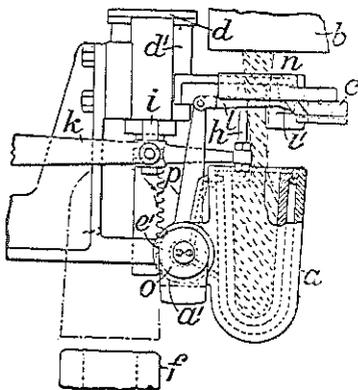


FIG. 104.

by the machine for making the ware. A finger, *h*, is fitted to the outer end of the rod, *k*, and, when the rod is lifted in order to cause the inversion of the cup, *a*, the finger trips a latch, *l*, and allows the blade, *c*, to be closed by a spring. The latch, *l*, is pivoted to the upper end of an arm, *p*, which is rotatable in the shaft, *o*. A stop on the shaft, *o*, alternately makes contact with shoulders on the arm, *p*, so that the arm is moved backwards to bring the latch behind the blade, *c*, and then moves the blade to permit a resumption of the flow of metal when the cup is again in the filling position.

H. G. C.

164. Grinding Glass Stoppers. M. MATHEU, Belgium (Brit.

Pat. No. 131547, February 17th, 1919, No. 3900).—Relates to apparatus for grinding glass stoppers against the necks of the bottles they are to fit. As shown, the stopper, 10 (Fig. 105), is held in a rotating carrier, 7, by means of an indiarubber or like elastic block, 8, the edges, 11, of which overlap the bulge of the stopper so as to grip it securely, but resiliently. The bottle, 12, is applied

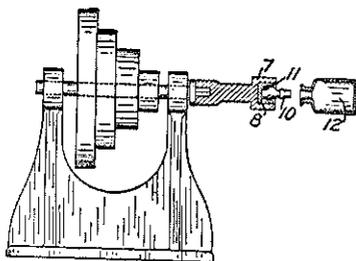


FIG. 105.

to the rotating stopper by hand.

H. G. C.

165. Glass Delivering

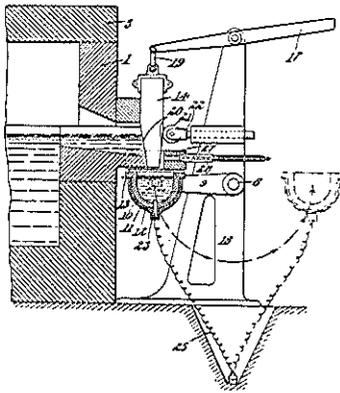


FIG. 106.

Apparatus. EMILE ROIRANT (U.S.A. Pat., June 17th, 1919, No. 1307150. Filed August 13th, 1918, No. 249706).—The invention consists of a device for collecting molten glass from a furnace and delivering it to a gathering device arranged at some distance from the furnace. It consists of a receiver, 11, which swings between the two positions shown, and can thus receive metal from a spout, 13, and convey it to a machine. The spout is closed by a gate, 14, which can be lifted by the receiver as it comes beneath the spout. In order to keep the metal in the receiver hot, an electric current can be

passed between two electrodes, 23, since the hot metal is a conductor, and thus maintain the temperature. G. D.

166. Glass Delivery Apparatus. F. L. O. WADSWORTH (Ball

Bros.' Glass Manufacturing Co.) (U.S.A. Pat. No. 1307527, June 24th, 1919. Filed July 30th., 1914, No. 854024).—The object of this invention is to deliver in an upward direction a constant stream of molten glass under a gravity head, and in such a condition that open-bottomed receptacles may be brought into register with the delivery orifice and filled.

The chamber, 2 (Fig. 107), which is built on to the working end of a tank furnace, is provided with a downward outlet, 4, which is surrounded by a furnace, and terminates in an

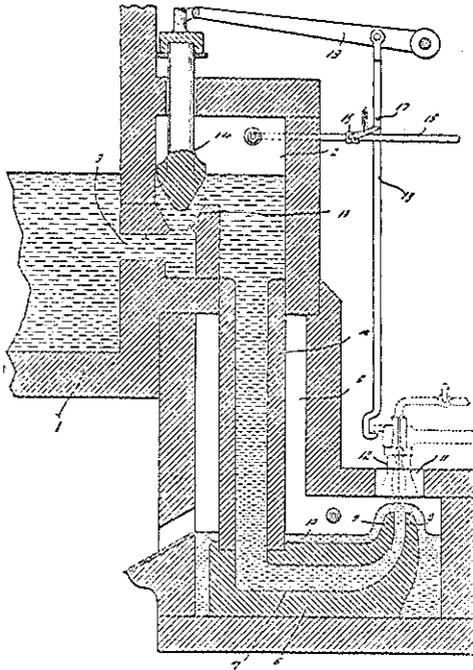


FIG. 107.

upwardly directed nozzle, 9. Immediately above the nozzle is an opening, 11, in the wall of the furnace, through which moulds or other receptacles can be lowered. If desired, a valve, 14, may be interposed between the furnace and the chamber, 2, so as to regulate the flow of glass. In cases where the pressure due to the head of molten glass is insufficient it may be supplemented by air or gas pressure through the pipe, 15, in which case the valve, 16, and the glass regulator, 4, may be operated simultaneously through the rod, 18, when the moulds are lowered into position.

S. E.

167. Glass Discharging Mechanism. J. RAU (U.S.A. Pat. February 3rd, 1920, No. 1329851. Filed September 10th, 1918, No. 253363).—In this method of discharging molten glass, a spout structure is built on to the working end of a tank as shown in section in Fig. 108. Across this spout structure is built a wall, 13, which has an opening, 14, into a plunger chamber. This plunger chamber is circular, and communicates with a delivery chamber through the orifice, 17. A circular plunger, 18, operates vertically in the chamber, so that in its downward stroke it closes the connection, 14, to the main tank and then forces molten glass through the passage, 17, and over the lip, 22. This lip projects outwardly so that it overhangs and stands out beyond the lower part of the front wall of the discharge chamber, thus the molten glass falls clear of the walls as it flows over the lip.

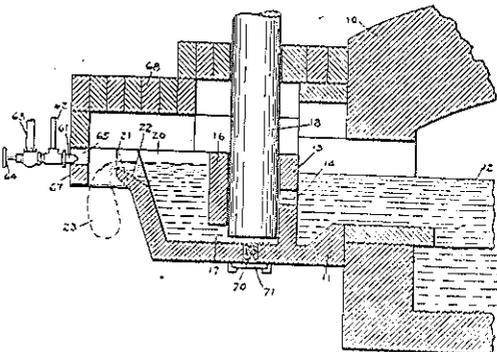


FIG. 108.

When the plunger is raised, the level of the glass in the chamber, 20, immediately falls and helps to sever the glass at the point, 21. This separation is assisted by a hot blast from the burner, 61, which not only facilitates the separation of the globule of glass, 23, but also cleans the lip by preventing the formation of threads of glass. The amount of glass forced over the lip can be varied by altering the length of the stroke of the plunger.

S. E.

168. Mould for Glassware. K. E. PEILER and W. A. LORENZ (Hartford Fairmont Co.) (U.S.A. Pat. No. 1331471, February 25th, 1920. Filed March 26th, 1915, No. 17181).—This invention relates to a sectional mould, the improvements enabling the mould to be opened or closed, locked or unlocked all by one hand of the operator, leaving his other hand free to remove the glassware.

Fig. 109 shows a plan view of an embodiment of the invention, showing the two halves of the mould in the open position. The mould sections 7 and 8 are hinged on a stud, 6, which is secured to the base plate, 5. The closing movements of the mould sections are controlled and made substantially equal by the links 22 and 23, which are connected to the mould sections by means of the studs, 25, and to the swinging arm, 10, by means of the stud 24.

The operating handle, 30, is hinged on a stud, 31, carried by a lug, 32, on either of the sections, in this case on section 7. This

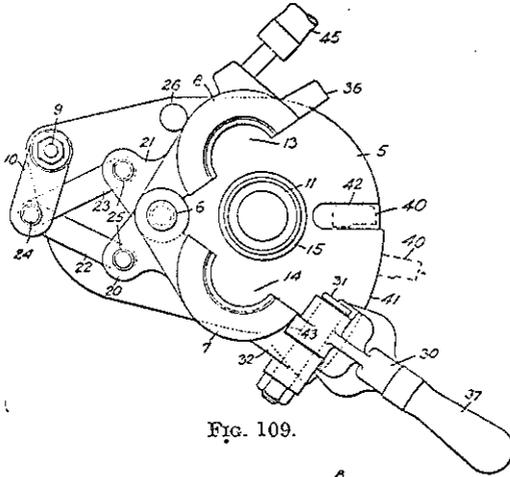


FIG. 109.

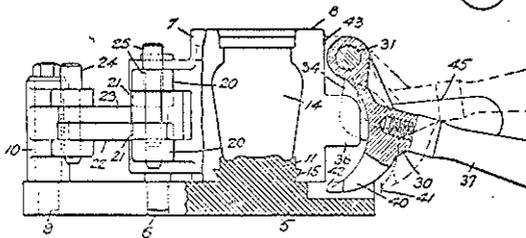


FIG. 110.

handle serves the double function of opening and closing the mould sections, and of clamping them together in the closed position. For its clamping function, the handle is provided with arms, 34, having bevelled inner faces, which engage the opposite outer sides of the lugs, 35 and 36, projecting from the mould sections. A suitable amount of end play of the handle on its hinge stud, 31, is allowed to permit the mould sections to centre themselves round the basepiece, 11, without any undue strain. Fig. 110 is a side elevation partly in section taken through the longitudinal centre of the apparatus when the sections are in their closed position. S. E.

169. **Cleaning off Machine.** A. A. KRIDER (U.S.A. Pat. No. 1329841, February 3rd, 1920. Filed November 30th, 1918, No. 264877).

— This machine consists of a double chain conveyor which carries used blowpipes along in front of and at right angles to a cleaning rotor, which has cutting blades for removing the unused glass from the ends of the irons.

In Fig. 111 *A* is a box adapted to receive broken off glass and has its base, 10, extended on one side, and this, in turn, carries the upright wall, 11. Between this wall, 11, and the side of the box

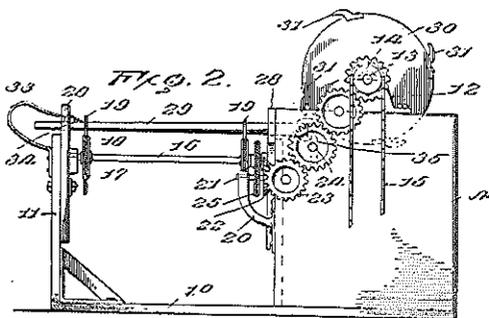


Fig. 111.

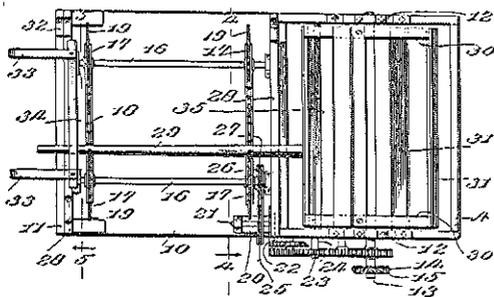


Fig. 112.

are two shafts, 16, carrying four gear-wheels, 17, over which pass two conveyor chains, 18, each chain being fitted at intervals with hooks for engaging with and carrying along the blowpipes, 29, which are placed across these conveyor chains.

Mounted above the box is a shaft, 13, which carries two discs, 30, to which are secured at intervals striker blades, 31. These blades, when in action, strike against the ends of the blowpipes supported on the chains, and remove any adhering glass.

Fitted to the wall, 11, is a retaining rail, 34, above the outer chain, which serves to prevent any upward swinging of the outer ends of the irons when they are struck by the blades, 31.

The conveyor chains are driven from the main shaft, 13, by a train of gear wheels and two bevelled gear wheels, 22 and 23.

S. E.

X.—Glassware Accessories.

170. Machine for Washing Bottles. A. J. PETERSEN
Dortmund, Germany (Brit. Pat. No. 133976, May 4th, 1918, No.
7533).—Relates to apparatus of the endless-chain conveyor type,

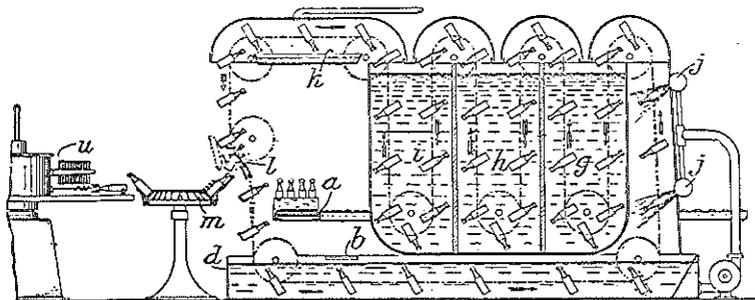


FIG. 113.

wherein the charging and the delivery of the bottles take place at the same end, the holders being opened and closed automatically. According to the invention, the charging is effected on one side of the conveyer and the delivery on the opposite side thereof. The dirty bottles are fed by a horizontal conveyer, *a* (Fig. 113), to a point where the operator at *b*

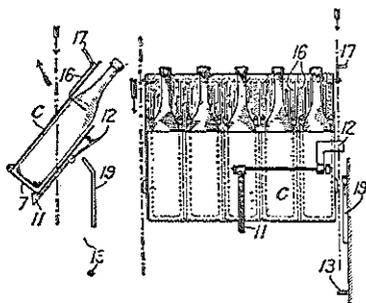


FIG. 114.

FIG. 115.

can place them base downwards in the holders. After passing through the tank, *d*, they are sprayed by jets, *j*, and then passed through rinsing-tanks, *g*, *h*, *i*, and over a draining tray, *k*, to an automatic releasing device at *l*, where they slide on to a conveyer, *m*, ready for being placed on to a brushing and syringing machine, *u*, on the side of the conveyer opposite to the charging point. The bottle-holders, *c* (Figs. 114 and 115), are furnished with spring-hinged bottoms, 7, which are held by latches, 11, the outer ends of which are formed with extensions, 12, moving in the path of a releasing stop, 13. Forked holders, 16, embracing the bottle necks, are freed by their ends, 17, coming into contact with a cam guide, 19. In a modified arrangement, the holders are emptied on the outer and filled on the inner side of the chains.

H. G. C.

I.—Glass-making Materials.

171. Points to be Regarded in Changing Supplies of Potash or Soda. L. SPRINGER (*Sprechsaal*, 1919, 52, 362).—Difficulties had frequently arisen in the glass industry through the substitution of one brand of soda or potash for another. The author discussed the source of and remedy for these irregularities.

A. *Potash*.—The chief sources of potash for the glass industry were: (i) From molasses, a by-product of the beet-sugar industry containing approximately 80—85 per cent. of K_2CO_3 , 7—15 per cent. of Na_2CO_3 , 4—7 per cent. of K_2SO_4 , and 3—4 per cent. of KCl. By further purification a 95 per cent. potash could be obtained from this, containing the other constituents in correspondingly smaller amounts.

(ii) Calcined mineral potash from the Stassfurth salt beds, containing 97—99 per cent. of K_2CO_3 , 0.05—1.25 per cent. of KCl, and traces only of other salts.

(iii) Hydrated or crystal potash, very pure and containing little chloride, but including 17.4 per cent. of water and only 80—83 per cent. of K_2CO_3 .

(iv) Occasional supplies from wood ashes, approximating in composition to (i).

The larger the amount of soda ash (Na_2CO_3) present, the more readily did the potash and glasses made from it melt, but such potash was unsuitable for the manufacture of pure potash glasses.

Alkaline chlorides were useless as sources of alkali, but had a beneficial effect on the plaining of the glass, as they volatilised at high temperatures.

Alkaline sulphates in small proportion were not deleterious, but if in excess gave rise to "glass gall."

Particular regard should be paid to the water content, as potash was very hygroscopic, and in ascertaining the moisture care should be taken to ensure that a representative sample was used. (The author mentioned a sample which showed 5.8 per cent. of moisture on the fine-sieved powder and 21.5 per cent. on the lumps in the same sample.)

The substitution of a high-grade potash (type ii) for a lower-grade one (type i) in the manufacture of a potash glass, such as Bohemian crystal, caused the glass to melt with greater difficulty, to plain more slowly, and frequently to contain a fine seed. The addition to the batch of 3 parts of common salt or 2 parts of salt-cake per 100 parts of sand caused the metal to plain readily, though pots with the same batch and in the same furnace, but without the addition of the salt, remained seedy.

Even with the addition of the salt the glass made from the higher grade potash took longer to found, and was harder than when the lower grade material was used. When the actual amount of K_2CO_3 in the lower grade material was calculated and the

amount of the higher grade potash in the batch reduced to correspond, with a simultaneous addition of soda-ash to make the composition of the batches the same, the results obtained were quite satisfactory.

If hydrated potash were used, an extra quantity should be added to introduce the same amount of K_2CO_3 , on account of the large moisture content.

Potash glasses entirely without soda could be made successfully, but a higher furnace temperature was required.

B. Soda.—Leblanc soda-ash, which frequently contained considerable amounts of chloride and sulphate, had now been superseded almost entirely by Solvay- or ammonia-soda, which was usually fairly pure and contained 97—99 per cent. of Na_2CO_3 , 0.3—2.0 per cent. of NaCl, and traces only of sulphate.

The chief difference in soda-ash samples consisted in the volume weight of the material, which might be either "light" or "heavy" soda.* Heavy soda was usually preferred, on account of its steadier melting in the furnace and less liability to excessive foaming, though both types were equally pure.

The moisture content of the soda-ash required control, particularly if kept long in storage. (The author quoted an instance of a sample of soda-ash containing 5 per cent. of moisture when delivered and 48.5 per cent. after lying in stock a considerable time.)

Soda-ash that had gone "lumpy" through storage required particular care in the ascertaining of the moisture content.

Some manufacturers made a brand of soda-ash containing 8—10 per cent. of salt-cake, and it was claimed that this gave good results in the glass industry, resulting in a glass that melted more readily and founded more rapidly than when pure alkali was used. The addition of a small quantity of salt-cake to a soda-ash batch was recommended, but if an excess was added it gave rise to difficulties with "glass gall."

In the production of a carbon amber, particular care was necessary to ensure that the batch contained a constant quantity of salt-cake. If the soda-ash used contained more sulphate than that previously in use, a much deeper amber tint would be obtained, and to ensure a constant colour either some salt-cake should be removed from the batch or the amount of added carbon be reduced.

J. H. D.

172. Potassium Nitrate from the Chilean Nitrate Industry.
P. F. HOLSTEIN (*J. Ind. Eng. Chem.*, 1920, 12, 290).—This paper presented some of the main facts of the situation and briefly described the means actually at hand by which potash might be recovered. The author stated that even should the price of potash drop to the pre-war level, a substantial profit would still remain to the nitrate manufacturers.

The potash nitrate was separated from the mother liquor result-

* This JOURNAL, 1917, 1, 44.

ing from the treatment of the "caliche," or crude nitrate ore. The composition of the hot concentrated liquor that was run from the boiling tanks to the crystallising pans varied, and many other salts, such as sulphates, borates, iodates, perchlorates, etc., might be in solution. For ores containing a fairly high percentage of potash (5 per cent. calculated as potassium nitrate) fractional crystallisation would give a commercially profitable potassium nitrate at an insignificant cost above that of the regular nitrate. When the liquor had reached the proper temperature in the crystallising pans it was transferred to other pans, where it cooled to air temperature, this second deposit being the high potash nitrate.

A solution containing a higher percentage of potassium nitrate might be obtained by evaporation of the mother liquor. In this case, care should be taken to regulate the time of standing in the crystallising pans, otherwise the nitrate would be rather high in sulphate and magnesium, and consequently in moisture.

Refrigeration of the mother liquor had yielded good results on some plants. The process was based upon the fact that the mother liquor was saturated with potassium nitrate at the temperature of the air, and that at lower temperatures the solubility of potassium nitrate decreased more rapidly than the solubility of sodium nitrate. By adding a small quantity of water to the mother liquor before refrigeration, a nitrate much higher in potash resulted in a single operation. A great economy was thus involved should the nitrate be subsequently refined.

Refrigeration would produce a higher grade nitrate at a much lower cost than evaporation, but if properly carried out evaporation had the advantage that the water removed from the system might be used as an additional wash water for washing the tailings in the boiling tanks, thus increasing the recovery of sodium nitrate.

C. M. M.

173. Solidification Points of Mixtures of Metallic Chlorides. Part I. Mixtures of Sodium, Potassium, and Calcium Chlorides. FRED C. A. H. LANTSBERRY and R. A. PAGE (*J. Soc. Chem. Ind.*, 1920, **39**, 37T).—*NaCl-KCl Series.*—These two components apparently formed a continuous series of solid solutions, for none of the cooling curves showed any arrest point after solidification was complete, which indicated the absence of a eutectic. The lowest melting mixture contained 55 per cent. of KCl and 45 per cent. of NaCl, and solidified at 650°.

CaCl₂-NaCl Series.—Again, no eutectic point was observed in any melt, hence it would appear that these two components formed a continuous series of solid solutions. It was found that when sodium chloride was added to calcium chloride, the freezing point was lowered considerably. The lowest melting mixture contained 72.5 per cent. of CaCl₂ and 27.5 per cent. of NaCl, and gave a freezing point of 505°.

CaCl₂-KCl Series.—This series proved quite different from the

two previous systems. Two eutectic points were most marked, while the liquidus reached a maximum at 725° , the mixture then containing about 70 per cent. of CaCl_2 . This corresponded to the formation of a double compound, $2\text{KCl}\cdot 3\text{CaCl}_2$.

The CaCl_2 compound eutectic melted at 608° and contained 17.5 per cent. of KCl , while the KCl compound eutectic had a melting point of 590° and contained 60 per cent. of KCl .

Ternary Series, KCl - NaCl - CaCl_2 .—In this system two ternary eutectics were formed, one containing 70 per cent. of CaCl_2 , 25 per cent. of NaCl , and 5 per cent. of KCl , and the other consisting of 30 per cent. of CaCl_2 , 20 per cent. of NaCl , and 50 per cent. of KCl . The former, which was the lowest freezing mixture of the whole series, began to freeze at 495° , while the latter mixture began to freeze at 530° .

The paper contained many interesting and instructive tables and diagrams. C. M. M.

II.—Glass: Manufacture and Properties.

174. Laminated Glass. M. W. GLEASON (Assignor to Gleason Tiebout Glass Co., New York) (U.S.A. Pat., June 1st, 1920, No. 1342282. Filed June 10th, 1919).—This invention relates to the formation of laminated glass, the various laminations being

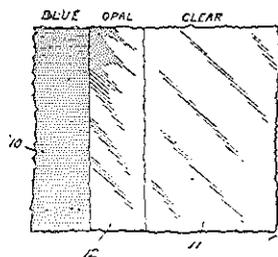


Fig. 116.

so chosen that when the compound glass is used as an electric lamp globe, it produces a light very similar to natural daylight. In Fig. 116, which is an enlarged section of such a compound glass, the innermost layer, 10, is relatively thin and of a distinct tint, such as blue, though being so thin and its colour relatively mild, it does not materially alter the appearance of the whole glass, but merely modifies the light passing through it. The intermediate layer, 12, which is approximately of the same thickness as the layer 10, is a white opal glass. The outermost layer, 11, is clear and colourless, and is materially thicker than the other two. The molten glass from which the several laminæ are formed is assembled by the blower dipping his pipe first into the blue, then into the opal, and lastly into the clear glass. S. E.

175. Reinforced Glass and a Process for Making It. LÉON F. MASCART (France) (Assignor to Société du Verre Triplex, Paris, France) (U.S.A. Pat., June 1st, 1920, No. 1342267. Filed March 21st, 1914).—In the manufacture of non-shatterable

glass by means of a core of celluloid, it was of importance to be able to use naturally hard or hardened gelatine to glue the sheets together.

In order to carry out this invention, two sheets of glass were each covered with a layer of gelatine in the ordinary way, and then a solution of nitrocellulose or celluloid was spread evenly over them and allowed to dry. The layer of celluloid thus obtained adhered strongly to the gelatine, but to ensure satisfactory adhesion in every case, it was necessary to add to the celluloid solution a small proportion of various substances which were solvents for both gelatine and celluloid, for example, acetic acid and formamide. For completing the manufacture, these prepared sheets were dipped into alcohol (90 per cent.), and after being exposed to a temperature of 60—70° were pressed against one another, or on to a sheet of celluloid or other cellulose ester which had been inserted between them. The process might be shortened by dipping the sheets of glass covered with gelatine films into alcohol containing one of the common solvents for gelatine and celluloid. It was then sufficient to press the sheets of glass against a core of celluloid inserted between them, the temperature conditions above referred to being observed.

Another improvement which contributed to the increased adhesive power of a celluloid sheet to a gelatine film consisted in mechanically or chemically treating the celluloid sheet. (See Abs. No. 176.)
S. E.

176. Manufacture of Reinforced Glass. LÉON F. MASCART (France) (Assignor to Société du Verre Triplex, Paris, France) (U.S.A. Pat., June 1st, 1920, No. 1342268. Original application filed March 21st, 1914, No. 826/411. Divided and this application filed September 12th, 1918).—The adhesion of a sheet of celluloid to a layer of hardened gelatine or a sheet of glass might be strengthened by slightly roughening the surface of the celluloid. This might be done by a sand blast or by treatment with a reducing agent, for example, an alkaline sulphide or any of the agents for denitrating nitrocellulose. The celluloid with its surface thus treated adhered to a sheet of gelatine if the two sheets were dipped into alcohol and pressed against one another while warm. The same results might be obtained by dipping a treated sheet of celluloid into a hot solution of gelatine and letting the gelatine dry on it. The compound sheet might then be dipped into alcohol and pressed between two sheets of glass, either uncoated or coated with gelatine.
S. E.

177. Making "Safety" Sheet Glass. C. SHUMAN and V. SHUMAN (Assignors to the Super-Glass Co.) (U.S.A. Pat., December 9th, 1919, No. 1324361. Filed April 20th, 1916, No. 92355).—The invention related to the manufacture of reinforced or splinterless glass in which a sheet of celluloid was secured

between two thin sheets of glass, thus forming a compound sheet which did not splinter when cracked.

The process, which was designed to avoid the use of cements or solvents for securing the sheets, consisted in assembling two sheets of glass (with or without dry coatings of celluloid) on each side of a sheet of celluloid, subjecting the assembled sheets to pressure, then raising the temperature of the sheets to about 230° F. to soften the celluloid, next applying a higher pressure, and after maintaining the heat and pressure for predetermined time, finally lowering the temperature and releasing the pressure.

Apparatus for carrying out the process was described in detail and illustrated in the specification. G. D.

178. The Character of Plate Glass Surfaces. I. MAKAZAWA and others (*J. Tokyo Chem. Soc.*, 1920, **40**, 422, 521).—The authors investigated the cause of the well-known "cloudy patches" which are frequently present on the surface of mirrors. Photomicrographs of these patches were obtained, and revealed a microscopic network, which also characterised those portions of plain plate glass which afterwards produced cloudiness in mirrors. This network was only visible in reflected light, though bright particles on a dark field could be observed when the glass was viewed obliquely by transmitted light. These bright spots were not due to dust or moisture, because they were present below as well as on the surface. The better the glass the more minute were the particles, and their size depended on the rate of annealing. This led the authors to suppose that they were granules formed at the time of solidification, and were of a crystalline nature.

J. R. C.

179. The Selection of Glass for the Manufacture of Ampullæ. G. E. EWE (*J. Franklin Inst.*, 1920, **189**, 649).—The results were given of tests made on various types of glass tubing intended for the manufacture of ampullæ. The tubing should not yield alkali or spicules of glass during the process of sterilisation of pharmaceutical preparations. Neither a 1 per cent. solution of morphine sulphate nor a normal saline solution containing 0.2 per cent. of strychnine sulphate should become turbid when sterilised in ampullæ which had been thoroughly washed before use in dilute hydrochloric acid and water. The sterilisation of a 0.6 per cent. solution of sodium chloride should not produce any spicules of glass from the ampullæ used. F. W. H.

180. A Practical Test for the Resistance of Optical Glass to Weathering. F. R. VON BICHOWSKY (*J. Amer. Cer. Soc.*, 1920, **3**, 296).—The author attempted to obtain a quick and trustworthy series of tests which would be varied enough to ensure that no possible fault in the glass as regards resistance towards climatic conditions could be overlooked.

Spotting with 1 per cent. acetic acid solution and allowing the acid to evaporate was not a sufficiently sensitive test, whilst exposure to 1 per cent. acetic acid or glucose solutions gave ambiguous results; in any case, these tests occupied too much time.

The glass tested was obtained in the form of pressed or polished plates from 1 to 2 cm. in thickness. The first test recommended was a very slightly modified form of Mylius's iodeosin test. Three solutions were needed, and details of these were given, and also a detailed description of the method used. The amount of dye remaining on the fresh surface of the glass was estimated by dissolving it in a little water and comparing the colour with a standard made by using a solution containing 0.01 milligram of free iodeosin per cubic centimetre. The number of cubic centimetres of the standard solution needed to match the test colour multiplied by 100 and divided by the area, in square centimetres, of the surface tested, gave the number of milligrams of adsorbed iodeosin per square metre. The author termed this value the surface alkalinity constant of the particular glass. On the basis of this constant glasses could be grouped in five classes, as, for example:—

Class.		Milligrams per square metre.	Example.
1	Totally insoluble glasses	0—5	“ Quartz glass ” (fused silica).
2	Resistance glass.....	5—10	Jena Geräte (chemical). Pyrex.
3	Hard glass	10—20	Flints, best crowns.
4	Soft glass	20—40	Ordinary crowns.
5	Poor glasses	over 40	—

Glasses high in lead, though very slightly soluble in water, gave high values in this test, possibly owing to the formation of a lead salt of iodeosin. Certain glasses containing barium and zinc gave low values, though they were highly soluble in acid. Hence the results of the surface alkali tests should always be considered, together with those of other tests.

For determining the rate of solubility of the glass in various agents several methods were tried and discarded. Finally, the glass was heated with the solutions in bomb tubes, and the surface appearances noted when wet and dry. The solutions used were water, 5 per cent. caustic soda, and 1:1 hydrochloric acid, no advantage being obtained by the use of other solutions. Half-inch cubes of glass were used and compared with a standard glass. For the water and alkali tests steel bombs were used, and for acid sealed tubes of Jena combustion glass. The tests in water and alkali were made at 225°, for four hours in the case of the former and two hours for the latter. The acid tests were made at 175° for six hours. The loss of weight of the cubes was also determined, but, owing to spalling and chipping, the loss in weight was

scarcely as trustworthy as the appearance. The author graded the glasses as follows:—

Grade.	Appearance wet.	Appearance dry.
9	Thick slushy film.	Film more than 1.5 mm. thick.
8	Thick film.	Flakes off when dry.
7	Deep etching in scratches and corners.	Thin film, flakes off.
6	Deep etching in scratches and corners.	Thin film, does not flake off.
5	Opalescent film.	Deeply etched.
4	Opalescent film.	Not etched.
3	Film.	Film.
2	Clear.	Film.
1	Clear.	Clear.

Typical results were tabulated as under:—

Glass.	Surface alkalinity constant.	Solubility in water. $\frac{1}{2}$ Milligrams per centimetre cube.	Grade by appearance.		
			H ₂ O.	NaOH.	HCl.
<i>B.L.</i> 100	44	130	6	7	2
<i>B.L.</i> 500	15	57	5	8	3
<i>B.L.</i> 3000	13	39	4	3	1
<i>B.L.</i> 3700	16	170?	1	2	1
<i>B.L.</i> 700	25	54 70	2	4	9
<i>P.P.G.</i> A.	24	420?	2	8	1
<i>P.P.G.</i> C.	33	86	4	2	2
<i>P.P.G.</i> E.	50	140	5	9	3
<i>P.P.G.</i> B.	13	51	3	5	1
Microscope flint .	39	—	1	2	1

Glass *B.L.* 700 lost one-tenth of its weight in boiling 1:1 hydrochloric acid in seventy-two hours, and in the six hours' test crystals of barium chloride separated out; otherwise it appeared to be a fairly good glass. Where all the tests indicated a poor glass, the author considered it likely that it would be unsatisfactory under actual weather conditions. Glasses giving results leading to different conclusions should be considered with suspicion until field data had been obtained.

In discussion, G. W. Morey considered that caution was necessary in considering tests made under such severe conditions as those indicated. Glass *B.L.* 700, for example, was found to give fair satisfaction in actual use, yet by one particular test it appeared very inferior. Tests were required to show the effect of changes of batch composition on a given glass, not merely the difference between various types of glasses, and if the method were long it

would be worth while if the results were trustworthy. The effect of polishing on weathering as compared with that of a freshly-broken surface was also a question for investigation. F. W. H.

181. Note on the Mechanics of the "Weathering" of Glass. F. R. VON BICHOWSKY (*J. Amer. Cer. Soc.*, 1920, 3, 309).—The author advanced a theory of the mechanism of the action of water on glass. It appeared to progress through six stages. The true adsorption of water on the surface was followed by the diffusion of the adsorbed water into the body of the glass. This water then reacted with the glass and formed a surface film, which in turn soaked up water and induced further reaction. The soluble salts from the surface film, alkaline carbonates, and hydroxides formed a strongly alkaline solution which dissolved the silica skeleton film.

The heating of a glass which had merely adsorbed water on the surface resulted in a loss of weight corresponding to the amount of water adsorbed, but the surface of the glass remained unchanged. Glass at the second stage, when heated, showed a fine pattern of cracks, larger isolated cracks, and splinters. At the third stage signs of chemical change were usually present, such as a translucent skin, but no chemical change was observable in the first two cases. The skin, when dehydrated, became opalescent and chipped off. Varying results were, of course, obtained, depending on the composition, hardness, density, and tensile strength of the glass, and also on the length of time and rate of heating.

F. W. H.

182. Twenty-three Types of Optical Glass. R. J. MONTGOMERY (*J. Amer. Cer. Soc.*, 1920, 3, 404).—The author gave a general survey of the ordinary types of optical glass. Combining published information and practical experience, there were certain points emphasised. By plotting the figures for the dispersion and refractive index, the former along the horizontal axis, the glasses were found to fall into natural groups. They could be divided into twenty-three ordinary types according to composition, each type representing a group of glasses similar in optical properties, composition, and method of manufacture. The twenty-three types were as follows, numbers 2, 5, 7, 11, 12, 13, 14, 16, 19, 20, 21, and 22 being manufactured successfully on a commercial scale in America:—

- | | |
|-------------------------------------|---------------------------|
| 1. Borosilicate crown. | 13. Baryta light flint. |
| 2. Borosilicate crown, high n_D . | 14. Baryta flint. |
| 3. Crown of low n_D . | 15. Dense baryta flint. |
| 4. Light silicate crown. | 16. Telescope flint. |
| 5. Ordinary crown. | 17. Extra light flint. |
| 6. Telescope crown. | 18. Borosilicate flint. |
| 7. Ordinary crown, low n_D . | 19. Ordinary light flint. |
| 8. Soft silicate crown. | 20. Ordinary flint. |
| 9. Zinc silicate crown. | 21. Dense flint. |
| 10. Barium silicate crown. | 22. Extra dense flint. |
| 11. Dense barium crown. | 23. Densest silica flint. |
| 12. Densest barium crown. | |

The glasses 16 to 23 showed the effect on the refractive index and dispersion of the increase of the lead content from 10 per cent. to 80 per cent., the refractive index varying from about 1.53 to 1.8, with a possible extension to 1.96, and the dispersion from about 57 to 33, with a possible extension to 19.7. Other lead-containing glasses, also containing barium and zinc, were illustrated by the dense baryta flint with about 10 per cent. of barium and 5 per cent. of zinc, the baryta flint and the baryta light flint containing 15 per cent. of barium and 10 per cent. of zinc. Glasses with lower refractive index were the borosilicate flint and an extra light flint where boric acid was used in place of barium. The telescope flint contained the smallest percentage of lead.

Of the glasses containing no lead, the first noted was the barium silicate crown with about 20 per cent. of barium, 10 per cent. of zinc, and 2 to 3 per cent. of boric oxide. The barium and boric oxide increased as the index increased from 1.54 to 1.61 through the dense barium crown to the densest barium crown containing about 40 per cent. of barium and 10 to 15 per cent. of boric oxide. The zinc decreased slightly with the high index values. Alumina, even up to 8 per cent., was often used in the densest barium glasses. The highest percentage of zinc was found in the baryta light flint and dense barium crown, reaching as high as 15 per cent. As the dispersion increased the percentage of zinc decreased, and was used in the zinc silicate and, to a small extent, about 2 per cent., in the soft silicate crown and ordinary crown with low index.

Soda-lime glasses were represented by the ordinary crowns, numbers 5 and 7, and the telescope crown, which also contained boric oxide and some barium.

Glasses containing boric oxide in larger amounts were the light silicate crown containing from 5 to 10 per cent., the borosilicate crown (No. 2), with about 10 per cent. and a rather high alkali, and the borosilicate crown (No. 1), with from 10 to 15 per cent., and which might also contain from 2 to 4 per cent. of barium or alumina.

For the development of new glasses the composition could be roughly determined by interpolation between known points in the particular field, as indicated in the plotted diagram previously mentioned. The diagram given included fields occupied by types of glasses with an index of from 1.45 to 1.8 and dispersion value of from 20 to 70. Borate and phosphate glasses, not containing silica, were not considered.

F. W. H.

183. Optical Glass. W. ROSENHAIN (*Phot. J.*, 1911, 51, 393).—Optical glass must be homogeneous, free from strain and colour, contain no "seed" or "stone," and show no sign of devitrification. Its hardness, durability, index of refraction, and dispersion must satisfy definite requirements according to its use.

In order to promote homogeneity, Guinand used a stirrer of the same fireclay as the melting pot, and this process was still

employed. Striae in glass could be detected as light or dark lines when examining the specimen in parallel light between two lenses.

Schott and Abbe's process of fine annealing, which retarded the rate of cooling from between 400° and 200° to $8-10^{\circ}$ in twenty-four hours, eliminated strain from the glass.

Freedom from colour was obtained by the use of pure materials, not by the use of decolorisers, and no colour should be perceptible in a thickness of 12 inches. Flint glasses showed a yellow colour due to the lead content, but this was essential for the high refracting power of the glass, according to the Drude theory of refraction and dispersion.

Bubbles were likely to occur in optical glass, as the chemical composition was bound within narrow limits.

Usually, n_D , the index of refraction for sodium light and the "mean dispersion," that is, the difference between the indices of refraction, n_C and n_F , for the red and green lines of the hydrogen spectrum, were the only optical constants measured, but in some cases partial and relative partial dispersions were determined.

Abbe and Schott showed that the increase in dispersive power with refractive index, as is the case with ordinary flint and crown glasses, did not hold if boric oxide and barium oxide were also constituents of a glass.

The constants of minerals lay between much wider limits than those of optical glass; for instance, diamond had an index of refraction greater than 2, whereas the refractive index of optical glass lay between 1.56 and 1.7. Also, v varied from 67—30 for glass, but for fluorite the value was 95. Hence minerals might replace optical glass as it was now produced. V. D.

184. Glass for X-Ray Tubes (*Times Eng. Suppl.*, December 27th, 1911).—A lithium glass was found to be about twice as transparent as soda glass to photographically active X-rays, and by using tubes provided with a lithium glass "window" 2 inches in diameter, the exposure necessary for radiographic work was reduced by half. V. D.

185. The Choice of Glass Batches containing Lime. W. E. S. TURNER (*J. Amer. Cer. Soc.*, 1920, 3, 379).—Dealing with the types of bottle batches containing sand, lime, and alkali, the author stated that batches with a high lime content, since the glass produced set quickly, were highly suitable for hand-working and for certain semi-automatic machines. For the modern, highly productive machines, a batch the composition of which might lie between 1000 sand, 412 soda ash, 166 limespar, and 1000 sand, 353 soda ash, 222 limespar, was generally found suitable, since a quick setting glass would render working difficult or even impossible when it came into contact with a mass of iron-work. Also, high lime glasses had a considerable tendency to devitrify, and would be liable to choke automatic-feeding devices. The glass with the lower lime content melted more quickly and was softer, rendering pressing and blowing easier and quicker.

Bottles and jars made from such glass could be left outside the lehr much longer than those made from a high lime glass, and hence were more suitable for automatic conveyors. The low lime glass was annealed at a lower temperature than the high lime glass, and therefore more quickly; it had a higher coefficient of expansion and a lower conductivity for heat. The higher conductivity of the high lime glass caused it to cool rapidly, and strains might be set up owing to the temperature of the articles falling below the annealing temperature before reaching the lehr. By preventing the entrance of draughts in the lehr, the possible trouble due to the higher coefficient of expansion of the low lime glass might be avoided.

As the lime content of the glass decreased so did the durability. The percentage of lime in the glass should not be less than about 7.5.

F. W. H.

186. The Solubility of Boric Acid Frits. G. BLUMENTHAL (*J. Amer. Cer. Soc.*, 1920, **3**, 152).—A number of commercial frits of unknown composition produced by sagger or furnace methods of melting were tested. Five grams of each, ground so as to pass a 20-mesh sieve but to be retained by one of 40-mesh, were placed in a glass cylinder with 350 c.c. of distilled water at room temperature and shaken for twenty-four hours in a shaking machine giving 17 revs. per min. Colloidal silicic acid separated out, and the water became more or less turbid after three or four hours. At the end of the shaking period the colloidal silicic acid was separated, dried at 110°, and weighed; the dissolved matter in 50 c.c. of the water was also determined, and the undissolved frit dried and weighed as a check on the amount of that dissolved. Blank estimations were run on the glass cylinders alone. The results were given as follows:

Kind of No. frit.	Appearance of frit.	Colloidal silicic acid. Per cent.	Portion of frit soluble in water. Per cent.	Appearance of solution after shaking.
1. Frit kiln	Glassy and clean ...	2.2	0.3	Clear; little silicic acid.
2. Sagger	Not thoroughly melted	5.1	1.7	Quite cloudy.
3. Frit kiln	Glassy and well fused	2.5	0.2	Cloudy.
4. Sagger	Poorly fused ...	27.2	24.6	Very cloudy; frit slaked.
5. Sagger	Slightly opaque, clean ...	2.2	1.9	Quite clear.
6. Sagger	Glassy, contained undissolved flint...	4.6	1.8	Cloudy.
7. Sagger	Glassy and clean ...	2.2	1.1	Clear.
8. Sagger	Well fused, hard, of smoky appearance	2.2	8.0	Clear.
9. Frit kiln	Glassy, undissolved flint.....	2.2	0.5	Clear.

The results showed that all the frits were soluble in water to some extent, but furnace-melted frits were apparently the least soluble, probably owing to more complete fusion and greater homo-

geneity. Considered theoretically, there was no objection to a high boric acid content when the type of composition tended to produce insoluble borosilicates, of which "Pyrex" glass was an ideal example.

F. W. H.

187. The Viscosity of Molten Borate Glasses. H. F. STALEY (*Eighth Int. Cong. Appl. Chem.*, 1912, Sect. III, C, Orig. Comm., 5, 127).—The relative viscosities of the molten glasses were measured by determining the time taken for an immersed body of definite weight and volume to fall through a known distance. The viscosity decreased at a decreasing rate with increase in temperature, and the rate was peculiar to the glass. Although the viscosities might vary considerably at a low temperature, the rates varied so much that at high temperatures the values converged towards what might be regarded as a minimum. Any mixture of boric oxide with the bases baryta, lime, or strontia had a lower viscosity, at any temperature, than the boric oxide alone. The homogeneous magnesia product of composition $0.5\text{MgO}, 1\text{B}_2\text{O}_3$ could not be obtained. In a series of boric oxide and baryta mixtures the viscosity decreased continuously with an increase in baryta, but was not proportional to the percentage molecular amount of baryta present up to the mixture $0.5\text{BaO}, 1\text{B}_2\text{O}_3$, and from this up to $2\text{BaO}, 1\text{B}_2\text{O}_3$ the decrease in viscosity was nearly proportional to baryta content. Volatilisation of boric oxide during melting took place only with mixtures containing less than 0.5 of the formula weight of the base to 1 of B_2O_3 .

There was no relation between melting-point curves and the lines representing temperatures of equal viscosity for a series of borates. These lines were straight and roughly parallel for mixtures containing more than 0.5BaO to $1\text{B}_2\text{O}_3$, and parallel and parabolic when the baryta was less than 0.5. The viscosities of mixtures of boric oxide and $0.5\text{BaO}, \text{B}_2\text{O}_3$ were below the added values of the viscosities of the constituents of the mixture; hence it might be assumed that dissociation took place to a considerable extent in one, or perhaps in both end-members of the series, and that boric oxide was a polymerised substance broken down into simpler molecules in the presence of the base.

V. D.

188. Watch Glass Manufacture. (*Sprechaal*, 1919, 52, 277).—The author maintained that it was an easy matter for any glass manufacturer making crystal or half-crystal glass to take up the production of watch glasses as a special branch, no great expense for plant being necessary and no special training required by the glass-blower.

As suitable batches for such a purpose, the following were suggested:—

	I.	II.
Sand	100	100
Soda	10	8
Potash	25	26
Limespar	20	15
Barium carbonate.....	20	—
Red lead	—	14

The working method was simple. A spherical bulb of glass was blown, the size of the bulb depending upon the thickness and curvature of the glasses required. After cooling, these spheres were cut up into suitably sized sections by means of a diamond-cutter and a three-cornered file, and from these sections the individual glasses were cut out with a diamond-compass or other suitable cutting arrangement.

The edges of the glasses were smoothed and bevelled to the desired degree by means of a grinding-stone, and the glasses then sorted according to their diameter, thickness, and curvature.

J. H. D.

189. Glass for Transmission of Ultra-violet Rays Only.

H. P. GAGE and W. C. TAYLOR (Brit. Pat., November 20th, 1919, No. 127586. Convention date, May 28th, 1918. Application date in U.K., May 28th, 1919, No. 13508).—This relates to a glass, made by the Corning, U.S.A., Glass Works, which has a high transmission factor for the ultra-violet rays while absorbing visible light. The patent covers the use of nickel oxide in proportions varying from 0.5 to 12 per cent. of the whole batch. If certain oxides are present in substantial proportions the desired results are not obtained to the fullest extent. These oxides are lime, magnesia, lead oxide, alumina, and boric oxide. Typical batches protected by the patent are as follows:—

	Per cent.	Per cent.	Per cent.	Per cent.
SiO ₂	48	54.1	51	57.4
K ₂ O	15.3	17.4	—	—
Na ₂ O	—	—	10.6	12.1
BaO	24.7	28.0	26.4	30.0
NiO	12.0	0.5	12.0	0.5
SiO ₂	53.0	60.0	60.0	68.0
K ₂ O	20.0	22.5	—	—
Na ₂ O	—	—	13.8	15.5
ZnO	15.0	17.0	14.2	16.0
NiO	12.0	0.5	12.0	0.5

A small amount of red radiation is transmitted by glasses coloured with nickel, and the best batch composition for the purpose required is stated to be:—

SiO ₂	50.0 per cent.	BaO	25.0 per cent.
K ₂ O	16.0 „	NiO	9.0 „

One or two per cent. (preferably the former) of cupric oxide added to this batch will cut out the red, but will also decrease the transmission in the blue.

J. R. C.

190. A Colloidal Method for Increasing the Volume of Adhesive Water-glass. J. D. MALCOLMSON (*J. Ind. Eng. Chem.*, 1920, 12, 174).—The author stated that the desirable properties of water-glass for use as an adhesive were, in general, a function of the viscosity, and he described a method of increasing, to the extent of 25 per cent., the volume of adhesive water-glass by the addition

of urine without impairing the viscosity and other desirable properties of the adhesive. This method involved the practical application of certain phenomena of colloid chemistry, such as coagulation and peptisation.

C. M. M.

III.—Lamp-worked and General Scientific Apparatus.

191. **A Manometer for Vacuum Distillation.** H. T. CLARKE (*J. Amer. Chem. Soc.*, 1920, 42, 786).—The author advocated the use of a hook-shaped trap (Fig. 117) to prevent access of air or moisture to the vacuous space owing to movements of the mercury during changes of pressure, and also to prevent the breaking of the sealed end of the tube by the impact of mercury when air was suddenly admitted into the apparatus. The trap prevented access of air to the vacuous space, and if the hook was made of capillary sufficiently fine the movement of the mercury was retarded.

F. W. H.

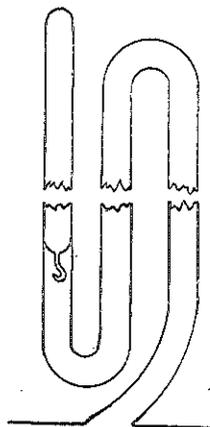


FIG. 117.

192. **A Valve for Glass Apparatus.** K. BUNGE (*Chem. Zeitung*, 1920, 44, 299).—A valve which could be used on burettes or on pipettes to prevent the entry of liquid into the operator's mouth was described. A glass tube, melted solid at one point, had on either side of the solid portion two small holes, the distance between the holes being not more than 1 centimetre. Over the valve was a piece of rubber tubing, and the valve could be operated by gentle pressure of thumb and finger. To mark the position of the valve a piece of coloured glass was used.

F. W. H.

193. **A Compensation Thermometer.** H. F. WIEBE (*Zeitsch. Instrumentenkunde*, 1910, 30, 245).—The author described a device to compensate for the change in the zero point of mercury thermometers. The thermometer was made of glass having a small thermal after-effect, a piece of glass having a large after-effect being placed in the bulb. The size of this piece, in order that the change may be eliminated, was calculated from the values of the after-effect in the two glasses. Thermometers so prepared were tested after many years and found to be satisfactory.

J. R. C.

194. **The Corrections for Enclosed Thermometers with Expansions in the Capillary.** W. MEISSNER (*Zeitsch. Instrumentenkunde*, 1909, 29, 93).—Six corrections were theoretically

obtained, namely, (1) the correction when the thermometer was made of mercury and only one kind of glass; (2) the correction for different expansions of the bulb and the capillary; (3) for different expansions of scale and capillary; (4) for the scale being fixed at a point other than the zero; (5) the correction for the parts of the capillary which are widened; (6) correction for the error of the zero. The total correction was evaluated for thermometers made of glasses 59^{III} and 16^{III}.
J. R. C.

195. Making Thermometers. F. J. BERBERICH (U.S.A. Pat., February 12th, 1918, No. 1255979. Filed June 26th, 1917, No. 176953).—The invention consisted of a process of making insulated thermometers, shown in Fig. 119, in which the mercury was contained in a capillary tube, *a*, protected by an outer tube, the graduations being marked on a strip of paper or opal glass, which is inserted in the outer tube.

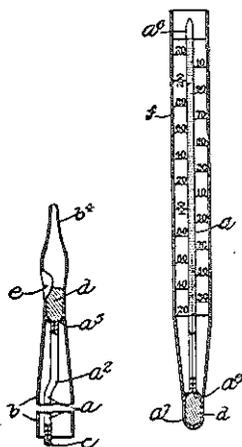


FIG. 118. FIG. 119.

In the first part of the process, a small bulb, *a*¹ (Fig. 120), was blown on the end of the capillary tube, *a*, and an offset bend, *a*², was formed near the bulb. The tube, *a*, was then inserted in the outer tube, *b*, as shown, which was constricted at *b*², and drawn to a tapered point, *b*⁴, the bulb, *a*¹, fitting snugly into the constriction, *b*². The tubes were then heated at this point, and the bulb, *a*¹, was burst, by blowing into the tube, *a*, so that it formed an open cylinder, *a*³ (Fig. 121), which united with the walls of the tube, *b*, as shown. The open end of the tube, *a*, was closed temporarily, and a measured quantity of mercury, *d* (Fig. 118), poured into the part, *a*⁵. A mark, *e*, was made

on the outer tube to determine the point at which the bulb was

FIG. 120.

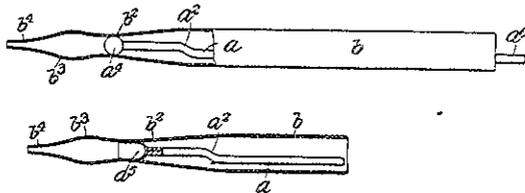


FIG. 121.

to be closed. The mercury was then poured out and the tubes formed into the complete bulb, *a*¹ (Fig. 119). The final operation of filling the bulb and tube, *a*, with mercury was conducted in the usual manner.
G. D.

IV.—Decorated Glass.

196. Modern Art in the Glass Industry. O. PARKERT (*Diamant*, 1918, 40, 16, 44).—The decoration of glass, according to the author, was undergoing a change similar to that taking place in all branches of art. The author made the same claims for the new generation of glass artists as were made for the modernist painters on canvas; he claimed for them originality instead of “uninspired imitation and continued copying.” He believed that the modern glass decorators concerned themselves primarily with representing the spirit of that which they sought to portray and considered that, because of their originality and of the animation manifest in their designs, technical shortcomings could be overlooked. He was of the opinion that we were at present in a transition period comparable to that when the introduction of three-colour decoration of glass, by films of different coloured glasses on the article to be decorated, one or more of which films being removed to produce the desired design, was revolutionising glass window decoration, leading to the disappearance of the lead work in “stained glass” windows. The introduction of this process gave rise to the hand decoration of vases and similar articles by craftsmen who, proud of their skill, produced beautiful work. The impetus which the introduction of this process gave to glass decoration had, in the author’s opinion, vanished, but the new spirit in art would effect as great an improvement in decoration as did that event.

J. R. C.

197. Articles with Painting between Glass Walls. F. HURN (*Diamant*, 1918, 40, 100).—Two methods were described for producing hollow glassware with the painting embedded in the glass. In the first, the hollow article was blown, the decoration painted inside it, and then a layer of glass was blown inside, using the outer glass article as a mould. Hitherto the painting had been done with easily fusible coloured glass ground fine and mixed with turpentine or lavender oil. This was dried, and when the inside covering of hot glass came into contact with it, it melted and was “burnt in” between the two colourless glasses. This had the disadvantage that, when the inner glass had to be very hot to be workable, contact with the easily-fused glass paint sometimes caused the colours to run, spoiling the painting. A German patent had been granted for the employment of coloured oxides which have a melting point approximately the same as that of the superposed glass. This prevented premature melting of the paint, and the colours did not run. By suitably choosing the coloured oxide this mode of decoration could be used with glass of any composition, whereas hitherto it had practically been confined to lead glasses.

In the second method the decoration was painted on the outside of the first hollow article while it was still on the pipe. The painted glass was then dried, warmed, and dipped into molten

glass, and by skilful blowing the whole was enlarged, care being taken that the painting was not distorted. In this method, of course, the easily-fused glass painters' flux could not be employed.

J. R. C.

198. The Firing of Painted Glass. F. HUTH (*Diamant*, 1918, 40, 43, 57).—Every mixture used for glass painting consisted essentially of a colouring substance and a fluxing agent, the latter effecting the combination of the former with the surface layer of glass during the firing process. These mixtures were divided into two classes: (1) those in which colouring oxides were mixed with the flux immediately before use, and (2) the so-called "glass-painters' fluxes," in which the oxide was already united with the fluxing medium to form a glassy body, this being pulverised and mixed with oil for application to the glass. In order to prevent the furnace gases from coming into contact with the painted glass, the object to be fired was enclosed in a muffle, and this was put inside the furnace. The muffle might be of iron or fireclay, iron muffles being used for colours which were to be fired at a relatively low temperature. The fireclay ensured a more uniform temperature throughout the interior of the muffle, and therefore was always used when great heat had to be applied. When the muffle was in the furnace, which might be heated by burning fuel inside it, the temperature was slowly increased, and the easily melted flux and the surface layer of glass combined and took up the colouring oxide. When this was accomplished the temperature must be very slowly lowered, or the glass would crack. In practice, test-pieces were put in the muffle with the decorated object, the furnace was run for about three days, and then the test-piece examined. If the firing was complete, the fuel was removed from the furnace, which was closed up and allowed to cool for a further three days before being opened. The firing might have to be repeated two or three times, in which case the second colouring mixture must contain more flux than the first. The repetition of the firing was a delicate process requiring careful handling.

J. R. C.

199. Choice of Colours in Letter-painting. F. HUTH (*Diamant*, 1918, 40, 129).—A short note in which attention was directed to the attractiveness of coloured letters. Examples were given of possible combinations of colours, such as yellow letters on a blue ground and black letters on a gold ground.

J. R. C.

V.—Optics and Optical Instruments.

200. Diffraction Patterns in the Presence of Spherical Aberration. (MRS.) C. H. GRIFFITHS (*Trans. Optical Soc.*, 1920, 21, 87).—The paper described the appearances of the images, and of the expanded images, of an artificial star on each side of the

focus of a telescope objective when there was a known difference of path between the margin and paraxial rays. With an objective free from spherical aberration the inside and outside focus appearances were almost the same. With an over-corrected objective the ring system outside the focus was clearer and better defined than that inside the focus, and the reverse was true for an under-corrected objective. The greater the aberration, the greater was the lack of symmetry.

J. R. C.

201. A Projection Spectropolariscope. F. J. CHESHIRE (*Trans. Optical Soc.*, 1920, **21**, 102).—A polariscope specially adapted for class and lecture work was described. By placing the crystal under examination immediately against the slit from which the polarised light issued, a much sharper definition of the bands was obtained than was the case with the more usual apparatus.

J. R. C.

202. Spectrographic Objectives. R. STEINHEIL (*Zeitsch. Instrumentenkunde*, 1909, **29**, 256).—Three methods of forming these objectives with two lenses were given. The aberration was shown to be small when one of these methods was used.

J. R. C.

203. The Construction of Optical Systems. H. HARTING (*Zeitsch. Instrumentenkunde*, 1910, **30**, 359).—Dealt with two lens objectives. Formulæ were calculated for the construction of objectives of this type.

J. R. C.

204. A New System of Correction Lenses. H. BORGEHOLD (*Zeitsch. Instrumentenkunde*, 1910, **30**, 302).—If an objective be corrected for chromatic aberration for one pair of wave-lengths, it was possible to correct it for another pair by the addition of another lens system. The author developed the theory of such a system.

J. R. C.

205. The Aberration of Sloped Lenses and their Adaptation to Telescopes of Unequal Magnifying Power in Perpendicular Directions. LORD RAYLEIGH (*Proc. Roy. Soc.*, 1908, [A], **81**, 26).—The paper consisted of two parts. The first part treated of the general unsymmetrical aberration caused by sloping a lens, and showed how this may be minimised so as to become unimportant. In the second part the advantage which often attended a magnification unequal in different directions was discussed. It was found that a combination of a sloped object lens with a compound cylindrical eye-piece constituted a satisfactory solution of the problem. Formulæ were given from which the required obliquity might be calculated when the nature of the eye-piece and the focal length of the object lens were known.

J. R. C.

206. Homogeneity of Optical Glass. W. ZSCHOKKE (*Zeitsch. Instrumentenkunde*, 1909, **29**, 286).—The refractive indices of 199

specimens from the same melt were measured and found to vary from 1.61290 to 1.61490. A simple method of ascertaining whether or not a prism was homogeneous was described. The prism was laid on one side, and parallel light from an illuminated cross was incident on one of the other sides. It was refracted so as to be reflected from the horizontal side on to the third side, and, after refraction, viewed through a telescope of 25 magnification. If the prism was not homogeneous, the horizontal and vertical bars of the cross were not equally sharp.

J. R. C.

207. Report of Standards Committee on Visual Sensitometry. (*J. Optical Soc. Amer.*, 1920, 4, 55).—A preliminary report summarising the data at present available on (1) the visibility of radiation; (2) the intensity and contrast sensibility; (3) chromatic sensibility; (4) rates of adaptation; (5) absolute sensibility. Further reports were to be made annually.

J. R. C.

208. The Surface Layer of an Optical Polishing Tool. J. W. FRENCH (*Trans. Optical Soc.*, 1920, 21, 81).—The author suggested that in the later operating stage the surface layer of a pitch, wax, or kindred polishing tool was a continuous layer of glass. The primary action of the rouge was that of an abrasive; it removed the material, and thus lowered the surface to the bottom of the pits. The author described experiments which led him to suppose that the glass removed formed a layer of glass on the polisher, in which layer, however, as it was only a few wave-lengths thick, the irregularities of the surface of the polisher caused small islands of pitch to be present. Assuming the presence of this layer, the action of the polisher in the second stage was due to surface flow. In a discussion which followed the paper, experiments were detailed which appeared to indicate that this layer was not formed, or, if present, was not completely continuous. D. Taylor holding that the action of the polisher was a case of abrasive action carried to molecular dimensions.

J. R. C.

VI.—Illumination and Illuminating Ware.

209. Colour Filters for Producing Artificial Daylight. M. LUCKIESH and D. A. DEWEY (U.S.A. Pat., February 24th, 1920, No. 1331937. Filed August 21st, 1915, No. 46737. Renewed November 29th, 1919, No. 341469).—The invention related to colour filters or absorbing screens adapted to be used in conjunction with artificial light for the purpose of producing an approximation to daylight. The filters referred to are integral glass colour screens, and the following is an example of a batch

which may be used to produce a glass suitable for use with a gas-filled electric lamp:—

Sand	1500 lb.	Arsenic	5 lb.
Soda	535 "	Manganese dioxide	3 "
Lime	160 "	Cupric oxide.....	5.66 "
Nitre	50 "	Black oxide of cobalt...	0.26 "

This batch resulted in a glass which was blue in colour, but had a slight green tinge. If it was desired to approximate more closely to skylight, a purple glaze might be applied to the surface of the glass. Such a glaze might be composed as follows:—

Vitrifiable carmine (carmine No. 45)	50	grams.
Vitrifiable blue (blue No. 245)	2.5	"
Vitrifiable flux (flux No. 10)	30	"

The patent covered any blue glass to produce daylight effects containing copper, manganese, and cobalt.

J. R. C.

VII.—Fuels, Refractories, and Furnaces.

210. Fuel and Producers. (*Sprechsaal*, 1919, 52, 463).—

The article dealt with points to be observed in attempting to reduce fuel consumption to a minimum and to obtain the best results from the fuel actually used.

Three systems had been used for heating glass furnaces, namely, direct firing from a grate, half-gas firing, and gas firing. Direct firing was very wasteful in regard to fuel consumption, and was now superseded. Half-gas firing required a better quality of fuel and was more wasteful than gas firing, so that gas firing was the only system to be considered.

For successful results the construction of the producers must be adapted to the work required, and they must receive adequate attention. Two points which called for attention were moisture in the fuel and the type of producer selected. Each kilo. of water in the fuel required 637 cal. to evaporate, and this heat was extracted from the gas. Further, if the fuel was very wet and the producers near the furnace, a large amount of steam was passed into the furnace with the producer gas, leading to pronounced cooling. If the producers were removed from the furnace, steam might condense in the gas mains.

For large-sized non-coking fuels, such as rough coal, briquettes, etc., shaft producers with flat grates were suitable if worked with a fairly deep fuel bed. Strongly coking coals were gasified more successfully in producers with sloping grates—either hanging or stepped grates.

Opinions varied regarding the most suitable size of producer, some preferring large and others small units. The author favoured the installation of three producers to each furnace, the size being such that in case of need the necessary gas could be produced from two of them whilst the third was under repair. Dimensions recommended by the author for single producers to gasify 8 tons of fuel in twenty-four hours were as follows:—

Shaft producers: 1.30 m. \times 1.20 m. \times 3.00 m. in width.

Step grate producers: 1.85 m. inside width, 2.00 m. depth, 3.00 m. outside height.

If only two producers were used and the capacity of these fully taxed to supply the necessary gas, shortage would occur periodically. If one of the producers were working sluggishly—say in consequence of a stoppage—the other would be driven more rapidly, would burn more fuel, but not produce the corresponding increase in the gas supply, so that a shortage of gas would result. Only by strenuous and repeated poking and cleaning out could the sluggish producer be restored to its normal action, and this would entail considerable waste in unburnt fuel. If one of these producers acted sluggishly, the other two were quickened, and the necessary amount of gas was available, so that the producer that was working badly could be brought back to a normal course gradually and without adopting drastic measures.

Intelligent working of and suitable attention to the producer were highly important in regulating fuel consumption. The depth of the fuel bed depended upon the nature of the fuel and upon whether the producer was working under natural or forced draught. The author recommended the following depths of fuel bed as suitable:—

	Under natural draught.	Under artificial draught.
Large coal	70 cm.	85 cm.
Bohemian lignite	60 "	70 "
Peat—compressed	80 "	95 "
Briquettes	85 "	120 "
Air-dry wood—20 cm. pieces	105 "	125 "

Under favourable draught conditions, for example, when the producers were at a low level and in the immediate vicinity of the furnace, the fuel bed should be rather deeper, and where the draught conditions were below normal the fuel bed could be rather shallower to reduce friction.

To regulate the height of the fuel bed and keep this constant the author recommended the provision of a cast-iron "filling shaft" reaching into the producer to the desired fuel level and supporting the usual feeding hopper at its upper end. As the fuel in the producer burned away and the level fell, fresh fuel dropped from the filling shaft, thus maintaining the fuel level in the producer. The shaft could be raised and lowered at will so as to regulate the height of the fuel level in the producer.

J. H. D.

211. General Remarks on Glass-house Pots. (*Sprechaal* 1919, 52, 464).—The author mentioned briefly the chief points to be observed in the production of trustworthy glasshouse pots, such as careful selection and sorting of suitable clays, the correct amount of grog to be added, the necessity for careful preparation of the pot clay and its freedom from adventitious impurities, and careful heating up of the pot in the pot-arch. The pot clay should mature at least six weeks before use. Care should be taken that clay intended for pot-making did not get frozen, since if this took place the pots made from the clay were untrustworthy and corroded readily. Clay for pot-making should not be obtained in the winter months and should be stored in a frost-proof chamber.

The author discussed particularly the best strength to make the pots. This would naturally depend to some extent on the purpose for which the pots were required; thus for sheet glass much stronger and heavier pots were required than, say, for table ware. In general, however, a medium thickness was best, and extremes in either direction should be avoided. Very thick pots certainly withstood collapse through corrosion rather longer, but were more difficult to dry and heat up successfully without crizzles; the glass was more difficult to melt and plain in them, and consequently they were exposed for longer periods to the full heat of the furnace, and once the inner surface of the pot became badly corroded it was not suitable for good glass-making, since clay particles became detached from the surface, causing the glass to become cordy and stony. The idea that inferior grades of clay could be used for pot-making if the pot walls were made thicker was a mistaken one.

Pots should be built narrower at the bottom than the top. They were not so likely to bulge out under pressure of the molten glass at high temperatures, and also allowed the heat to get round them better, thus ensuring more uniform and regular founding of the glass.

Dimensions recommended were as follows:—

Pots for sheet glass: thickness of wall at the top, 8—10 cm. and at the bottom 12 cm. Bottom thickness, 13 cm.

Pots for table glass: thickness of bottom, 9 cm., the side walls tapering to 6 cm. at the top.

J. H. D.

212. A Lining for Glass Pots. S. R. SCHOLDS (*J. Amer. Cer. Soc.*, 1920, 3, 498).—A process was described for the manufacture of glass pots making them less corrodible by molten glass, particularly a heavy lead-potash glass. An attempt was made to develop a lining on the pot wall which would protect it. A refractory clay body having the general character of porcelain was formed by using a mixture of 90 per cent. ordinary clay batch and 10 per cent. felspar. This mixture gave a dense body after burning at 1300°, and showed no sign of over-firing. The felspar formed a sintering bond between the clay particles, producing the phenomenon generally referred to as vitrification.

This lining was applied to the pot during building in the

ordinary way, so as to give a finger course about half an inch thick up to the metal line, and continued 8 inches above that in gradually diminishing thickness. No difficulty was found in drying the pot, and a homogeneous body was always obtained. It was found that it was often necessary to reduce the proportion of felspar 5 per cent., depending on the temperature at which the pot was to be used. The lining was very dense, formation of stones was reduced to a minimum, and the useful life of the lined pot was from two to three times that of an ordinary pot in lead-potash melts. The lined pots were easier to handle than pots made entirely of the porcelain material, because the more porous structure in the raw condition enabled them to be heated in the pot-arch as rapidly as ordinary pots. The only difficulty experienced was the formation of cracks in the lining, owing to the sudden cooling of the dense material by the introduction of cold batch.

F. W. H.

213. Determination of the Strength of Stoneware Bodies and the Connection between the Values Obtained and the Composition and other Properties of these Bodies.

H. HARKORT and A. SCHERBIUS (*Sprechsaal*, 1919, 52, 297, 309, 321).—The tensile strength of the bodies was determined by subjecting suitably shaped pieces of the body in question to gradually increasing tension until fracture took place. Preliminary experiments showed that it was difficult to get results in satisfactory agreement, owing to the difficulty in applying the tension directly down the middle axis of the test-pieces. By exercising great care in the formation of the test-pieces and the application of the weight, these difficulties were overcome to a great extent and fairly trustworthy figures obtained.

The bending strength (or resistance to fracture by bending) was determined on test-pieces 150 mm. long, 20—30 mm. broad, and 10 mm. thick in the middle, in which a notch was cut on both sides previous to burning. One end of the test-piece was clamped fast up to the notch, and from the free end, at a measured distance from the notch, gradually increasing pressure was applied until the test-piece broke.

As the fired bodies were porous, it was exceedingly difficult to obtain homogeneity throughout the piece, and this was probably the chief cause in the lack of uniformity in the results. The resistance to fracture by bending was considerably greater than by tension, the average ratio of the values found being 2.84:1.

Various bodies were investigated to study the influence of plastic and lean clays, sand, felspar, and chalk on the properties of the fired body, the molecular compositions varying from 1.0 clay substance, 2.18 silica, 0.038 alumina, 0.349 fluxes, to 1.0 clay substance, 5.77 silica, 0.06 alumina, 0.217 fluxes.

Determinations of the bending and tensile strength were carried out on test-pieces burned at SK 01 α , 4 α , and 8—9 (1080°, 1160°, and 1250—1280°). The apparent porosity of the burnt pieces was

also determined. The detailed results were given in a series of tables, and the authors summarised their conclusions as follows:—

1. Great divergences were met with in the strengths of different bodies, the variation being as great in some cases as 3:1.

2. The most important influence was the temperature of firing, the increase of strength of the body amounting to as much as 100 per cent. in the temperature range investigated (1080—1280°).

3. The increase of strength of the body through increased content of clay substance did not amount to more than 50 per cent. The influence of felspar on the strength became particularly apparent at about 1250°, and at this temperature an addition of 5 per cent. of felspar to the body increased the strength (cold) by 50 per cent.

4. At lower temperatures chalk had a slight beneficial influence on the strength of the body, but reduced it at higher temperatures. It did not decrease the porosity, as was the case with felspar.

5. No particular clay was indispensable in the production of stoneware bodies of high mechanical strength, but some required a much higher firing temperature than others to attain the desired result.

6. The bending strength of a good stoneware body should be at least 100 kg./cm.

J. H. D.

214. The Nature and Resisting Properties of "Grog" Bricks in Tank Furnaces. J. BALDERMANN (*Sprechsaal*, 1919, 33, 285).—Examination of such bricks and blocks with a lens showed that they contained particles of free quartz to a greater or less extent, and were porous owing to being of too coarse a texture.

In tank furnace practice the batch usually contained salt-cake, a portion of which floated undecomposed on the surface of the metal (as "glass gall") and penetrated into the pores of the blocks, causing increased attack and eventually partial disintegration. The particles of quartz dissolved in the fused salt-cake and gave rise to further cavities, and consequent increased attack, with the result that the blocks were badly corroded and particles became detached and appeared as stones in the glass.

The remedy was to make the flux-line blocks in tank furnaces of the same material as was used for making glasshouse pots, that is, of fine, close texture and as free as possible from quartz grains. Bottom blocks and bottom side blocks could be made of cheaper materials, since they had not to withstand the action of raw batch materials, particularly fused salt-cake.

In the author's experience, the extra cost of special flux-line blocks had been amply justified in the increased life of the furnace and the freedom of the glass from stones.

J. H. D.

215. The Specific Heat and Heat Conductivity of Refractory Articles (*Sprechsaal*, 1919, 52, 499).—The article summarised the contents of three published papers on the subject.

1. "Experiments on the Heat Conductivity of Refractory Building Materials."*

This paper dealt with methods of determining the heat conductivity of refractory blocks. The brick or block under test was built in with similar blocks above and below, and one face heated electrically by means of an iron plate, a temperature of 1550° being attained. Thermo-elements at the heated face and in borings in the block at fixed distances from the face allowed the temperature changes to be followed.

The heat conductivity (K) of the block was given from the equation $K = a^2cs$, where a^2 = the temperature gradient, c = the specific heat, and s = the specific volume of the block tested.

Some of the results obtained are given in the following table:—

Material.	Percentage composition.	Specific volume.	Specific heat at			Conductivity at		
			200°.	600°.	1200°.	200°.	600°.	1200°.
Grog brick.	About 40Al ₂ O ₃ , 57SiO ₂ .	1.88	0.225	0.272	0.305	0.0014	0.0022	0.0027
Grog brick.	24-34Al ₂ O ₃ , 71-05SiO ₂ , 2.46Fe ₂ O ₃ .	1.77	0.217	0.263	0.304	0.0009	0.0012	—
Silica brick.	96.92SiO ₂ , 1.56Al ₂ O ₃ , 0.62Fe ₂ O ₃ , 0.97CaO.	2.04	0.237	0.282	0.291	0.0013	0.0017	0.0021
Magnesite brick.	88.85MgO, 9.31Fe ₂ O ₃ , 0.35CaO, 0.17Al ₂ O ₃ , 0.2SiO ₂ .	2.35	0.253	0.291	0.340	0.0011	0.0012	0.0014

The results showed that the variation in specific heat with the chemical composition of "grog" bricks was small, and the increase with rising temperature practically constant. The differences in the heat conductivity of the various types of bricks were fairly significant. In all cases the conductivity increased with rising temperature, although the temperatures of the experiments were below those at which the blocks had been burnt. After several heatings the "after-firing" effect appeared to approach an end. In the case of the silica brick, a sudden increase in the conductivity was observed above 1035°, possibly due to quartz inversion.

It was important that one should know the final values of the conductivity in the case of blocks for industrial purposes, and this should be ascertained from blocks which had been in actual industrial use over a considerable period.

* E. Heyn, O. Bauer, and E. Wetzel: *Mitteilungen aus dem Kgl. Material-Prüfungsamt*. Berlin-Lichterfelde. (33, 1914. Nos. 2 and 3.)

2. "The Mean Specific Heats of some Ceramic Bodies in Two Different Temperature Zones."*

This paper showed that the mean specific heats of grog, hard porcelain, and Marquardt's body were very similar, but that a pure magnesia body exhibited considerable variation.

3. "The Specific Heat of Refractory Products."†

In this paper the author gave the results of a number of determinations of the mean specific heat of twenty different refractory materials between 20° and 200°.

The results showed that for all materials composed chiefly of silica and alumina the mean specific heat may be taken as constant, with a constant increase with rising temperature. Between 20° and 200° the value was about 0.204, and between 20° and 400° 0.225.

J. H. D.

216. **The Geology of the Refractory Materials of the North of England.** J. B. ATKINSON and J. T. STOBBS (*Trans. Cer. Soc.*, 1918-19, xviii, 433).—The authors stated that nearly the whole of the refractory materials in the north of England were derived from the Carboniferous system, chiefly from the Coal Measures; to a less extent from the Millstone Grit and the Carboniferous Limestone series. In the Comondale district of the North Riding of Yorkshire some siliceous rock was obtained from the Estuarine series of the Lower Oolite. In Durham, the Permian formation furnished some dolomite. The Millstone Grit probably contained much valuable refractory material, but it had not been much explored.

Much valuable information was given, and the paper was illustrated with diagrams.

C. M. M.

217. **Ceramic Processes Associated with Colloid Phenomena.** A. V. BLEININGER (*J. Ind. Eng. Chem.*, 1920, 12, 436).—In this paper the author presented some of the aspects of colloid chemistry which had a bearing upon the technology of clays.

Clays were mixtures of finely divided hydrated aluminium silicates with granular matter, such as quartz, felspar, mica, etc. The dispersed state of the aluminium silicates, chiefly $\text{Al}_2\text{O}_3 \cdot 2\text{SiO}_2 \cdot 2\text{H}_2\text{O}$ —the clay substance—imparted the property of plasticity, the ability of the substance to be moulded when mixed with water, and to retain the shape imparted to it. Kaolinite, the pure type mineral, rarely occurred in clays, but had usually been reduced to particles of the magnitude of 5μ or smaller admixed with colloidal material like ferric oxide and organic matter, and often stained by absorbed salts. In the natural state clays were not necessarily plastic. They might have been indurated by pressure or heat or other agency, so that they could not be made plastic without the aid of grinding. This was found to be the

* W. Steger (*Silikat Zeitschrift*, 1914, 2, Part 3).

† W. Steger (*Silikat Zeitschrift*, 1914, 2, Part 11).

case with materials consisting of hydrated silicates other than $\text{Al}_2\text{O}_3 \cdot 2\text{SiO}_2 \cdot 2\text{H}_2\text{O}$, such as halloysite, pyrophyllite, indianite, etc.

A clay was said to be very plastic, fat, or sticky when the colloid matter was in excess; or sandy, weak, or non-plastic if the granular matter predominated. The colloidal characteristics were substantiated most effectively by ultramicroscopic examination. The author stated that recent work of Jerome Alexander had shown that Brownian movement was observed with practically every type of clay suspended in water. This movement varied from the rapid motion of the finer particles to the more sluggish motion of the larger particles or aggregates, or when hampered by the presence of electrolytes.

Clay suspensions were affected by various reagents, both electrolytes and non-electrolytes. The phenomenon of absorption was probably the most striking. An appreciable amount of the basic ion was absorbed, but practically none of the acid ion from solutions of salts like NH_4Cl , BaCl_2 , $\text{Al}_2(\text{SO}_4)_3$, and CuSO_4 . Deeply coloured solutions of metallic salts might thus be decolorised by passage through clay. This type of absorption followed the general exponential equation with fair agreement. As was common with all dispersed materials, salts as a class tended to coagulate clay, while bases deflocculate it. This type of reaction was of considerable technical importance. Thus NaOH , Na_2CO_3 , or Na_2SiO_3 in increasing the dispersion of the clay particles produced a decided decrease in the viscosity of the system, and hence, according to Stokes's law, rendered possible a sharper and quicker separation of the granular matter of the clay substance proper, which fact had been made use of in the washing and purification of kaolins.

The so-called casting process illustrated another industrial application of the deflocculation of clays. In this case the constituents of the ceramic body were stirred with water containing about 0.3 per cent. of Na_2CO_3 and Na_2SiO_3 in terms of the dry weight of the clay materials to form a thick, but readily fluid, suspension. The addition of the alkaline reagents reduced the water content required to keep the mass in the liquid condition. In casting, the clay suspension was poured into a plaster mould which absorbed sufficient water to cause the mass to solidify. Coagulating agents, acids, and salts, however, were employed to increase the plasticity and strength of certain clays and to thicken suspensions of glazes and enamels.

The author stated that all the phenomena of deflocculation and coagulation occurred in stages. Thus when alkali was added to a clay suspension there was a decided viscosity minimum followed by alternating maxima and minima until the phases finally merged in a definite direction. Similar conditions prevailed also in a coagulation series, the phases being in reverse sequence. It had been found, also, that certain organic substances, like the tannins, reacted upon clay suspensions after the manner of alkalis, but the phases were less definite. They might also assume the function of a protective colloid in that they rendered the clay less sensitive to the action of electrolytes.

Viscosimeters had been used for estimating the deflocculating or coagulating effect of reagents, and such determinations of the viscosity or its reciprocal, the fluidity, of clay suspensions afforded a means of establishing the relative plasticity of different clays, inasmuch as equal concentrations would show fluidities inversely proportional to the general plastic nature of the materials.

An interesting phenomenon in connection with clay suspensions was the electrical deposition of the particles by a direct current upon the positive electrode against the flow of water away from it. The addition of small amounts of sodium hydroxide increased the charge of the clay particles and facilitated their deposition.

Plastic Clay.—Without doubt, the plasticity of clay was greatly affected by the presence of organic matter—humus, tannins, etc.—and it seemed to be a fact that acidity was conducive to the greatest development of this property. The ageing of clays improved their plastic working quality, and it was thought that this was partly due to the formation of organic acids, caused by bacterial action or chemical processes. It had been found that alkalis inhibited the plastic quality of clay to a very pronounced extent. Electrolytes increased or reduced the water required for the development of the plastic condition, and also the shrinkage upon drying.

Drying Shrinkage.—In this process the contraction in volume of the plastic clay was a typical property of colloid materials, and it might show a magnitude as much as the true volume of the clay itself. This shrinkage, therefore, was a criterion of the colloid nature of the clay, being the greater the more pronounced this development was. Electrolytes affected not only the magnitude of the contraction in drying, but the capillary flow of the water through the clay as well. The drying shrinkage was the greater the more slowly evaporation of the water was allowed to take place, and *vice versa*.

Firing of Clay.—The dehydration was endothermic and was associated with a marked increase in molecular volume. At about 900° an exothermic reaction occurred which might be associated with an irreversible change of a colloidal nature or the dissociation of the aluminium silicate, perhaps into Al_2O_3 , SiO_2 , and silica.

The external clay volume contracted as the firing temperature was raised, especially if fluxes were present, due to the effect of surface tension, until the heat intensity was sufficient to bring about practically complete closing of the pore space. The clay was then said to be vitrified.

Wherever the chemical composition and the heat treatment permitted it, the end result was the partial elimination of the colloid phases and their replacement by crystalline identities. Thus the clay substance decomposed into *sillimanite* and silica.

C. M. M.

218. A Possible Explanation of Failure under Load at High Temperatures as Displayed by Fireclay Refractories. A. S. WATTS (*J. Amer. Cer. Soc.*, 1920, 3, 448).—It was generally regarded as a fact that all clay refractories failed under load when

a temperature of 1300° was reached. Bleining and Brown suggested that high flux content rather than high silica content was a cause of inferiority and the development of easily fusible silicates at low temperatures, and the progressive solution of additional silica and alumina with increased temperature or with a prolonged exposure to the same temperature was sufficient cause for the failure of the refractory under load. But many bricks showed weakness under load at temperatures below 1300° , despite low alkali content and the near approximation to *kaolinite* of the $Al_2O_3-SiO_2$ ratio. Bleining and Brown's results showed that a brick with high silica content and low alumina content stood the load test, whereas three bricks with alumina and silica contents approaching the *kaolinite* formula failed. Flux contents were very similar, and the present author considered that the difference in behaviour of the high silica brick was due either to high silica or low alumina. Bleining and Brown further admitted the advantage of reducing the flux content by the addition of pure silica in the form of clean sandstone, but did not note the effect of reduction of the alumina content. They also suggested that hard burned bricks were superior to soft burned bricks, justifying that by the fact that the more fusible bond clays absorbed some refractory flint clay, and were thus improved as regarded resistance to load.

The author was therefore led to inquire whether the weakness of the high alumina clay refractories was really due to such chemical solution at higher temperatures or could be more correctly attributed to a period of physical weakness produced in the mass by the decomposition of the kaolin and the recombination of the alumina and silica as *sillimanite*.

The author had proved that *sillimanite* could be formed at 1170° . Vitrification was not necessary for the formation of *sillimanite*, and Glasenapp had shown that the development of *sillimanite* was not a case of crystallisation out of solution, but one of molecular rearrangement by which all clays became crystalline at high temperatures coincident with the decomposition of the clay substance. Thus the mechanical failure of the mass would begin as soon as the temperature was sufficiently high for the molecular rearrangement to take place. Zoellner showed that three kaolins fired at cone 15 yielded from 20 to 23 per cent. of *sillimanite*, but two ball clays, with almost the same alumina content as the kaolins and vitrifying at cone 15, yielded less than 6 per cent. of *sillimanite*.

In accordance with Zoellner's results, the author mentioned that saggars made from ball clays and highly siliceous clay, such as a wad clay, were far superior to any produced from the best flint and plastic fireclays, and whereas a high *sillimanite* development was found in fireclay saggars, it was absent from saggars made from ball and wad clays. Further investigation was, however, necessary before a positive statement could be made on this particular failure question.

An interesting discussion followed the paper.

F. W. H.

219. Note on the Load Behaviour of Aluminous Refractories. A. V. BLEININGER (*J. Amer. Cer. Soc.*, 1920, 3, 155).—The results obtained were as follows:—

No.	Composition.				Temp. of firing. Cone.	Firing shrink- age, per cent.	Con- traction in load test, per cent.	Softening point, Cone.
	Calcined flint clay, per cent.	Artificial <i>silli- manite</i> , per cent.	Plastic fire clay, per cent.	Kaolin, per cent.				
1.	75	—	12.5	12.5	14	1.06	2.40	33
2a.	80	—	10.0	10.0	14	0.47	2.80	33
2b.	80	—	10.0	10.0	16	0.35	0.84	33
3.	80	—	—	20.0	16	0.83	0.88	35
4.	—	80	10.0	10.0	16	—	0.61	above 35
5.	—	80	—	20.0	16	—	0.48	above 35

The artificially prepared *sillimanite* consisted of 71.6 per cent. kaolin and 28.4 per cent. anhydrous alumina. The mixture No. 1 was moulded into standard sized bricks by the soft mud process and the others by dry pressing under a pressure of 5000 pounds per square inch. In the case of No. 1, the load test, pressure being maintained at 50 pounds per square inch, was carried out at 1350° and, for the others, at 1400°. The contraction was expressed in percentage of the original length of the brick. The fusion test was carried out in a pot furnace using natural gas with air at a pressure of 40 pounds per square inch, the maximum temperature obtained being at cone 35.

Providing the burning temperature was sufficiently high, refractories high in alumina could be made which resisted load conditions and were practically constant in volume. The use of synthetic *sillimanite* necessitated a calcination temperature sufficiently high for the ready transformation of the mixture into the compound desired, and intimate mixing of the kaolin and alumina before calcination.

F. W. H.

220. Refractory Properties of Aluminous Products.

H. LE CHATELIER and B. BOGITCH (*Compt. rend.*, 1919, 169, 495).—In spite of the highly refractory nature of bauxite, this material has not been a success when used in the construction of steel furnaces, on account of its great porosity and considerable shrinkage. The low expansion of alumina renders it useful in increasing the resistance to sudden change of temperature, and for this reason bauxite is often mixed with a small quantity of clay. Too great porosity and shrinkage are eliminated by fusing the bauxite, either in the electric furnace, when the product, known as alundum, loses its iron oxide and silica, as silicate of iron, or in the cupola, by Lecesne's process, when the less expensive, but less pure, corindite is produced, retaining the iron oxide and the silica. This material softens at a temperature of about 1800°, but, when mixed with 10 per cent. of kaolin, or of syrupy sodium silicate mixed with its own volume of water, it shows no shrinkage up to

a temperature of 1600°, and can be heated rapidly without any sign of cracking.

Experiments were made by the authors to test the resistance to heat of certain bricks, carborundum being used for comparison, with pure bauxite and corindite. The chemical compositions of the products used were determined, and the coarsely ground corindite and carborundum were graded.

The following specimens were studied, pure water being used to produce plastic pastes, which were moulded by hand, and heated for three hours at a temperature of 1200° for corindite and 1400° for carborundum:—

1. Brick of pure bauxite, moulded by pressure, and dried at 1300° in a large furnace.
2. Corindite with 10 per cent. of bauxite.
3. Corindite with 10 per cent. of kaolin.
4. Corindite with 2 per cent. of solution of syrupy sodium silicate.
5. Corindite with 6.5 per cent. of solution of syrupy silicate.
6. Carborundum with 10 per cent. of kaolin.

The resistance to crushing, on heating, was investigated, the pressure at which the height of the specimen test-piece was reduced by one-third being measured. All these specimens became plastic at temperatures between 1200° and 1500°. Although alumina and carborundum are infusible at these temperatures, the particles move freely, without any cohesion, in a melted mass, whereas silica, although more fusible, forms a continuous network, due to the crystallisation of tridymite. Alumina, then, like magnesia, although highly refractory, yields bricks which cannot resist heat and pressure.

The results of the experiments show that the mixtures with silicate of sodium are less resistant than those containing kaolin, but for the construction of small laboratory furnaces, where there is no great weight to support, they are very useful, as, on drying in the cold, they become hard enough to manipulate with safety up to a temperature of 1400°.

Mixtures containing 95 per cent. of alumina, and consisting of (a) calcined alumina 80, white bauxite 20, and (b) alumina 90, kaolin 10, were found to break in all directions and contract enormously on first heating, but if they were then crushed, mixed with one-quarter the weight of the same raw mixture, moulded under pressure, and again heated to 1700°, they did not soften up to a temperature of 1600°. At this temperature, their resistance to fracture was 20—40 kilos. per sq. cm., and these products could be heated up to a temperature of 1600° very rapidly, whereas silica bricks would need careful heating.

V. D.

221. Comparative Tests of Machine-made and Hand-made Silica Bricks. W. EMERY and L. BRADSHAW (*Gas Journal*, 1920, 150, 577).—The bricks were prepared from Dinas

silica rock, using lime as binding agent. Part of the material was moulded into bricks by hand and a second portion by power press, those made by machine being more accurately shaped than those made by hand.

The results showed that machine-made silica bricks were in no way inferior to the hand-made variety, but, on the contrary, in certain ways they were superior. Similar results were obtained for both types of bricks in tests on porosity, refractoriness with and without load, reversible expansion at 1200°, and, after-expansion on heating to 1350°. The apparent specific gravity of the machine-made bricks was 1.85 and that of the hand-made bricks was 1.8, and the resistance to crushing of the latter type was 28 per cent. less than that of the former type. When subjected to the action of a sand blast the machine-made bricks gave the greater resistance towards abrasion.

Spalling was tested, first, by determining the loss in weight after heating and quenching alternately, and, secondly, by determining the reduction in strength after heating to 600° and then allowing to cool. The best results in both tests were given by the machine-made bricks.

F. W. H.

222. The Effect of the Method of Preparation on the Viscosity of a Casting Slip. V. S. SCHORY (*J. Amer. Cer. Soc.*, 1920, **3**, 286).—Experiments were made during which it was attempted to keep all possibly variable factors constant and determine the effect on the slip of different methods of preparation. The body was prepared by blunging, screening, and filter-pressing, and in every case the same proportions of body, water, sodium carbonate, and sodium silicate were used. Using a viscosimeter of the Bureau of Standards type, the relative time of flow of the casting slips was compared with that of water at 15°. The instrument delivered 200 c.c. of water in 14.8 seconds, and the time of flow of each slip was divided by 14.8 to obtain a figure which was termed the viscosity of the slip.

In the first six cases the slip was prepared by blunging in the ordinary double blunger, and in a further six cases by grinding in a pebble mill. The sodium carbonate and sodium silicate were added in the form of 8 per cent. solutions, and the amounts of anhydrous reagents added were sodium carbonate 0.027 per cent. and sodium silicate 0.036 per cent. of the dry weight of the body. The specific gravity of the slips was 1.75, corresponding to a water content of approximately 30.5 per cent.

The results obtained were as follows:—

Method of preparation.	Viscosity.	Method of preparation.	Viscosity
1	5.21	7	4.68
2	2.72	8	3.64
3	4.77	9	5.09
4	3.07	10	10.3
5	4.60	11	4.18
6	3.78	12	8.3

In Nos. 1 and 3 both alkaline reagents were added at the same time; in Nos. 5 and 6 the sodium silicate was added early in the operation, and sodium carbonate last of all; in Nos. 2 and 4 the sodium carbonate was added early and the sodium silicate last. Of Nos. 7 to 12, three of the slips were made from filter-press cake containing 21 per cent. of water, and three from crushed, dried cake. The slips made from the wet cake were all of a lower viscosity than those made from dry cake by corresponding processes. Similar tests made on another body confirmed the results previously obtained.

Further tests were carried out on slips made by the foregoing methods from the second body, these slips containing such proportions of the alkaline reagents as to give slips with approximately the same viscosity. The viscosities of the slips were between 3.35 and 3.65. The percentages of reagents used were:—

Method of preparation.	Sodium carbonate, per cent.	Sodium silicate, per cent.	Method of preparation.	Sodium carbonate, per cent.	Sodium silicate, per cent.
1	0.0745	0.099	7.....	0.0585	0.078
2	0.0545	0.0725	8.....	0.0465	0.062
3	0.0645	0.086	9.....	0.0595	0.079
4	0.0570	0.076	10.....	0.0855	0.114
5	0.0645	0.086	11.....	0.057	0.076
6	0.0620	0.083	12.....	0.0805	0.1075

The slips were cast in plaster moulds. Of the slips prepared by blunging (Nos. 1 to 6), those with the lowest alkaline reagent content gave the firmest casts; the methods of preparation requiring the greater amounts of sodium salts to bring the slips to their best casting condition gave the softer casts. No. 10, prepared by grinding with the largest percentage of salts, gave the softest cast. Apart from the fact that blunged slips with the lowest content of alkaline reagents gave the firmest casts, high alkaline content tended to cause a frost-like growth on the moulds, which after a time became a comparatively impervious film and hindered drying. The salts also separated out on the ware when removed from the mould, and consequently the surface layers were rendered more fusible.

F. W. H.

223. Elutriation Tests on American Kaolins. H. G. SCHURECHT (*J. Amer. Cer. Soc.*, 1920, 3, 355).—A description was given of the elutriation of clays, using the Schulze elutriator, and the precautions necessary for obtaining accurate results were indicated. The apparatus was described in detail, and also the method of standardisation. The velocities of flow for the elutriation cans were respectively 0.347, 0.180, 0.059, and 0.0197 millimetre per second.

The material passing through a 200-mesh sieve was used, and deflocculated by sodium hydroxide. Distilled water was better than tap-water, since the soluble salts in tap-water caused coagulation of the clay particles, and consequent settling as larger grains.

The deflocculated clay was fed into the elutriator drop by drop, and during this operation the velocity of flow was reduced by one-third. Results were more trustworthy when the residues were stirred at intervals.

The grain size of each residue was measured under the microscope by taking the average of at least sixty grains. For calculating the average size of grain, the following formula, where d_1 represents the maximum diameter and d_2 the minimum diameter, was used:—

$$D = \sqrt[3]{\frac{(d_1 + d_2)(d_1^2 + d_2^2)}{4}}$$

To express the fineness of grain, which was inversely proportional to the diameter of the particles, the Jackson-Purdy surface factor was used.

The results tabulated were extensive, and comprised English and American clays, comparing observed with calculated values, and the values obtained using distilled water with those obtained using tap-water. Using distilled water, the observed diameters closely agreed with the calculated values obtained by using Schöne's empirical formula. The English ball clay examined contained 98.55 per cent. of fine material carried away by a flow of 0.0197 millimetre per second, whilst only 40.75 per cent. of English kaolin was carried off at that velocity. The greater plasticity and bonding strength of the ball clays were, in the author's opinion, due largely to their finer grains. The results on p. 157 were tabulated for the English clays.

F. W. H.

224. The Classification of Clays on a Ceramic Basis.

A. S. WATTS (*J. Amer. Cer. Soc.*, 1920, 3, 247).—The author discussed the confusion arising from the lack of definiteness in classifying clays. He suggested a classification based on five properties, namely, colour, shrinkage, bonding strength, vitrification, and fusion, the last two properties being possibly combined under the term "refractoriness."

As regards colour, the terms white, cream, buff, and tan might be used for the shades closely related to white, and then distinct colours. Shrinkage should be divided into two sections, drying and total shrinkage, both expressed as percentages of the original wet dimensions. The drying shrinkage might be separated into five divisions, as, for example, less than 3 per cent., 3 to 6 per cent., 6 to 9 per cent., 9 to 12 per cent., and more than 12 per cent. Similarly, total shrinkage at some definite temperature might be subdivided into those less than 4 per cent., 4 to 8 per cent., 8 to 12 per cent., 12 to 16 per cent., and more than 16 per cent. Bonding strength should be determined on a mixture of equal parts by weight of the clay and a standard sand by the effect on shrinkage, or, better, by determining the modulus of rupture on a mixture of 50 per cent. by weight of clay and 50 per cent. by weight of potters' flint (Report of the Committee on Standards, 1919, pp. 40—43). The clays could then be classified

as having a modulus of 800 lb. per square inch or more, 400 to 800 lb. per square inch, 200 to 400 lb. per square inch, 100 to 200 lb. per square inch, or less than 100 lb. per square inch.

Vitrification should be taken as referring to the stage of firing at which the clay showed no absorption. The vitrification and fusion, or "softening-point," data should be expressed in terms of cones and divided into five sections, namely, below cone 5, between cones 5 and 15, 15 and 25, 25 and 30, and above cone 30.

F. W. H.

225. Investigations on Zirconium. J. W. MARDEN and M. N. RICH (*J. Ind. Eng. Chem.*, 1920, 12, 651).—The authors stated that the following was an abstract of a report to be published by the U.S. Bureau of Mines in the near future.

I. PREPARATION OF ZIRCONIUM OXIDE.

Most of the experimental work was done on the Brazilian ore *zirkite*, which consisted of a mixture of *zircon* ($ZrSiO_4$) and *baddeleyite* (ZrO_2) containing about 73—75 per cent. of ZrO_2 .

In decomposing the zirconium ores the following methods were employed:—

- (a) Fusion with $NaHSO_4$, commercial nitre cake, etc.
- (b) Fusion with caustic soda or soda ash, together with sodium peroxide.
- (c) Fusion with $NaHF_2$ or treatment with hydrofluoric acid.
- (d) Ignition with charcoal and subsequent chloridising.
- (e) Electric arc fusions of zircon, CaO and carbon, leaching with water, and chloridising the residue.

After decomposition of the ore, the zirconium was brought into solution, and the hydroxide precipitated and converted to the oxide by ignition. It might further be purified by dissolving in acids and reprecipitating, or by recrystallisation as the oxychloride. The authors made many trials of the above methods on quantities of the ore varying from 1 gram to 10 lb. On a commercial scale the use of fluorides and saltpetre was found to be expensive. The most efficient and successful methods proved to be the phosphate method and the basic sulphate.

II. PREPARATION OF PURE POTASSIUM FLUORZIRCONATE AND THE CRYSTALLINE ZIRCONIUM ALUMINIUM ALLOYS.

The quickest and most satisfactory method was to dissolve ZrO_2 in hydrofluoric acid and purify the product by successive crystallisation. The potassium salt was formed by adding potassium carbonate solution to a solution of K_2ZrF_6 , obtained as above.

Aluminide (Zr_3Al_4), the so-called "crystalline zirconium," could be prepared by fusing K_2ZrF_6 in a graphite dish and adding to the fusion one and a-half times its weight of aluminium.

A crystalline silver zirconium alloy might also be prepared by the aluminothermic reduction.

III. PREPARATION OF ZIRCONIUM METAL.

Four varieties were referred to: amorphous, crystalline, graphitoidal, and sintered.

The following methods had been employed:—

Amorphous.—(1) Reduction of K_2ZrF_6 with a small excess of sodium in an iron tube. (2) Passing $ZrCl_4$ over heated sodium. (3) Reduction of ZrO_2 with calcium.

Crystalline.—This had proved to be an alloy of zirconium and aluminium.

Graphitoidal.—After repeated failures to prepare this form, the authors held that there was no such variety.

Sintered or "Coherent."—(1) Alumino-thermic reductions. (2) Reduction of ZrO_2 with carbon.

The authors appended a list of both physical and chemical properties of the amorphous and coherent forms of zirconium.

C. M. M.

226. Improved Glass Tank Furnace. HARRY E. DE VAUGHN and WALTER A. JONES (U.S.A. Pat., November 25th, 1919, No. 1322767. Filed October 6th, 1916, No. 124090).—The tank to which the improvement is applied is used for drawing sheet glass, and is of the type in which the crown and the topstone of the drawing end are supported on piers built up from the bottom

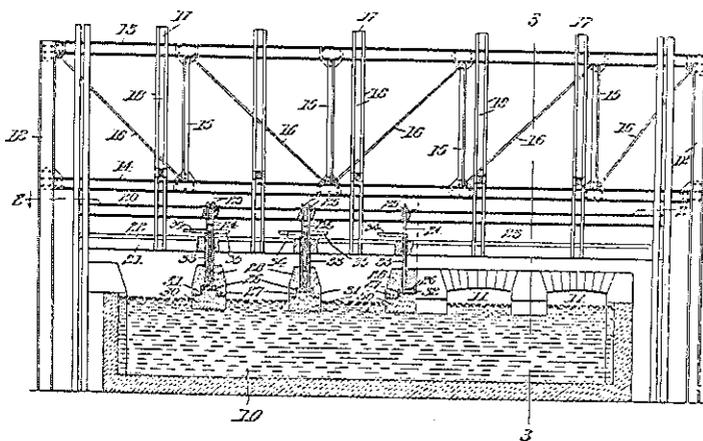


FIG. 122.

of the tank. The destruction of these piers entails loss of production while repairs are undertaken, and adversely affects the quality of the glass through the solution of the refractory material. In order to avoid these disadvantages, the inventor, instead of using piers, suspends the skew blocks, 28, that support the crown and the topstone, from girders above the tank. The suspending rods, 24, are screwed into members, 26, on the underside of the

skew blocks, and the rods may be water-cooled. The members, 26, are also protected by blocks, 30, floating on the metal in the tank.

G. D.

227. The Working of "Siphon" Tanks. H. KNOBLAUCH (*Sprechsaal*, 1919 52, 311).—In the author's opinion, for ordinary tank-furnace practice to be efficient, a free glass surface of about 40 sq. metres was necessary, as if less than this either the temperature ruling in the furnace would be too low to ensure proper founding conditions or the glass at the working holes would be too hot and too fluid for working. Small tanks were only suitable for intermittent working, that is, alternate melting and working out. Small tanks could be used successfully for continuous working if arranged as "siphon tanks." Siphon tanks were similar in general construction to ordinary tanks, with the particular feature that "siphons" or bent, curved fireclay pipes were introduced into the molten glass. The lower ends of these pipes dipped below the surface of the glass to any desired depth, so that the fluid glass was forced upwards into the "siphon." The upper, exposed end of the "siphon" constituted the working hole.

One distinct advantage of the siphon tank was that since the glass was drawn from a deeper level in the tank than was the case in ordinary tank practice—using rings or boats—it was more homogeneous and thoroughly melted. In the opinion of the author, under customary tank-working conditions, the glass was frequently worked from too shallow a layer, and so was gathered too soon after being melted and without having time to become properly homogeneous, while a large quantity of well melted and thoroughly homogeneous glass remained in the tank stagnant.

The author described a tank suitable for siphon work, of which the principal features were as follows:—

A rectangular tank with glass surface 10 m. \times 1 m. and depth of glass 1 m.

Nine siphons (and working holes) along one side and six along the other, the three vacant spaces being utilised as filling-on holes to allow of the batch being spread out as evenly as possible.

The furnace was heated by gas, four burners being placed in each of the ends of the furnace, and the direction of the flames reversed periodically. Gas and air entered in parallel currents, a small mixing chamber being built at the front of the burner. The mixing of gas and air occurred slowly, so that a long flame resulted.

The gas- and air-reversing valves were operated by mechanism from the floor of the glass-house, gas and air being reversed simultaneously. The construction was such that the gas and air regenerator chambers could be exchanged at will to ensure equable heating in the furnace. The supply of gas to each regenerator could be regulated by an adjustment in the valve cover.*

The regenerators were placed at each side under the furnace,

* For detailed description, see *Stahl- u. Eisen*, 1912, No. 38. 7

and directly beneath the burners and between these and the regenerators were chambers to retain batch dust, etc., from the furnace. The author claimed that in such a furnace about $11\frac{1}{2}$ tons of well-melted, homogeneous glass could be withdrawn in 24 hours, the fuel consumption being from $7\frac{1}{2}$ to 8 tons of coal, with an approximate calorific value of 6500 cal.

The construction of the furnace was illustrated by several diagrams.

J. H. D.

228. The Durability of the Burners in Glass-melting Furnaces. H. KNOBLAUCH (*Sprechsaal*, 1919, 52, 407).—Abnormal working of a furnace always led to a reduction in its working life, even when constructed of the best materials, but frequently the cause of the shortened life of a furnace was due to the poor quality of the refractory materials and the inefficient method of working. Irregularity in reversing was a frequent source of failure of the burners, particularly in the case of regenerative gas-fired pot furnaces. The life of the burners was influenced by their construction and the correct regulation of the flame in the furnace. The best melting conditions were attained when a slight positive pressure was maintained in the furnace, as evidenced by the tendency of the flame to flicker outwards through any casual cracks and the lack of any tendency for air to be drawn into the furnace from outside. The amount of flame generated should be as small as possible consistent with the attainment of the requisite temperature. Gas and air should be burnt in the furnace and the chimney draught reduced until only just sufficient to carry away the burnt gases. If the temperature required was not reached, more gas and more air should be sent into the furnace and the chimney draught correspondingly increased until the required temperature was attained. If the chimney draught was too great the flames were drawn into the burners, causing more rapid corrosion and also leading to fuel wastage.

The author described the failure of burners of faulty construction and under faulty working conditions. The type of furnace referred to was the gas-fired pot furnace, either of the "Bütten" type or with slotted burners. Two burners were built in the sole of the furnace, the flame forming an arc between them, and each burner serving in turn as the exit flue for the gases.

The "Bütten" type—with open burners in which gas and air mix below the furnace floor-level—had not proved very satisfactory, since combustion took place in the burner itself and not entirely in the furnace. This led to excessive temperature in the burner and consequent rapid burning away, particularly in the lower part of the burner. The burners should not be significantly narrower at the top than at the bottom, since this increased the tendency of the burners to burn hollow.

Better results were obtained with slotted burners, that is, burners in which gas and air were conducted independently through parallel slits into the furnace, where they mixed and burned.

Here very little combustion occurred inside the burner, which consequently had a longer working life. The gas and air mixed rather slowly, so that this type of burner was unsuitable for very small furnaces, since there was the danger that the gases were incompletely burnt by the time they reached the exits. Shortening the dividing walls between the slits helped to prevent this, since not only did it give the flame a rather longer travel, but it also tended to mix the air and gas rather more rapidly.

Slotted burners were usually corroded or melted away from the top downwards. When this occurred with open burners it was a certain indication that the draught had been too great, and that flame as well as burnt gases had been drawn into the burner.

The author described a furnace with burners of the open type in which the burner was divided into two parts by a fireclay partition; that is, it was a compromise between an open and a slotted burner. To ensure the equal distribution of gas and air into each section of the burner, corresponding division walls were erected in the regenerators, so that each half of the burner was connected with a separate half of the regenerator, and since the gases passing through separate halves of the regenerators could be controlled by dampers, it was possible to regulate the flame distribution in the furnace as desired. This was of considerable value, especially in the case of getting heat to the corner pots.

The various points raised were well illustrated by sketches.

J. H. D.

229. Annealing Apparatus. E. L. ZIEHMANN (U.S.A. Pat., February 26th, 1918, No. 1257441. Filed July 9th, 1917, No. 179497).—The invention consists of a hot stove in which blown

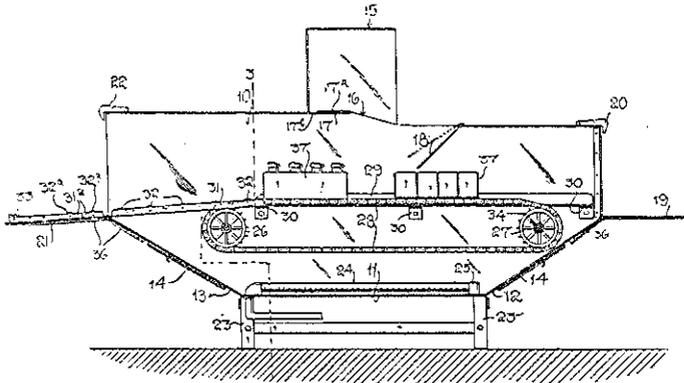


FIG. 123.

ware is placed after being knocked off from the iron until a certain number of pieces have been made, the whole being then taken-in to the lehr. It is explained that the device is designed to overcome the shortage of boys for taking-in.

The device, shown in sectional elevation in Fig. 123, consists of a sheet-iron casing, 10, about 60 inches long by 18 inches wide and 20 inches high, heated by gas burners, 24, and having in its top a hood, 15, covering an aperture, 16, through which the ware is inserted. The ware is placed in compartmented pans, 37, which are supported on an endless chain conveyor, 28, that can be moved by hand when a pan is filled. Doors, 19, 21, are fitted to the ends of the casing, and when it is desired to remove a pan full of ware, the door, 21, is lowered, and the filled pan rolls out on rollers, 32^a. The pan is now carried to the lehr, emptied, and returned to the casing through the door, 19. G. D.

230. Muffle Lehr. H. M. THOMPSON (U.S.A. Pat., February 19th, 1918, No. 1257150. Filed October 1st, 1917, No. 194132).—Relates to a muffle lehr designed to prevent the leakage of gas between the combustion chamber and the muffle or annealing chamber, and thus avoid discoloration of the ware. The lehr, shown in sectional elevation in Fig. 124, consists of side walls and an arched crown, 6, as usual, but below the crown is a flat roof formed of tiles, 12, supported on the flanges of inverted T-girders,

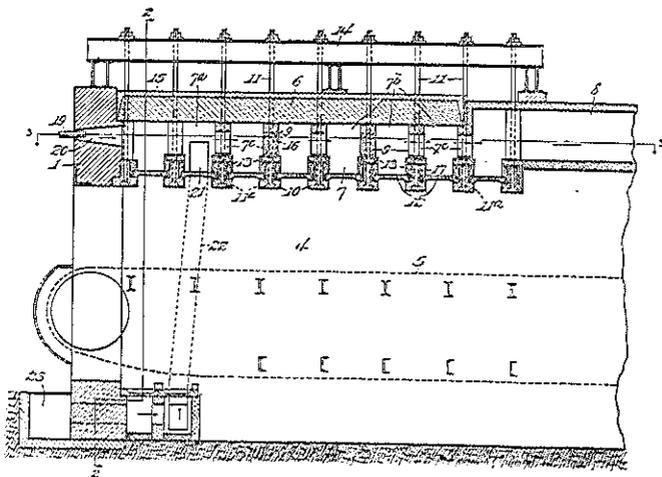


FIG. 124.

10, that are suspended by rods, 11, from outside beams, 10. The tiles thus form the floor of the combustion chamber, 7, which it separates from the annealing chamber, 4, containing an endless band, 5, the ware on the band being annealed by heat conducted through the tiles. Division walls, 9, having openings or ports, 7^e, staggered in respect to one another, break up the combustion chamber, 7, into smaller chambers, forming a tortuous passage, through which the gas must pass to reach the flue, 8. When natural gas, oil, or clean producer gas is used as fuel, it is admitted

through openings, 20, in the front wall of the chamber, 7. Coal may be burned in a grate, 23, communicating with the chamber, 7, by flues, 22, in the side walls of the lehr. G. D.

231. On the New Method of Setting Regenerator Chambers. G. SUCHY (*Sprechsaal*, 1919, 29, 247).—The author continued a discussion on the subject of regenerator chambers in which the chequer work was built up on a series of carriages which could be withdrawn and replaced at will. The idea was not new, but had never met with general acceptance.

In the usual type of furnace—if the dampers were closed during filling-on and correctly regulated during founding, so as to avoid excessive draught—batch dust would not be drawn into the regenerators, and their subsequent stopping up or collapse would be hindered to such an extent that re-setting should not be necessary for one to one and a-half years. After this period the regenerators should be re-set entirely.

In a tank furnace conditions were different. Batch was filled on at hourly intervals and dampers were rarely altered, so that much more batch dust was drawn into the regenerators. The "new" system might be of advantage under these conditions, but as the chambers would have to be re-set along their length the process would be very disagreeable.

Glass from the sieve could be prevented from leaking into the regenerators to a great extent by paying particular attention to the covering of the chambers. As the furnace grew older, however, cracks developed, and some glass frequently found a way into the chambers. To avoid this as far as possible, the following procedure was recommended. Before the first pot setting rake over the sieve a dry mixture of two-thirds quartz sand and one-third plastic clay to fill up all cracks. At each subsequent pot setting fill up all cracks or channels with the same mixture made into a slip with water, and then cover with a liberal coating of sand. In this way the sieve remained intact, and glass could not leak through.

Soft glasses, such as the more fusible lime-soda glasses, could usually be made in furnaces depending chiefly on top heating, but for harder glasses, such as Bohemian crystal, bottom heat was essential. This could be attained by correct furnace practice. For instance, in the improved Siebert furnace, where the regenerators were close under the furnace, so soon as the second filling-on had melted down, the dampers should be lowered. The heat was driven upwards from regenerators and under-furnace, and the flames became clearer, and a steady, successful found resulted.

Overflowing from the glass pocket into the chambers could be prevented by closing the pocket with a fireclay stopper luted lightly with fireclay. When the glass pocket became too full, the fluid glass forced out the stopper and flowed into a special pit, thus obviating the arduous work of drawing the glass from the pocket.

The author agreed that elliptical regenerator blocks were prefer-

able to the ordinary form, but from experience preferred blocks $32 \times 10 \times 10$ cm., on the ground that they distributed the heat more uniformly throughout the chambers.

J. H. D.

232. On the New Method of Setting Regenerator Chambers. J. BALDERMANN (*Sprechsaal*, 1919, 52, 363).—The author maintained that the system of setting regenerator chambers by means of movable carriages had proved efficient in practice. For each chamber three carriages were necessary, and all four chambers could be re-set in two to three hours, whereas in the case of badly fused chambers it took from forty-eight to sixty hours to put these into good order by the older method.

With regard to other points raised in the discussion, the siege of the furnace could be maintained in much better condition by the use of grog than by using the sand-clay mixture recommended by Suchy, since well-burned grog was not so readily attacked by the overflowing glass as were sand and clay, and consequently remained permanent, whereas sand and clay were dissolved by the glass, leaving exposed cracks and channels in the siege. Further, the pots did not bind so firmly to the siege when set on coarse grog as when sand is used. In a furnace with top-flame heating it was quite possible to melt a glass containing 30 parts of soda to 100 parts of sand, or even somewhat harder. The harder the glass the cheaper it was and the better the colour.

The author pointed out that if the dampers were closed during filling-on the result would be that the flame would be driven out through the filling-on holes. He approved the idea of the automatic emptying of the glass pocket, but it remained to be seen whether this would work out well in practice.

J. H. D.

VIII.—Chemical Analysis.

233. Methods for the Determination of Zirconium. J. W. MARDEN and M. N. RICH (*J. Ind. Eng. Chem.*, 1920, 12, 651.)

The following methods were tested, and a table given as to their relative merits:—

1. Phosphate precipitation. Hillebrand, *U.S. Geol. Survey, Bull.* 73 (1900); Lundell and Knowles, *J. Amer. Chem. Soc.*, 1919, 41, 1801; Nicolardot and Reglade, *Compt. rend.*, 1919, 168, 348.

2. Thiosulphate or SO_2 precipitation. Baskerville, *J. Amer. Chem. Soc.*, 1894, 16, 475; Ferguson, *Eng. Min. J.*, 1918, 106, 356, 793.

3. Iodate separation. Davis, *Amer. Chem. J.*, 1889, 11, 25.

4. Peroxide separation. Bailey, *J. Chem. Soc.*, 1886, 149, 481; Walker, *J. Amer. Chem. Soc.*, 1898, 20, 513.

5. Phenylhydrazine precipitation. Allen, *J. Amer. Chem. Soc.*, 1903, 25, 421.

6. Cupferron precipitation. Ferrari, *Atti ist. Veneta Scienze Lettere ed arti*, 1914, 73, 445; Brown, *J. Amer. Chem. Soc.*, 1917, 39, 2358.

7. Fluoride separation. Headden, *Proc. Colo. Sci. Soc.*, 1917, 11, 185.

The authors recommended the following method of analysis:—

Preparation of Sample.—Thorough grinding of the sample was important.

Method of Solution and Separation of Silica.—Alloys were treated with aqua regia and evaporated nearly to dryness to separate the silica, which was filtered, washed and ignited, and then determined by the usual method of volatilisation with HF and H₂SO₄. After the silica had been removed, the filtrate, containing 5 per cent. of H₂SO₄, was made up to a known volume, and suitable aliquot parts of this solution were taken for the determination of zirconium. In no case should more than 0.1 gram of ZrO₂ be taken.

In the case of an ore, 1 gram of the substance was fused in a nickel crucible with four parts of NaOH and one part of Na₂O₃. The fused mass was extracted with water and acidified with sulphuric acid. Silica was then separated as above.

Analysis of Solution containing Fe, Al, Cr, Ni, Mo, W, Ni, Co, Zr, Ti, and P.—An aliquot portion of this filtrate was heated to about 90° and ammonia added until a slight permanent precipitate was formed. Dilute HCl (1:1) was added from a burette until the solution was just clear again, and then five more drops of HCl were added. Three c.c. of an aqueous solution of phenylhydrazine were added, the solution was stirred vigorously, and filtered immediately. The precipitate was washed with hot water and ignited in a platinum crucible. This separated practically all the iron from the zirconium, titanium, and aluminium. To separate further the zirconium and titanium from aluminium the following method was employed. The residue was fused in the platinum crucible with 5–10 grams of Na₂CO₃ and 1 gram of KNO₃. Disintegration with hot water, filtering, and washing followed. The residue now contained zirconium and titanium free from interfering substances (Al, etc.), except perhaps traces of iron. The sodium, zirconate, and titanate were ignited in a platinum crucible, the residue fused with bisulphate, and the zirconium estimated by any of the above-mentioned methods.

If zirconium alone be desired, the following method might be employed. A known volume of the filtrate from the silica, together with 2 c.c. of H₂O₂, was heated nearly to boiling, and a slight excess of disodium phosphate solution added. A white or greenish-white, flocculent, gelatinous precipitate was formed. It was allowed to stand for at least two hours and then filtered, washing

with hot dilute sulphuric acid. It was then ignited in a platinum crucible, and finally the blast applied to remove carbonaceous matter. This ignition was one of the most difficult steps of the whole procedure. The weight of the pyrophosphate, ZrP_2O_7 , multiplied by 0.4632, gave the weight of ZrO_2 .

Iron was determined in a known portion of the filtrate from the silica by precipitating as sulphide from ammonium tartrate solution. The sulphide was filtered, washed, and weighed in a porcelain crucible as Fe_2O_3 .

Titanium might be determined on a separate portion of the original filtrate (remove all HF or HNO_3) colorimetrically or by titration with methylene-blue.

Aluminium was usually determined by difference.

C. M. M.

234. The De Roode-Perchloric Acid Method for Determining Potash. T. E. KEIT (J. Ind. Eng. Chem., 1920, 12, 276).

—This was a preliminary report of work done by the author using the De Roode method of combustion. The procedure was as follows:—2.5 grams of the sample were placed on a 12.5 cm. filter paper and washed with boiling water into a 250 c.c. flask until the washings amounted to about 200 c.c. While hot, the solution was acidified with 5 c.c. of concentrated HCl . The sulphates were precipitated by adding a slight excess of normal $BaCl_2$ solution acidified with HCl , and when cold the solution was made up to 250 c.c. When the precipitate had settled, a 50 c.c. aliquot part, corresponding to 0.5 gram, was transferred to a porcelain evaporating dish, 30 c.c. of aqua regia were added, and the solution was evaporated to dryness on a hot plate. A second 30 c.c. of aqua regia were added and again evaporated to dryness. Finally, 10 c.c. of concentrated HCl and 20 c.c. of distilled water were added and evaporated to dryness. The residue was now dissolved in 20 c.c. of hot water, and 5 c.c. of perchloric acid (sp. gr. 1.12) were added. This was evaporated on a hot plate until copious fumes were evolved. When cold, a second portion of water and perchloric acid were added, and again evaporated until fumes appeared. After cooling, 20 c.c. of 95 per cent. alcohol were added, and then left to stand for about half an hour. The precipitate was collected either on a Gooch crucible or a tared filter paper and washed with alcohol containing 0.2 per cent. of perchloric acid. Finally, the precipitate was washed free from perchloric acid with alcohol ether (1:1). It was next dried at 120° for thirty minutes and, when cold, weighed. The potassium perchlorate was dissolved from the Gooch crucible with about 200 c.c. of hot water, and, to facilitate drying, the asbestos pad was washed with alcohol ether mixture, dried for thirty minutes, and weighed as before. The loss in weight was potassium perchlorate, which, multiplied by 0.34, gave the amount of potassium oxide.

A table was given which summarised the analytical data.

C. M. M.

235. Rapid Determination of Small Amounts of Copper by the Iodide Method. H. F. BRADLEY (*J. Ind. Eng. Chem.*, 1920, 12, 800).—Copper was precipitated as sulphide and washed free from chlorides. (The author stated that it was not necessary to remove iron completely.) The precipitate was then moistened with a few drops of a strong neutral zinc nitrate solution free from chlorides, and ignited.

The residue of zinc oxide and cupric oxide was dissolved by warming with 1 c.c. of 1:2 hydrochloric acid. The solution was next neutralised with a 5 per cent. solution of potassium hydroxide, and then acidified with acetic acid. A little phosphate solution was also added to prevent the action of iron. Finally, 2.5 grams of solid sodium iodide were added, and the solution titrated as usual.

The author stated that the copper sulphide in the first place should not contain more than 0.05 gram of copper. C. M. M.

236. The Use of Cupferron in Quantitative Analysis. G. E. F. LUNDELL and H. B. KNOWLES (*J. Ind. Eng. Chem.*, 1920, 12, 344).—In this paper the authors presented a review of the literature dealing with the use of cupferron (the ammonium salt of nitrosophenylhydroxylamine, $C_6H_5 \cdot N \cdot NO \cdot ONE_4$) as a quantitative precipitant. These precipitates were salts in which the ammonium radicle of the reagent had been replaced by metals. In all cases cold solutions must be employed to prevent decomposition of the reagent into various organic substances, for example, nitrobenzene. Wash waters were always cold, and for iron precipitates the authors suggested a 5 per cent. (by volume) solution of ammonium hydroxide, and a 10 per cent. (by volume) solution of hydrochloric acid for titanium and zirconium precipitates. The ordinary procedure was to ignite the precipitates to oxides, but caution must be exercised in the early stages owing to excessive liquefaction when wet precipitates were ignited and to the heavy liberation of gaseous products from dried precipitates.

Cupferron had been used successfully for the quantitative determination of copper, iron, titanium, zirconium, thorium, and vanadium, but many elements interfered with the determinations. The authors pointed out that in any given determination the partial or complete precipitation of the above six elements must be considered in addition to the following known interfering elements:—lead, silver, mercury, tin, bismuth, cerium, tungsten, uranium in the quadrivalent condition, silica, and in certain cases phosphorus, alkali salts, and alkaline earths when present in excessive amounts. This reagent should not be employed unless the qualitative composition of the material to be analysed was known, otherwise a most careful quantitative examination of the ignited and weighed cupferron precipitate should be made.

In certain separations, namely, iron from manganese and iron and titanium from aluminium and manganese, cupferron might be used advantageously.

C. M. M.

237. Notes on the Preparation of Cupferron. D. R. KASANOF (*J. Ind. Eng. Chem.*, 1920, 12, 799).—The author had obtained a good yield of phenylhydroxylamine from nitrobenzene by using amalgamated zinc dust.

The method of procedure was as follows. Sixty grams of nitrobenzene were thoroughly emulsified by vigorous stirring in 700 c.c. of water containing 30 grams of ammonium chloride. Eighty grams of zinc dust were amalgamated with a 2 per cent. solution of mercurous nitrate acidified with a few c.c. of nitric acid. After settling, the supernatant liquid was poured off and the zinc dust washed with water, under suction, until free from acid, when it was added in small quantities to the nitrobenzene emulsion. Vigorous shaking was essential, and the temperature should be kept at about 16°. After complete reduction, the zinc hydroxide was filtered off, the filtrate cooled to 0°, and sodium chloride added to saturate the volume of filtrate. A voluminous precipitate of phenylhydroxylamine was produced, which, after standing some fifteen minutes, was filtered off with suction and dried between filter paper. (This substance was a violent skin poison. Alcohol was the best remedial application.)

The damp phenylhydroxylamine was dissolved in 500 c.c. of ether and allowed to stand for twelve hours in a closed flask in contact with fused calcium chloride. The ethereal solution was then filtered, cooled to 0°, and saturated with dry ammonia. Sixty grams of cold, freshly distilled amyl nitrite were next added to the ethereal solution, when the vessel became filled with crystals of cupferron, which might be filtered off, washed with ether, and preserved in a glass-stoppered bottle in which a lump of ammonium carbonate was suspended.

C. M. M.

238. A Convenient Method for the Preparation of a Hydrochloric Acid Solution of Cuprous Chloride for Use in Gas Analysis. FRANCIS C. KRAUSKOPF and L. H. PURDY (*J. Ind. Eng. Chem.*, 1920, 12, 158).—In gas analysis, a solution of cuprous chloride in ammonium hydrate or hydrochloric acid was used for the absorption of carbon monoxide. Unless kept from contact with the air, it changed to the stable cupric salt, which was not an absorbent for carbon dioxide.

The present work was undertaken by the authors to ascertain whether a solution of cuprous chloride, produced by the action of stannous chloride on cupric chloride in hydrochloric acid solution, and hence containing stannic chloride, would be as efficient for the absorption of carbon monoxide as would be a solution of cuprous chloride formed by the reduction of cupric chloride by its action on metallic copper, and thus containing no other salts.

The conclusions arrived at were:—

1. That the efficiency for the absorption of carbon monoxide of a solution of cuprous chloride in hydrochloric acid was not impaired by the presence of stannic or stannous chlorides, even in relatively large amounts.

2. That for the preparation of cuprous chloride for absorbing carbon monoxide, a practical and efficient method consisted in dissolving cupric chloride in concentrated hydrochloric acid and reducing to cuprous chloride by the addition of stannous chloride.

The authors stated, further, that such a solution of cuprous chloride might be renewed from time to time, and prove as efficient as the original solution, by heating to 60° or 70° to drive off the carbon monoxide. If in this process a small amount of copper were oxidised and the solution were not colourless, a few drops of a concentrated stannous chloride solution would again reduce it.

C. M. M.

239. The McCrudden Gravimetric Calcium Method Modified. J. O. HALVERSON and J. A. SCHULZ (*J. Ind. Eng. Chem.*, 1920, 12, 77).—The substitution of the volumetric asbestos Gooch method for the gravimetric procedure in the McCrudden calcium method was first employed by the authors in the determination of small amounts of calcium in biological and agricultural products.

High-grade ignited long-fibred asbestos was used, and this was digested at 60° to 70° for one hour with hot sulphuric acid (1:5). A few drops of potassium permanganate were added and the beaker kept covered. The material was then washed free from acid on a Buchner funnel. The Gooch crucible was prepared with some care, using the long, coarse fibres of asbestos first as a foundation, next the medium fibres to fill the interstices, and finally the fine sediment to form a compact top layer.

After the calcium oxalate had been precipitated it was filtered through a Gooch crucible and washed free from oxalate and oxalic acid. The precipitate and pad were then transferred with a small amount of hot water to an Erlenmeyer flask and titrated immediately at 65° with potassium permanganate solution, using sulphuric acid 1:5.

The authors found that this method gave almost identical results with the gravimetric procedure. The method described was rapid and the treated ignited asbestos did not tend to reduce potassium permanganate in the presence of 1:5 sulphuric acid at 65°.

C. M. M.

240. Substitutes for Platinum Wire in Bead and Flame Tests. C. C. KIPLINGER (*J. Ind. Eng. Chem.*, 1920, 12, 500).—The author held that the use of platinum wire in qualitative laboratory work was an important source of waste. It had been found feasible to use the "lead" from a lead pencil as a substitute for platinum wire for making bead tests. A stout piece of "lead" was held in the Bunsen flame by means of tongs until the end was red hot, when it was dipped in borax and returned to the flame. This drop constituted the bead, and the tests were made as usual. The reducing action of the carbon did not seem to interfere materially. The author had found the method described by

Ehringhaus very convenient when used in conjunction with the following device. A glass tube 15 cm. long and 6 mm. in internal diameter was bent at an angle of 45° 2 cm. from one end, and the latter held in the flame until the opening was reduced to 3 mm. in diameter. A small strip of filter paper was rolled tightly to fit the opening, and the longer arm of the tube was filled with the test solution, or with dilute hydrochloric acid if a powder was to be tested on the paper. The burner was supported horizontally, and the upper end of the paper wick was placed so that it barely touched the bottom portion of the flame. The salt solution was vaporised, and coloured the flame with the minimum consumption of paper.

The author also stated that a clean iron nail was of value in these tests, as, in general, the spectra of the iron salts did not interfere.

C. M. M.

241. The Removal of Ammonium Sulphide in Qualitative Analysis. F. FEIGL (*Zeitsch. analyt. Chem.*, 1920, 59, 12).—

The ordinary method of removing ammonium sulphide by acidifying and boiling off the hydrogen sulphide often resulted in the formation of colloidal sulphur, and probably in the production of some sulphuric acid, owing to oxidation of the sulphur. The formation of sulphuric acid interfered with tests for the elements of group IV. These difficulties could be avoided by adding to the solution containing the ammonium sulphide a slight excess of lead hydroxide, warming the mixture, and then filtering. The filtrate obtained was quite clear and free from lead and sulphur.

F. W. H.

242. The Determination of Potassium as Perchlorate.

G. P. BAXTER and M. KOBAYASHI (*J. Amer. Chem. Soc.*, 1920, 42, 735).—The authors recommended the use of a platinum sponge crucible, absolute alcohol, and a low temperature (0°) in washing, the solution of the precipitate in water, and a further evaporation during the course of washing. For the washing of the potassium perchlorate after the sodium perchlorate had been extracted with alcohol containing perchloric acid, a saturated solution of potassium perchlorate in alcohol containing perchloric acid at the temperature of washing was also recommended. The saturated solution should be made by dissolving the requisite amount of potassium perchlorate in a hot concentrated solution of perchloric acid in water and adding the solution to absolute alcohol.

F. W. H.

243. The Separation of Chromium and Manganese.

M. HERSCHKOWITSCH (*Zeitsch. analyt. Chem.*, 1920, 59, 11).—To the solution containing the manganese and chromium as permanganate and chromate, respectively, ammonium sulphate was added, and then excess of ammonium hydrate. The mixture was heated on a water-bath for some hours and the whole of the manganese precipitated. The manganese precipitate was filtered off, washed

with a 5 per cent. solution of ammonium sulphate, finally washed with hot water, ignited to Mn_2O_3 , and weighed as such. The filtrate contained the chromate unchanged.

F. W. H.

244. The Separation of Zirconium and Titanium as the Phosphates. J. BROWN and H. T. MADDEN (*J. Amer. Chem. Soc.*, 1920, **42**, 36).—The solution containing the sulphates of zirconium and titanium was rendered acid to the extent of from 1 to 2 per cent. of free sulphuric acid by volume. Excess of hydrogen peroxide was added and the zirconium phosphate precipitated by the addition of excess of sodium or ammonium phosphate. After standing overnight, any titanium in the zirconium phosphate, after filtering and washing, was removed as in the original Hillebrand method, and the filtrates were added to the main filtrate from the zirconium precipitation.

The combined filtrate containing titanium was heated to remove hydrogen peroxide, adjusted so as to contain 2 per cent. excess of sulphuric acid by volume, and then excess of sodium or ammonium phosphate was added and the solution allowed to stand one hour. After filtering and washing, the phosphate was converted to titanium oxide and weighed as such, since it was found that the titanium phosphate precipitate was of variable composition.

F. W. H.

245. The Use of Iridium Crucibles in Chemical Operations. W. CROOKES (*Proc. Roy. Soc.*, 1908, **80**, [4], 535).—Iridium was as hard as steel, and a crucible was almost unaffected by any mechanical treatment that could reasonably be applied to it. The author subjected an iridium crucible to a large number of exacting tests, and there was no loss in weight or apparent action on the metal, when a platinum crucible would have been affected badly. Nickel, gold, iron, and zinc were melted in it and poured off with no injury to the crucible. Copper melted in it for some time made it brittle whilst hot, but if the copper was burnt off at a high temperature the iridium was undamaged.

A rhodium crucible was found to be nearly equally resistant, and as the weight would be only one-half of that made of iridium the cost would be less.

J. R. C.

IX.—Machinery for the Working of Glass.

246. Bottle-blowing Machine. MICHAEL J. OWENS (U.S.A. Pat., November 25th, 1919, No. 1322726. Filed October 26th, 1914, No. 868730).—The invention consists of detailed improvements in the Owens machine, particularly that form of the machine described in U.S.A. Pat. No. 1185687. The improvements consist of (1) a steadying device for supporting the parison and preventing

it from swinging, and also for avoiding the shear mark caused by returning the cut-off knife in position, as at present; (2) a vertically rising blow mould; and (3) the use of compressed air for opening and closing the blow moulds.

On each arm of the machine a bracket, *K* (Fig. 125), is secured below the blow mould, and this bracket carries two air cylinders, one of which, *L*, raises and lowers the blow moulds, and the other, *L'*, has a bottom plate, *Q*, secured to the upper end of its piston rod, *N'*. After a charge has been sucked into the parison mould,

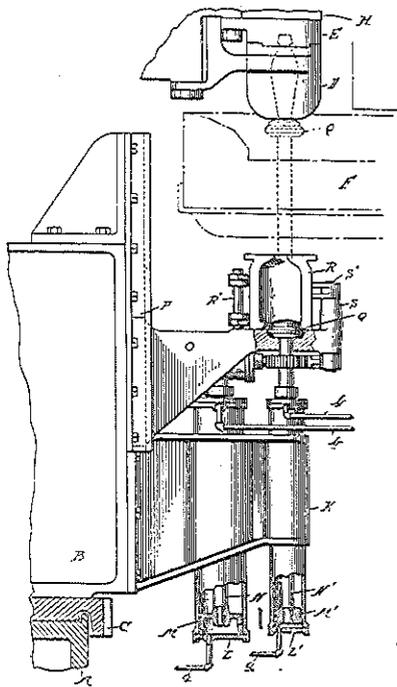


FIG. 125.

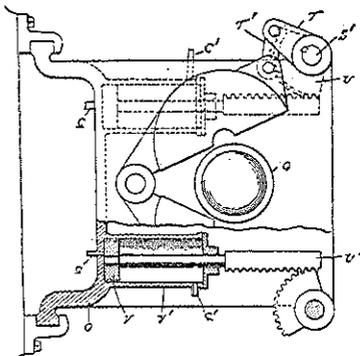


FIG. 126.

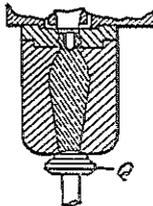


FIG. 127.

D, from the rotating tank, *F*, the shears cut off the thread of metal and is then withdrawn. The bottom plate, *Q*, is then raised, and closes the bottom of the parison mould, as shown in Fig. 127. The plate, *Q*, remains in place when the parison mould is open, and thus prevents the parison from swinging while the blow mould is being raised and closed about the parison. The halves of the blow moulds are connected by links, *T'* (Fig. 126), to cranks, *T*, which are rotated by racks, *v*, *v'*, formed on the piston rods of air cylinders, *V'*, secured to the slides of the blow moulds. By the use of air to operate the moulds, the danger of breakage due to chilled glass getting between the sections of the mould is avoided. G. D.

247. Semi-automatic Bottle-blowing Machines. JOHN RAU (U.S.A. Pat., December 16th, 1919, No. 1325331. Filed January 12th, 1917, No. 142023).

The specification describes the parison-forming mechanism of a semi-automatic bottle-making machine in which the mould table, 15, is rotated step by step by hand, and the blow-head, 73, for admitting air for packing the metal into the parison mould, is lowered on to the moulds by hand. The invention lies chiefly in the construction of a valve, 27, which controls the air supply. The upper end of the stem, 26, of this valve locks the table against rotation, and it is depressed by means of a pedal, 32, to free the table. Thus the action of locking or unlocking the table controls the air for packing the metal into the mould, for operating the plunger, 66, which forms the mouth of the bottle, for operating the mould cover, 91, and for blowing-up the parison in the mould against this cover. The construction of the valve and the arrangement of the air pipes are described in detail in the specification.

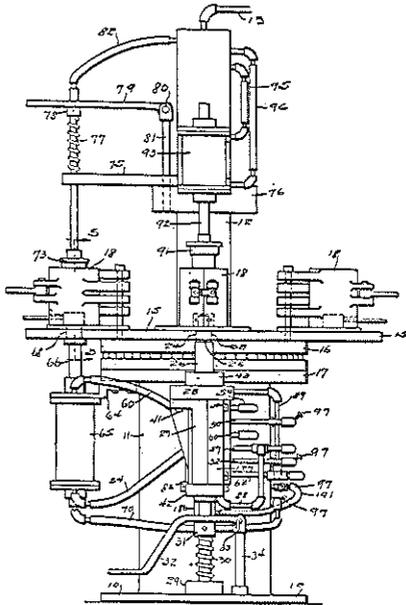


FIG. 128.

The upper end of the stem, 26, of this valve locks the table against rotation, and it is depressed by means of a pedal, 32, to free the table. Thus the action of locking or unlocking the table controls the air for packing the metal into the mould, for operating the plunger, 66, which forms the mouth of the bottle, for operating the mould cover, 91, and for blowing-up the parison in the mould against this cover. The construction of the valve and the arrangement of the air pipes are described in detail in the specification.

G. D.

248. Improvements to Bottle-blowing Machines. KARL E. PEILER (Assignor to HARTFORD-FAIRMONT Co.) (U.S.A. Pat.,

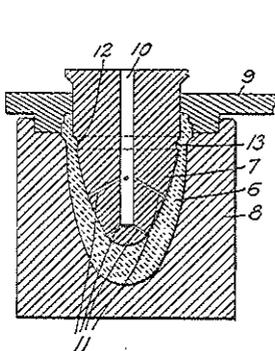


FIG. 129.

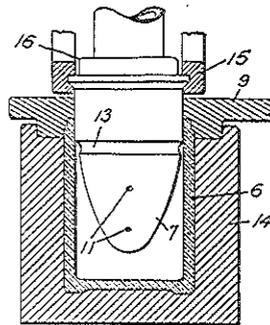


FIG. 130.

37847).—In order to avoid the use of a two-part ring mould, particularly with automatic or semi-automatic machines, the press plunger, Fig. 129, which forms the parison, has a shallow, circumferential groove, 13, near its base, and is also pierced with air passages, 10, 11. Part of the metal of the parison is forced into the groove, 13, and gives sufficient anchorage to enable the parison to be transferred to the finishing mould by means of the plunger. When the parison is blown out in the finishing mould, as shown in Fig. 130, by air admitted through the passages, 10, 11, the temporary shoulder formed inside the parison disappears and the plunger can be withdrawn from the finished article. The plunger can also be used with machines which gather by suction. G. D.

249. Making Vacuum Bottles. HARRY BASTOW (U.S.A. Pat. February 12th, 1918, No. 1256427. Filed March 14th, 1917, No. 154721).—The specification describes a process of making vacuum vessels by pressing.

The mould comprises a base, 10 (Fig. 131), with an upstanding

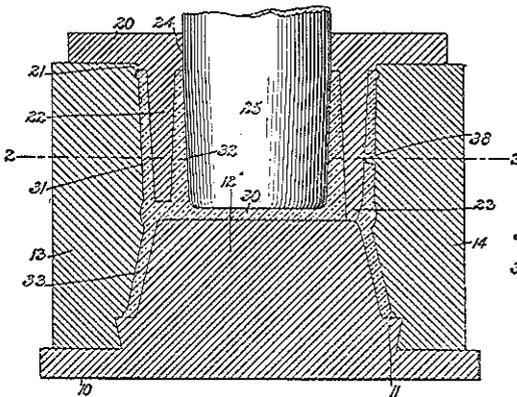


FIG. 131.

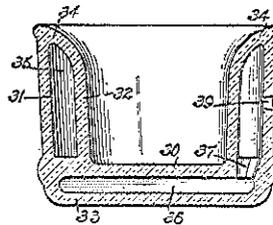


FIG. 132.

core, 12, a two-part body, 14, and a ring mould, 20, with a depending annular core, 22, which at one or more places, 23, is extended to meet the core, 12. After removal from the mould, the blank, of the shape shown, is "warmed in," and the walls and bottom are closed in by hand to form a vessel of the shape shown in cross-section in Fig. 132. G. D.

250. Mould for Bottle-blowing Machines. EDWARD S HUTTON (U.S.A. Pat., January 15th, 1918, No. 1253246. Filed February 12th, 1916, No. 77991).—The parison mould and finishing mould of a bottle-blowing machine are arranged in one framework and contiguous to one another, and the halves of both moulds are opened simultaneously, so that the parison is moved quickly

from one mould to the other and undue chilling is avoided. The moulds are shown in end elevation in Fig. 133 and in side elevation in Fig. 134. They are arranged side by side, and the halves are screwed to cross-frames, 14, 15, which are mounted in guideways formed by bars, 13. The bar 15 is stationary in the guides, but the bar 14 can be moved along the guides by a tube, 18, movement of which thus opens or shuts both moulds. The frame, 12, to which the bar, 13, is secured is mounted on trunnions, and can be oscillated by a crank, 20, to invert the moulds. The upper ends of the corresponding mould halves are connected by a guideway, 23, and a "lift-over," 25, carrying the halves of the ring mould,

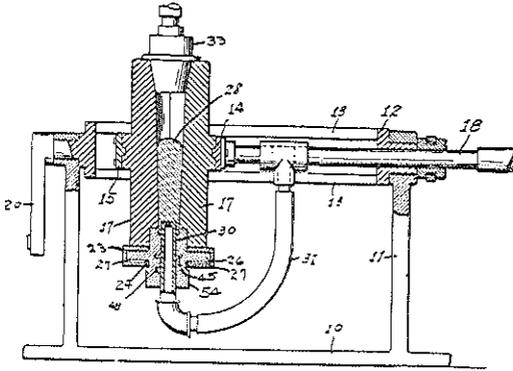


FIG. 133.

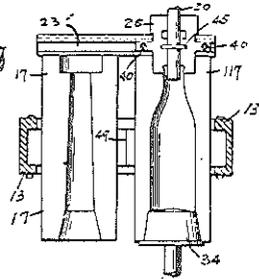


FIG. 134.

slides in this guideway. A blow tube, 30, connected by a tube, 31, with the tube 18 is also carried by the lift-over.

In use, the "lift-over" is moved to bring the ring mould over the parison mould, the moulds are closed, and are then inverted, as shown in Fig. 133. Metal is then dropped into the mould and is packed down into the ring mould by air admitted from a blow-head, 33. The parison is then blown by air admitted to the tube, 30, the blowhead, 33, removed, and the moulds inverted. The mould halves are next separated by sliding the tube, 18, and the "lift-over" is moved along the guideway, 23, so that the parison is suspended in the finishing mould, as shown in Fig. 134. The moulds are closed, a bottom, 34, is moved into place, and the parison is blown in the finishing mould. The corresponding halves of each mould could be made in a solid piece, but it is preferable to keep them separate in order to facilitate cooling. G. D.

251. An Automatic Taking-off Device for Glass-blowing Machines. H. C. FENTRESS (U.S.A. Pat., April 6th, 1920, No. 1336028. Filed February 21st, 1919).—This automatic taking-off device consists of a pedestal, 19, fixed vertically in front of the blowing-machine table, 17 (Fig. 135). On this pedestal is mounted in a horizontal plane an annular bearing concentric with

the post, 19. Journalled to the post, 19, and carried by ball bearings in the annular rim, is a turntable, 23. This turntable has

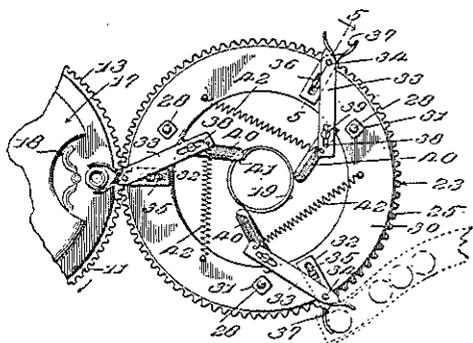


FIG. 135.

peripheral gear teeth, 25, meshing with similar teeth, 13, on the table of the blowing machine. Mounted above the turntable, and held in position by the studs, 28, and binding nuts, 31, is an annulus, upon which are carried the taking-off jaws, each of which consists of a pair of levers, 32 and 33, connected together in crossed relation by the pivot, 34. The lever, 32, is slidally

mounted, but otherwise fixed by the set screw, 36, while the lever, 33, is movable and is operated by the tripping cam, 41, cut on the upper end of the post, 19, and the retractile spring, 42, which keeps the lever, 40, up to the cam, 41.

In operation, the turntable, 23, moves along with the table, 11, and the take-off jaws are set at intervals, so as to synchronise with the bottle moulds. The action of the tripping piece, 40, and the tripping cam, 41, then causes the jaws to grasp the bottle, and, as the table rotates, to carry it round and deposit it on a conveyor or into a receiver.

S. E.

252. Ring Mould for Bottle-making Machine. W. STENDER (U.S.A. Pat., March 19th, 1918, No. 1259800. Filed April 2nd, 1917, No. 159053).—

Relates to a ring mould chiefly designed to prevent the formation of fins on the bottle mouth. The mould is made in halves, 8, 9 (Fig. 136), as usual, and the complete mould is of conical shape, so that it fits into a conical recess, 6, in the block, 5, that holds the mould. Thus when moulding pressure is applied to the mould, the halves are forced tightly together, and the formation of seams,

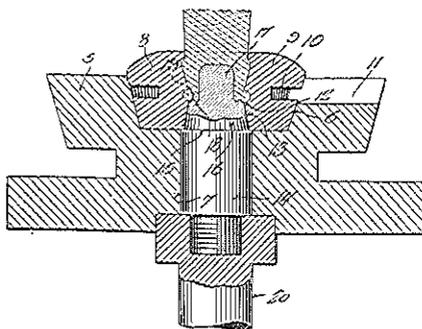


FIG. 136.

resulting in fins, on the bottle neck is prevented. The plug, 14, slides in the bore, 7, of the block, 5, and has a conical portion, 16, which fits into a conical recess in the ring mould. The plug and the inner surface of the mould are shaped to form a bottle mouth,

having an annular groove suitable for the capsule closure, described in U.S.A. Pat. No. 1191194. G. D.

253. An Improved Mould. KARL E. PEILER (Assignor to HARTFORD-FAIRMONT Co.) (U.S.A. Pat., March 12th, 1918, No. 1259280. Filed March 17th, 1914, No. 825237).—A mould for either hand-working or for machine consists of a body, 3 (Fig. 137), of the usual size and shape, and a liner, 13, which constitutes the mould proper. Thus one set of bodies will serve for moulds of many different patterns, and a liner when worn can be replaced cheaply. G. D.

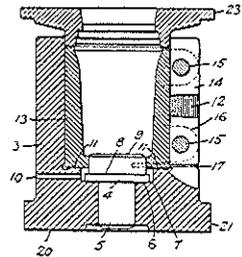


FIG. 137.

254. Apparatus for Transferring Glass to Moulds. R. LA FRANCE (Assignor to the Owens Bottle Machine Co.) (U.S.A. Pat., February 24th, 1920, No. 1331511. Filed June 17th, 1918).—The object of this invention is to guide formed gobs of glass into the moulds of a continuously moving machine. An oscillating transfer device, 16 (Fig. 138), in the form of a trough is the means used to guide the glass into the moulds, 17, on the

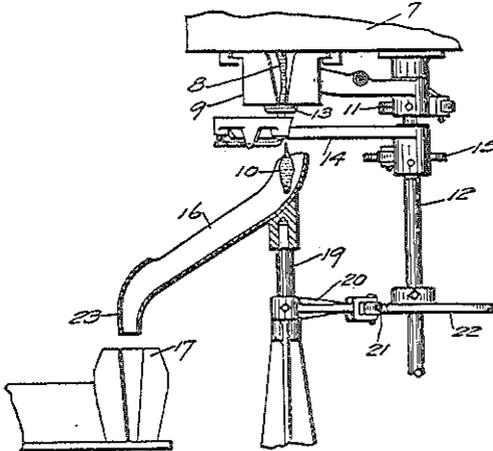


FIG. 138.

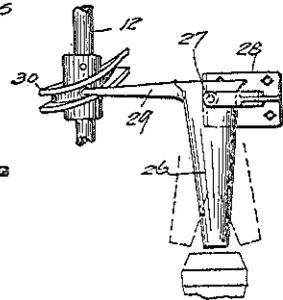


FIG. 139.

moving table of the machine. The chute, 16, is mounted on a vertical rocking shaft, 19, to which is secured an arm, 20, carrying a cam roll, 21, held by a spring (not shown) against the cam, 22, which is mounted on the cam shaft, 12. The cam, 22, is so formed that it oscillates the trough, causing it to move in the same direction as the mould, 17, and in register therewith, while the mould is passing the charging station.

In a modified form (Fig. 139) the transfer device is in the form of a funnel, 26, pivoted on a bracket, 28, so as to swing about a horizontal axis, 27. An arm, 29, extending horizontally from the upper end of the funnel engages a cam, 30, on the shaft, 12. This cam is so formed as to swing the lower end of the funnel in an approximately horizontal direction, the limit of movement being indicated by the broken lines.

S. E.

255. Apparatus for Transferring Charges of Glass.

J. M. LENTS (Assignor to the Owens Bottle Machine Co.) (U.S.A. Pat., February 24th, 1920, No. 1331512. Filed May 20th, 1918).—This invention relates to means for transferring charges of molten glass from a flowing device or gob-forming apparatus to two forming machines. Molten glass is allowed to

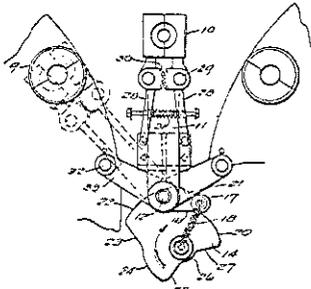


Fig. 140.

flow into a preliminary gob-forming or accumulating device, and then when ready is allowed to fall into the transfer cup, 10 (Fig. 140), which is carried on a rocking arm, 11, fixed on the shaft, 12. The shaft is journalled in a standard and rocked by means of a cam, 14, carried on a continuously rotating shaft, 15. An arm, 16, fixed to the rocking shaft carries a cam roll, 17, which is held against the cam by a spring, 18. The cam is so formed that the cup, 10, is held stationary beneath the flow opening while it receives a charge, and then swings alternately to the right and the left to transfer the charges in turn to the two machines. The cup, 10, is made in sections carried on arms, 28, which are mounted on pivots, 29, and have intermeshing gears, 30. Normally, the cup is held closed by the spring, 31. As the cup comes over a mould in the discharging position, one of the arms, 28, engages a stop, 32, thus opening the cup, as indicated by the broken lines.

S. E.

256. Removing Glass from Furnaces. E. T. FERNGREN

(U.S.A. Pat., June 1st, 1920, No. 1342042. Filed September 4th, 1913, No. 788174).—When glass is withdrawn from a furnace by mechanical means, for example, by suction moulds, the removing tool dips into the mass of glass each time at substantially the same point, thus causing a very appreciable chilling at that point. When the gathering is done by hand this source of trouble does not arise if the worker does not dip his tool into the surface of the glass at the same place a number of times in succession.

If the surface layer of the glass be moved in between the successive dips of a mechanically operated tool, then no local chill-

ing can occur, and each gather will consist of fresh, uninjured glass. This movement of the surface can be obtained by allowing the glass to overflow from the fining chamber into a trough with a slight downward inclination, from which the glass is gathered. This trough preferably opens into an enlarged receptacle adapted to receive such glass as is not removed from the trough in flowing through. The glass flowing into the collecting receptacle may be returned to the furnace in any desired manner.

S. E.

257. Means for Transferring Molten Glass to Moulds.

L. D. SOUBIER (Assignor to the Owens Bottle Machine Co.) (U.S.A. Pat., February 24th, 1920, No. 1331536. Filed July 8th, 1918).—A continuously rotating bottle machine is more rapid in operation than an intermittent one, but as the moulds of such

a machine are not stopped at the charging point, special provision must be made to guide the glass into the moving moulds. This may be effected in this invention, in which a series of inclined troughs, 15, are mounted on a vertical axis. Each trough is pivoted to the bracket, 17, which is mounted on the continuously rotating vertical shaft, 18. The path of travel of the discharging end of the troughs is controlled by the stationary cam, 20, mounted on a standard, 30.

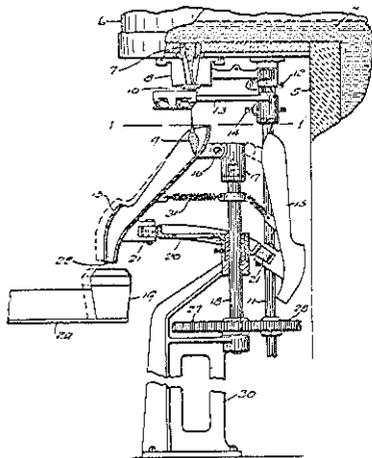


FIG. 141.

The guides have cam rollers, 21, which are held in position against the cam surface by tension springs, 31. The cam, 20, is formed with a re-entrant portion, the curvature of which is substantially concentric with the path of the moulds, thus the discharge opening of each chute remains in register with the corresponding mould while travelling through an arc of some length. The cam, 20, is so shaped that it allows the chutes to drop into a vertical position when they have passed over the mould table, thereby allowing the apparatus to be used in a limited space.

S. E.

258. Mechanism for Delivering Glass. R. NETTER U.S.A. Pat., September 2nd, 1919, No. 1314691. Filed November 12th, 1915, No. 61015).—In Fig. 142 *A* indicates the usual delivery end of a tank furnace, *B* an auxiliary spout, *C* the cut-off mechanism, and *D* the mould table. Beneath the opening, 2, in the delivery

end, *A*, is a circular chamber, 5, intended to hold the head, 7, of the auxiliary spout and allow it to rotate. The spout, *B*, is pivoted between the forked end, 12, of an extension of the central column, 8, of the mould machine, and its height may be adjusted by the set screw, 14. This spout is preferably comprised of a refractory lining, 15, and a supporting casing, 16, and is arranged so that its lower end moves along the same path as the moulds. Attached to the lower end of the spout is a water-cooled plate, 17, to which the cutting members are attached. Mounted on the central column, *A*, is a spring, 30, which, operating against the extension, 31, keeps the spout when it is free in its initial position against the stop, 32.

The operation of the device is as follows. Glass flows from the tank shoe, *A*, through the opening, 2, into the spout, *B*, which is held by the spring, 30, against the projection, 32, until a mould comes underneath the lower end of the spout. The member, 23, then comes against an extension, 22, of the cutting mechanism, and, pressing against it, opens the cutting shells, thus allowing the glass to fall into the mould. The member, 23, by bearing against the extension, 22, also carries the spout along with it for some distance before the cutting shells are released and brought together again by a spring. When the stream of glass has been severed, the spring, 30, brings the spout back to its initial position ready for the next mould coming along.

The glass in the spout may be maintained in a molten condition by suitable heating means.

S. E.

259. Flowing Molten Glass. J. WHITTEMORE (Assignor to the Owens Bottle Machine Co.) (U.S.A. Pat., July 15th, 1919, No. 1310225. Filed December 26th, 1918, No. 268256).—The primary object of this invention is to provide means for reheating the severed end of a mass of glass that has been severed and chilled by a cutter, and at the same time to reheat the whole mass of glass and prepare it for entering the mould.

Just below the exit from a flow chamber, a cap with an inner refractory lining is provided. This lining is heated by a coil of resistance wire, and in turn serves to heat the gob of glass falling from the furnace extension. The glass is prevented from coming into actual contact with the heated lining by means of jets of hot air supplied through perforations in the walls of the cup. Suit-

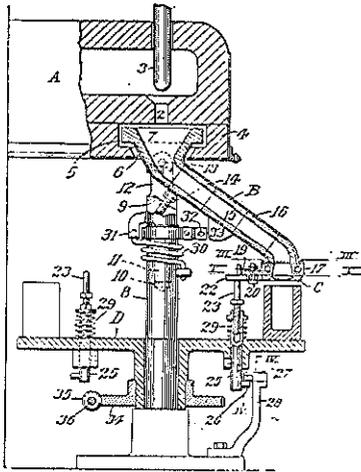


FIG. 142.

able mechanism is provided for automatically dropping the cup away from the glass and swinging it to one side after the glass has been sufficiently reheated. The cam-operated shears then sever the stream of glass and allow the gob to drop into the mould.

S. E.

260. Apparatus for Delivering Mould Charges from Glass Furnaces. S. DAVIDSON and A. L. SCHRAM (Assignors to Schram Glass Manufacturing Co.) (U.S.A. Pat., April 27th, 1920, No. 1338214. Filed July 21st, 1917, No. 182046).—The aim of the inventors is to provide means for separating and dropping charges of molten glass into moulds under the action of gravity alone, and without any chilling of the depending end of the stream of glass. The chilling of the glass at the point of severance is avoided by having the molten glass above the shears drawn upwards immediately it has been cut, so that at no time do the shears support the stream of glass.

As shown in Fig. 143, the furnace bed, 13, is apertured to receive

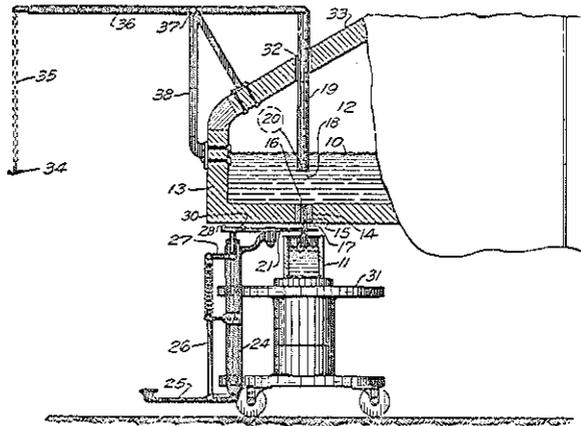


FIG. 143.

the bushing, 14, through which the orifice, 15, extends. The mouth of the orifice, 16, is closed when the apparatus is at rest by the lower face, 18, of the plunger, 19. The plunger is mounted through the aperture, 32, in the furnace top, and is operated through the lever, 36.

When a mould is in position to receive a charge the plunger is raised, thus permitting a stream of glass to flow through the orifice, 15. When sufficient glass has flowed through the orifice, the shears, 21, are actuated, severing the stream of glass just below the mouth, 16. As soon as the shears have made the cut, the plunger, 19, begins to move upward, and in so doing pulls the column of glass, 23, with it, so that it becomes reheated by contact with the mass of glass in the furnace. By the time the downward movement of

the plunger has begun, the glass of the column, 23, has thoroughly mixed with the body of glass, and the discharge of a new mould charge has begun under the action of gravity. It is found that the upward movement of the glass responds more certainly to the action of a plunger having a cupped cavity in its lower face.

S. E.

261. Means of Charging Glass Moulds. J. F. RULE (Assignor to the Owens Bottle Machine Co.) (U.S.A. Pat., February 24th, 1920, No. 1331528. Filed July 26th, 1918).—The object of this invention is to provide a mechanism comprising a receptacle in which glass is accumulated and formed into gobs, and which can be moved from a filling to a discharging position, and thereby serves as a transfer device for transferring gobs to the moulds.

A continuous stream of glass flows through an opening, 7 (Fig. 145), in the bottom of the furnace extension, 6, and through a compartment, 8, into the transfer cup, *C*. The cup, *C*, is carried on an arm, 11, mounted to rock on a shaft, 12, by means of which

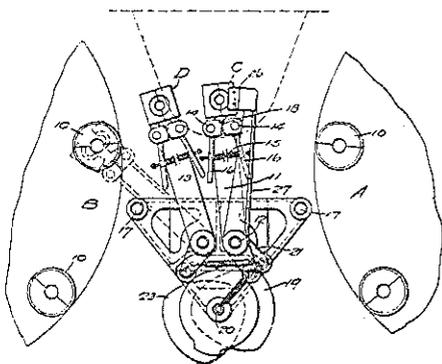


FIG. 144.

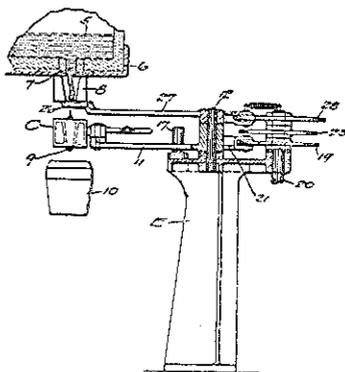


FIG. 145.

the cup can swing to its discharging position above the mould, 10. The transfer cup, *D* (Fig. 144), is similarly mounted, and can swing over the mould, 10, on table *B*. Each of these transfer cups is built up in sections made to swing on pivots, 14, permitting the sections to separate and drop their charges into the moulds. As the cup swings to its discharging position, a stop, 17, in the path of the arm, 16, separates the cup sections against the action of the spring, 15. Intermeshing gears, 18, ensure equal movement of the cup sections about their pivots.

The cup-carrying arm is rocked by a cam, 19, on a continuously rotating shaft, 20. The cam is so shaped that during nearly one-half revolution the cup, *C*, is held below the opening, 7, and is then swung into position over the mould, 10, and held there until the gob has dropped into the mould. The movements of the cup,

D, are controlled by a similar cam, 23. These cams are so arranged that as soon as one cup begins its travel towards the mould table it is immediately replaced by the other cup. A knife, 26, forms a temporary bottom for the receptacle, 8, during the short interval in which one cup is being replaced by the other. S. E.

262. Making Globes and Shades. FREDERICK W. STEWART (U.S.A. Pat., March 12th, 1918, Nos. 1259156 and 1259157. Filed June 20th, 1916, Nos. 104668 and 104669).—Relates to the method of making globes, shades, and other open-ended hollow articles by pressing and blowing, the lower end portion of the article when taken from the mould being cracked-off and ground.

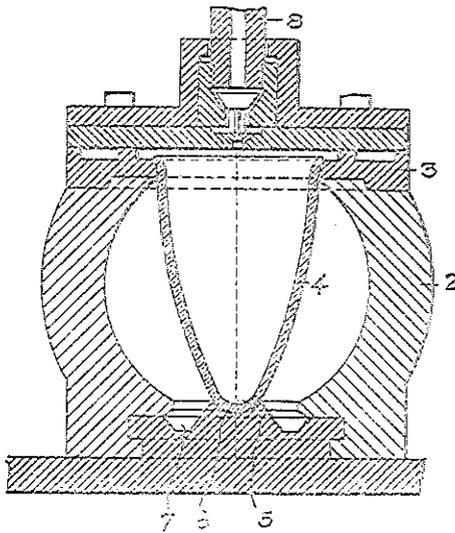


FIG. 146.

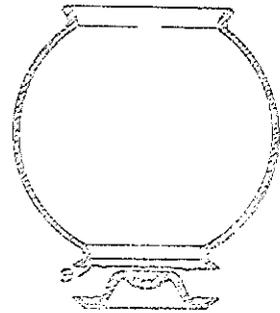


FIG. 147.

According to the invention, the bottom of the finishing mould has a raised central boss, 5 (Fig. 146), with a concave seating, 6, which supports the lower end of the parison, 4, as shown, when it is placed in the mould. When the parison is blown out to fill the mould, the part that fills the recess, 7, is thinner than the wall of the globe proper owing to the chilling of the end of the parison by resting in the seating, 6. The bottom can now be removed by tapping it from the inside, when it breaks away along the thin part, 9, as shown in Fig. 147. G. D.

263. Shearing Hot Metal. W. A. LORENZ (Assignor to The Hartford-Fairmont Co.) (U.S.A. Pat., December 30th, 1919, No. 1326460. Filed March 27th, 1917, No. 157668).—The invention consists of shears for severing a stream of molten glass into drops. The blades, 1, 2 (Fig. 148), are stamped from relatively

thin sheet steel, and are provided with V-shaped cutting edges, 15. The points, 5, of the V-shaped notches are bent as shown in Fig. 149, in order to ensure that the blades will ride past each other when they come together for cutting. One of the blades is

FIG. 148.

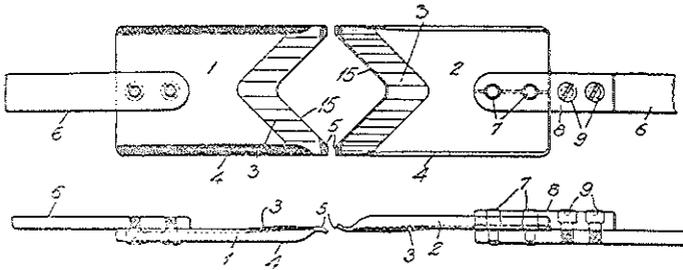


FIG. 149.

secured firmly to its shank, while the other is free to rock slightly in its shank. The purpose of this arrangement is to ensure that the cutting edges of the two blades remain in contact with one another during cutting. The blades are stiffened by bending over the edges, 4. G. D.

264. Drawing Glass. CLARENCE P. BYRNES (U.S.A. Pat. December 30th, 1910, No. 1326571. Filed February 4th, 1914, No. 816507).

—The invention consists in drawing two or more cylinders simultaneously, one within the other, in order to increase output. It is stated that the method may be used to produce double-walled vacuum-jacketed receptacles. Two concentric baits, 2^a, 3^a (Fig. 150), are employed, and air is admitted to the cylinders either through the baits or, as shown, through tubular bosses, 17, in the pot. A water-cooled box, 18, projecting into the inner cylinder is used to cause setting of the glass of the inner cylinder, and a water-cooled jacket, 15^a, surrounding the outer cylinder may be used.

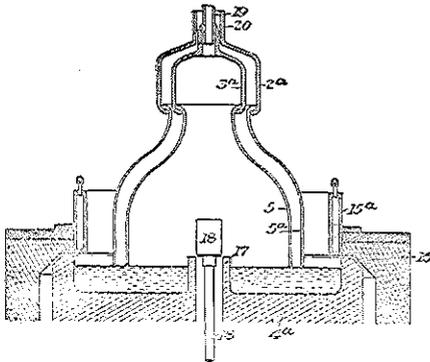


FIG. 150.

G. D.

265. Drawing Glass Sheets. HARRY G. SLINGLUFF (Assignor to Pittsburg Plate Glass Co.) (U.S.A. Pat., January 1st, 1918, No. 1251932. Filed May 16th, 1916, No. 97797).

—The inven-

tion relates to the drawing of glass in sheet form and to means for preventing the pulling-in of the edge of the sheet. The drawing member consists of a block, 4 (Figs. 151 and 152), floating on the metal, 3, and provided with an elongated slot, 15, through which the sheet, 16, is drawn. Drawing-blocks, 5, rest in the ends of the slot, 15, and the height of each block above the member, 4, is adjustable by means of a refractory block, 7. Each block, 5,

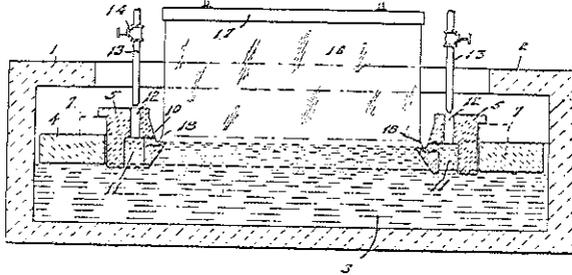


FIG. 151.

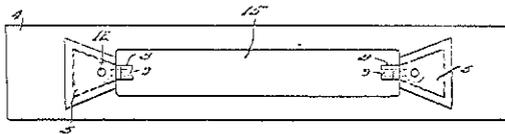


FIG. 152.

has an extension or shelf, 8, having its upper face grooved, and this groove communicates by an opening, 10, with vertical openings, 11, 12, pierced through the block.

In use, the blocks, 5, are adjusted so that the edges of the sheet are drawn from the grooved upper faces of the extensions, 8, as shown in Fig. 152. If the sheet tends to pull in its edges, jets of air from pipes, 13, are directed into the openings, 12, thus cooling and stiffening the metal from which the edges of the sheet are drawn.

G. D.

266. Drawing Glass Cylinders. CLYDE S. ROBB (U.S.A. Pat., February 12th, 1918, No. 1256260. Filed January 16th, 1917, No. 142622).—The specification describes an apparatus for drawing glass cylinders. The pot, 2, is of usual construction, and is fitted with a hollow central standard, 6, for admitting air to the interior of the cylinder. The bait, 8, is cylindrical, and telescopes on to a base, 8, which is fixed to a vertical guide rod, 11, sliding through bearings, 12. Lugs, 23, on the bait are engaged by hooks, 24, on cables, 25, which are drawn upwards by a motor, 16. The motor is situated in a cage, 13, which runs on overhead rails, 15. In use, a cylinder is drawn until a latch, 20, engages

a notch, 19, in the rod, 11. The cylinder is then severed at its lower end and the bait is lowered until it is free from the base, 9, and the cylinder is then removed. During drawing, the cylinder is surrounded by a rectangular framework, 29, having louvered

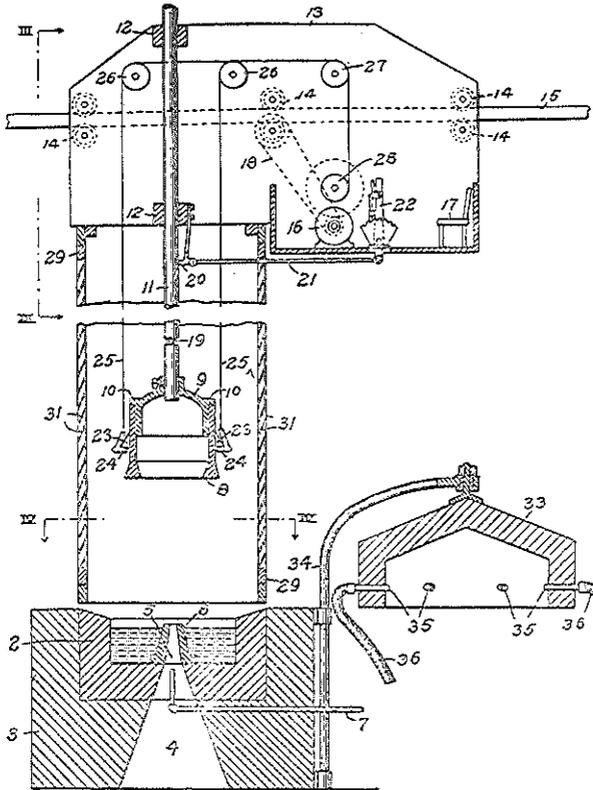


FIG. 153.

sides, which are adjustable like the slats of a venetian blind. By this means, the circulation of air along the cylinder can be regulated. A protecting cover, 33, of refractory material, and fitted with gas burners, 35, is arranged so that it can be swung over the pot when required. G. D.

267. Drawing Sheet Glass. HALBERT K. HITCHCOCK (U.S.A. Pat., December 16th, 1919, No. 1324965. Filed January 2nd, 1918, No. 209867).—Sheet glass is made by drawing the metal upwards in a flat strip or sheet, 7 (Fig. 154), through a longitudinal slot in a refractory member, 1, supported above the body of molten metal, 3. The drawing-slot is partly filled with a refractory bar,

6, the distance of which below the surface of the metal may be adjustable. This bar serves as a shield to protect the sheet, 7,

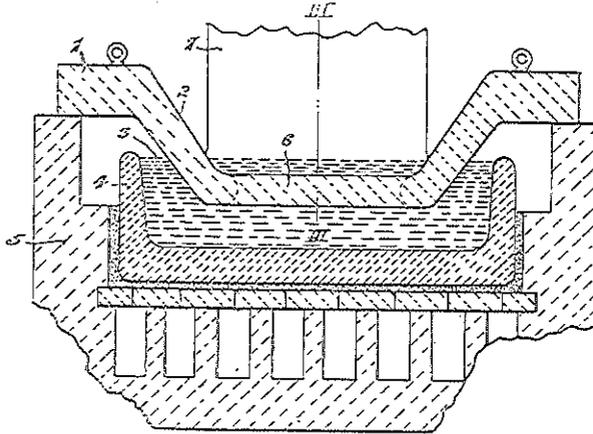


FIG. 154.

from the heat radiated from the hot metal below the drawing-slot.
G. D.

268. Drawing Glass Cylinders. OCTAVE C. NATALIS (U.S.A. Pat., January 1st, 1918, No. 1251561. Filed February 28th,

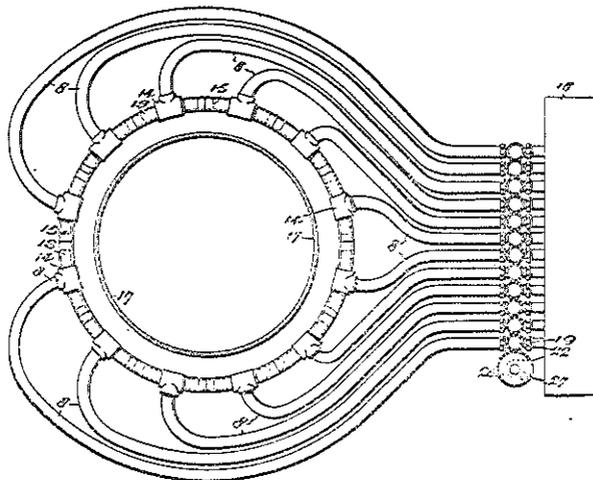


FIG. 155.

1917, No. 151474).—In order to overcome variations in the thickness of a cylinder as it is being drawn, means are provided for

directing either a hot or a cold blast on the cylinder, the temperature of which may be varied at different points around the circumference of the cylinder. The device consists of a ring, 13, surrounding the cylinder near the point at which it is drawn from the tank, and provided on its inner side with perforations or ports for the emission of the blast. The ring is made up of separate sections, each connected by a pipe, 8, with a tank, 18. Each pipe has its own control valve, 19, all of which are geared together and with a master gear, 26. Thus the valves can be operated together, but each valve can also be operated separately, in order that the blast from any section of the ring, 13, may be varied. The ring may be supplied with air for a cold blast or with gas that can be lighted at the ports for a hot blast. G. D.

269. Drawing Glass Cylinders. HARRY G. SLINGLUFF (U.S.A. Pat., January 1st, 1918, No. 1251931. Filed January 20th, 1914, No. 813197).—A tank from which cylinders are drawn is provided with inwardly projecting deflecting or baffle walls, 12, 13, between the melting end, 3, and the drawing end, 5. These

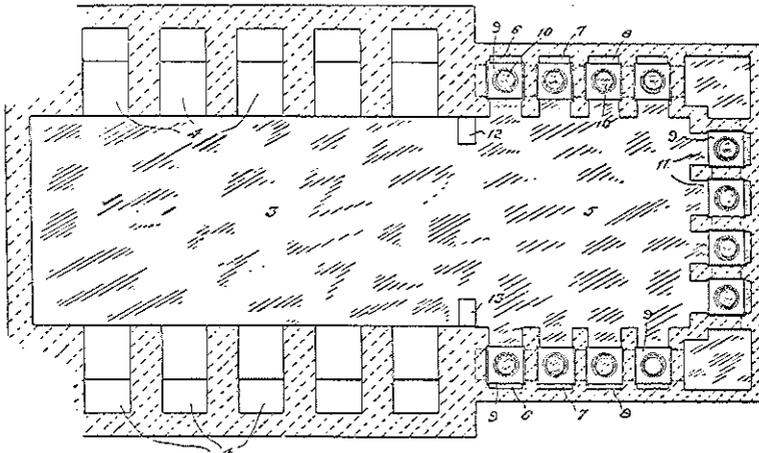


Fig. 156.

walls, projecting into the metal, prevent the accumulation of impurities in the nearer drawing openings, 6, and also tend to equalise the temperature of the metal in all the drawing openings. G. D.

270. Drawing Glass Cylinders. LEVI SHERMAN (U.S.A. Pat. March 5th, 1918, No. 1258159. Filed June 9th, 1917, No. 173799).—The invention consists of a floating drawing-pot for use with a tank furnace. The pot consists of a cylindrical fireclay

body, 4, having a bottom, 5, formed with an opening, 6. A circular baffle plate, 7, of greater diameter than the opening, 6, is supported a little distance below the bottom, 5, by means of lugs, 8. The baffle assists in supporting the pot, so that normally the bottom, 5, is level with the surface of the metal, as shown. In use, the drawing-shield, 3, is lowered to depress the pot so that the metal from which the cylinder is drawn enters through the opening, 6. The baffle, 7, protects the metal in the pot from radiation, and also prevents chilling of the body of metal beneath the pot. After the cylinder is drawn, the pot is pushed into the body of the tank, where the greater heat melts the aftermath, which flows out through the opening, 6. G. D.

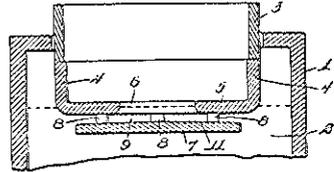


FIG. 157.

271. Drawing Glass Cylinders. G. L. CATLIN and D. MORRISON (U.S.A. Pat., February 12th, 1918, No. 1255983. Filed May 19th, 1917, No. 169711).—A drawing-pot consists of a

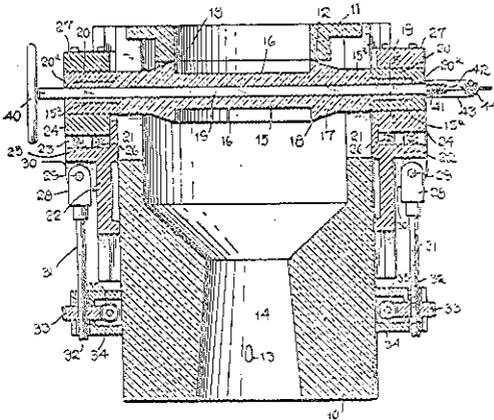


FIG. 158.

topstone, 11, having a depending flange or body, 12, and a reversible bottom, 16, mounted on trunnions, 20. The rim, 18, of the bottom which makes contact with the flange, 12, is very narrow in order to permit expansion of the rim, 17, and to minimise sticking between the topstone and the bottom. The bottom is raised and lowered by means of worm gear, 33, and the trunnions, 20, are supported by springs,

26, in order to permit expansion of the rim, 17, and yet secure good contact between the rim and the flange, 12. The pot is mounted in a furnace, 14, supplied with gas burners, 13, to melt the aftermath off the bottom, 16, after it is reversed. G. D.

272. Drawing Glass Cylinders. L. S. SKELTON (U.S.A. Pat. December 30th, 1919, No. 1326296. Filed June 26th, 1917, No. 176973).—The invention relates to the drawing of glass cylinders,

and consists of a bait designed to avoid the breaking of the neck of the cylinder and imperfect formation of cylinder necks due to faulty control of the air supply.

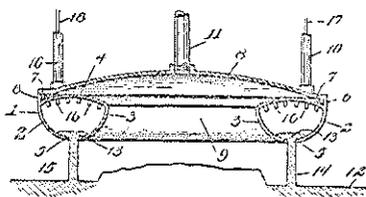


FIG. 159.

The bait consists of a hollow annular member having a domed top wall, 4, and curved lower walls, 2, 3, which are separated at their lower ends to form a slot, 5. This bait is screwed to a cover, 8, having an air pipe, 11, as usual. In use,

the bait is lowered into the metal, 14, which passes through the slot, 5, and forms a neck, 13, that supports the cylinder, 14. The slot, 5, is of the same diameter as the cylinder, so that losses due to imperfect formation of the neck of the cylinder are avoided.

The temperature of the interior of the bait is kept constant by means of an electrical heating device, consisting of a resistance wire wound on insulators, 16, secured to the interior of the top, 4. A modified form of bait is illustrated, but is described more fully in a co-pending application. G. D.

Reviews.

Annual Reports of the Society of Chemical Industry on the Progress of Applied Chemistry, Vol. IV. 1919.—The Annual Reports of the Society of Chemical Industry have now become well established and provide an exceedingly useful review of the whole field of applied chemistry, including such varied industries as Fuels, Gas and Mineral Oils, Colouring Matters, Textiles, Cellulose and Paper, Glass, Refractory Materials, Chemicals and Building Materials, the Metallurgical industries, Paints, India-rubber, etc. The particular sections which will be of interest to the readers of this JOURNAL are those on Glass, Refractory Materials, Fuel, Plant and Machinery. The section on glass extends to an eight-page review, and affords in a very small space a *résumé* of the year's activity. The section on refractory materials fills eleven pages and again there seems no important omission from its report of the year's work. The section on fuel very well deserves perusal by all who are interested in fuel economy and conservation. A considerable amount of progress has been made on this subject during 1919 and the summary is particularly useful. For those whose time is taken up too much to enable them to follow closely the progress made in the various branches of technical chemistry, there is no better method of keeping in touch with the progress of chemical industry than through these annual reports, of which the present volume is a very successful number. W. E. S. T.

I.—Glass-making Materials.

273. **Drying Sand.** A. P. DIGGER, Coventry (Brit. Pat. No. 136379. February 17th, 1919, No. 3876).—Relates to a machine for drying sand for use in foundries or for other purposes. The dryer consists of a rotatable cylinder, *C*, the shaft, *C*¹, of which is journalled in bearings in the removable end covers of an inclined stationary casing, *A*. The cylinder has longitudinal ribs or baffles on its inner surface to agitate the sand, and is heated by gas

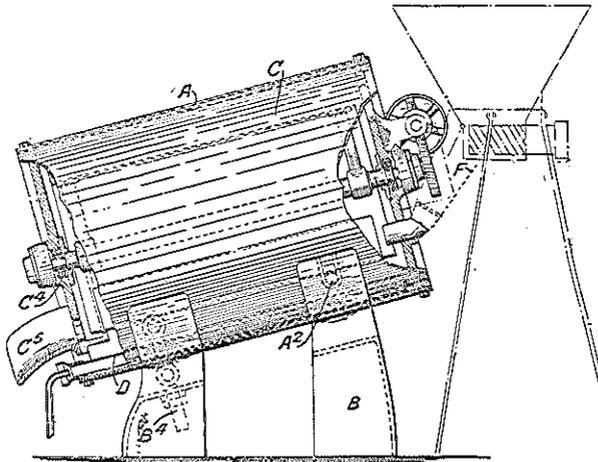


FIG. 160.

burners, *D*, or by electric coils. The casing has trunnions, *A*², which rest on bearings in a standard, *B*, and is supported near its lower end by a crew, *B*¹, which enables the inclination, and therefore the rate of the flow of the sand through the cylinder, to be varied. The moist sand is fed from a hopper, *F*, into the cylinder through an aperture into the upper end cover of the casing, and, after being dried by contact with the heated cylinder, is discharged through an aperture in the lower end cover. H. G. C.

II.—Glass: Manufacture and Properties.

274. **The Thermal Dilatation of Glass at High Temperatures.** C. G. PETERS and C. H. CRAGOE (*J. Optical Soc. Amer.*, 1920, 4, 105).—The first portion of the paper was devoted to a very complete summary of previous work. All the published

TABLE I.

No.	SiO ₂ .	CaO.	Na ₂ O.	As ₂ O ₅ .	MgO.	ZnO.	PbO.	BaO.	Fe ₂ O ₃ .	Al ₂ O ₃ .	B ₂ O ₃ .	Sb ₂ O ₃ .	K ₂ O.
1—2	58.8	—	1.7	—	—	2.5	12.7	14.3	—	—	1.7	—	8.3
3*	71.3	12.5	13.4	0.9	0.3	—	—	—	0.1	—	—	—	0.1
4*	72.0	10.2	16.2	0.3	—	—	—	—	0.1	—	—	—	0.3
5*	71.5	12.4	13.7	0.1	—	—	—	—	0.1	—	—	—	—
6*	72.5	11.5	13.8	—	—	—	—	—	0.1	—	—	—	0.2
7*	71.3	14.7	10.4	—	—	—	—	—	0.4	—	—	—	0.4
8	67.0	—	12.0	0.4	—	1.5	—	10.6	—	—	3.5	—	5.0
9	68.6	—	12.0	0.2	—	1.0	—	9.7	—	—	3.5	0.5	5.0
10	66.5	—	9.8	0.2	—	2.0	—	7.8	—	—	7.8	—	5.9
11	47.6	—	2.0	1.4	—	9.9	—	29.2	—	—	4.0	—	6.0
12	44.3	3.0	3.5	0.2	—	—	44.0	—	—	—	—	—	5.0
13	53.9	2.0	1.0	0.3	—	—	35.2	—	—	—	—	—	7.6
14	54.0	2.0	1.0	0.3	—	—	36.7	—	—	—	—	—	6.0
15	67.0	—	12.0	0.4	—	1.5	—	10.6	—	—	3.5	—	5.0
16	74.0	5.8	17.1	—	3.1	—	—	—	—	—	—	—	—
17	74.3	5.5	17.2	—	3.0	—	—	—	—	—	—	—	—
18—19	74.0	7.2	16.1	—	2.7	—	—	—	—	—	—	—	—
20*	73.0	0.7	10.8	—	4.3	5.6	—	—	0.4	1.0	3.6	0.6	0.3
21*	80.5	0.3	4.4	0.7	0.1	—	—	—	0.3	2.0	11.8	—	0.2
22*	64.7	0.6	7.5	0.1	0.2	10.9	—	—	0.3	4.2	10.9	—	0.4
31—32*	71.9	—	11.0	—	—	—	—	—	—	5.0	12.0	—	—

* The samples marked with an asterisk were analysed. Batch compositions are given for the rest.

data relating to glasses of known composition were collected and arranged in tabular form. Most of the observations dealt only with the dilatation at temperatures below 100°, and the purpose of the present experiments was to determine the dimensional changes in the annealing temperature region. The methods employed by previous investigators were reviewed, and an interference method was chosen. A full description of the apparatus and procedure was given. Thirty-one glasses were examined, their compositions being given in Table I and their coefficients of expansion in Table II.

TABLE II.

No.	Designation.	Temp. interval °C.	α $\times 10^4$.	Temp. interval °C.	α $\times 10^4$.
1-2	Barium Flint, B.S. 145 ..	22-494	0.088	519-550	0.331
3	Plate, American	19-461	0.099	563-579	0.373
4	Do.	20-508	0.108	540-560	0.401
5	Do.	23-494	0.101	564-583	0.466
6	Plate, German	21-496	0.099	564-589	0.477
7	Plate, French	21-513	0.094	597-613	0.424
8	Light Crown, B.S. 103 ..	24-422	0.104	494-507	0.548
9	Light Crown, B.S. 20 ..	22-426	0.102	502-522	0.555
10	Borosilicate Crown, B.S. 94	22-498	0.090	539-562	0.393
11	Barium Crown, B.S. 87 ..	23-499	0.090	589-610	0.649
12	Medium Flint, B.S. 110 ..	23-402	0.097	452-478	0.396
13	Light Flint, B.S. 188	22-451	0.088	494-512	0.347
14	Light Flint, B.S. 33	23-420	0.076	495-511	0.292
15	Light Crown, B.S. 103 ..	24-422	0.104	496-505	0.550
16	Commercial Glass	23-445	0.107	510-534	0.309
17	Do.	22-452	0.103	—	—
18	Do.	22-464	0.102	523-552	0.318
19	Do.	21-474	0.102	544-557	0.316
20	Macbeth-Evans flask	22-449	0.069	567-586	0.454
21	Pyrex.	21-471	0.036	552-571	0.151
22	Schott & Gen. flask.	19-414	0.056	540-562	0.404
23	Soda tubing	21-372	0.120	506-525	0.234
24	Lead tubing	21-338	0.091	464-483	0.236
25	Lead tubing	21-345	0.096	457-477	0.225
26	Fluorite tubing	22-364	0.098	510-561	0.284
27	Lead tubing	21-333	0.097	430-469	0.227
28	Vacuum tube tubing	23-405	0.116	509-545	0.205
29	Fusing in glass, German..	23-383	0.090	456-481	0.283
30	Fusing in glass, Corning..	22-376	0.083	460-485	0.258
31	Jena 59 III, pll. to axis ..	38-522	0.064	564-600	0.437
32	Jena 59 III, \perp to axis ..	22-491	0.062	562-603	0.452

The expansions were also represented graphically. They were very regular during the first 350° to 550°, but, on heating further, the rate of expansion changed. With well-annealed glasses it increased rapidly; with unannealed it first decreased, then increased. The region in which the change took place was found to coincide with the annealing temperature. Above the highest temperature given in the table, a rapid decrease in the rate of expansion took place, followed by a contraction. If the rod was cooled after the contraction had commenced, it returned to its original length, provided the highest temperature did not exceed

the critical or annealing temperature. If held at a constant temperature in the critical region, it first expanded and then slowly contracted. Above the critical region, the contraction increased with temperature. The dimensional change above this temperature was investigated in detail for glasses 2 and 11. It was found that the samples underwent a permanent decrease in length. This was attributed to the effect of surface tension when the glass was fluid, that is, above the critical temperature. Heat absorption occurred in the same temperature range as the critical change in expansion.

J. R. C.

275. The Binary System *Akermanite-Gehlenite*. J. B. FERGUSON and A. F. BUDDINGTON (*Amer. J. Sci.*, 1920, 50, 131).—The binary system *akermanite* ($2\text{CaO}, \text{MgO}, 2\text{SiO}_2$)—*gehlenite* ($2\text{CaO}, \text{Al}_2\text{O}_3, \text{SiO}_2$) formed a complete series of solid solutions with a minimum melting point at 1388° . The minimum melting point corresponded to a composition of about 74 per cent. *akermanite* and 26 per cent. *gehlenite*, and was 70° below the melting point of *akermanite*, the component with the lower melting point. The optical characters of crystals of certain intermediate compositions were found, on determination, to be a continuous function of the composition. The isomorphous character of the system was confirmed by the densities of crystals and glasses of *akermanite-gehlenite* and several intermediate mixtures. *Akermanite* glass had a higher density at 25° than the corresponding crystals.

F. W. H.

276. An Approximate Determination of the Melting-point Diagram of the System Zirconia-Silica. E. W. WASHBURN and E. E. LIBMAN (*J. Amer. Cer. Soc.*, 1920, 3, 634).—The silica employed was pure quartz powder, and the zirconia, obtained from zirconium hydroxide by ignition, contained 99.17 per cent. of ZrO_2 and 0.71 per cent. of Fe_2O_3 . This iron was completely removed by heating the material in a tube furnace at 300° whilst a current of phosgene gas was passed through.

The melting temperatures investigated were those of pure zirconia and mixtures of zirconia and silica in the following molecular proportions:— $\text{ZrO}_2, \text{SiO}_2$, $\text{ZrO}_2, 2\text{SiO}_2$, $\text{ZrO}_2, 3\text{SiO}_2$, $2\text{ZrO}_2, 3\text{SiO}_2$, $2\text{ZrO}_2, \text{SiO}_2$, $3\text{ZrO}_2, \text{SiO}_2$, and $3\text{ZrO}_2, 2\text{SiO}_2$. An elaborate method of mixing, grinding, fusion, re-grinding, extraction with dilute hydrochloric acid, and washing was repeated three times with each mixture. Then after burning to a cherry-red heat in a stream of oxygen, the mixtures were pure white.

Portions of each mixture were made into sticks, using an electric arc, well-fused crystalline pencils about 2 inches long and one-eighth inch diameter being obtained. The melting points were determined by feeding a stick slowly into an oxy-acetylene flame and noting the temperature of the small drops of fused material on the tip of the stick by means of an optical pyrometer. The temperature readings could be duplicated to about $\pm 100^\circ$. The

following are the estimated "true" melting points of the mixtures expressed in molecular proportions:— ZrO_2 , 2720°; $3ZrO_2, SiO_2$, 2685°; $2ZrO_2, SiO_2$, 2650°; $3ZrO_2, 2SiO_2$, 2460°; ZrO_2, SiO_2 , 2550°; $2ZrO_2, 3SiO_2$, 2420°; $ZrO_2, 2SiO_2$, 2420°; $ZrO_2, 3SiO_2$, 2420°; natural zircon, 2550°.

The mixtures on the ZrO_2 side, composed of ZrO_2 and $ZrSiO_4$, melted quickly, were very fluid, and the drops were perfect spheres showing complete liquefaction. The mixtures on the SiO_2 side, composed of SiO_2 and $ZrSiO_4$, fused with difficulty.

The results indicated that for use as a refractory up to 2550° the presence of silica as an impurity in zirconia was not necessarily detrimental, since addition of SiO_2 up to a 33 per cent. total eliminated its fluxing action. Such a refractory would have the properties of zirconium silicate, but would be nearly as resistant to high temperatures as pure zirconia. Refractories of considerable strength, it was suggested, could possibly be made from powdered zircon bonded with a mixture of zirconium hydroxide and silica in molecular proportions and fired in an electric furnace. F. W. H.

277. Note on the Motion of the Stirrers Used in Optical Glass Manufacture. E. D. WILLIAMSON and L. H. ADAMS (*J. Amer. Cer. Soc.*, 1920, 3, 671).—The authors discussed mathematically, for two simple cases, the shape of the curve traced by the stirrer in the glass, the variation in the velocity of the stirrer at different parts of the curve, and the area of the curve traced in relation to the surface area of the glass in the pot. F. W. H.

278. The Manufacture and Uses of Rolled Optical Glass. H. S. ROBERTS and J. C. HOSTETTER (*J. Amer. Cer. Soc.*, 1920, 3, 750).—The glass, made in the usual way for optical glass, was poured from the pot, after stirring in a large circle at low speed, and subsequently treated as ordinary plate glass. There was a great saving in pots and pot-arching, and the glass might be made in the usual plate-glass furnace. Large sheets of optical glass were obtained in thicknesses up to two and a-half inches. Polishing and cutting to size were very easily accomplished, there was much less waste in the cutting, and rolled optical glass could reach the final inspection within a week of pouring.

The uses of this type of glass were obviously somewhat restricted, since some striæ were necessarily present. When working up the glass it was necessary to take into account the fact that it contained a certain amount of parallel layers of glass, differing in refractive index from the main portion. It was necessary to choose the glass for various optical systems so that the path of light rays cut the striations in a direction as nearly as possible normal to the direction of the striations themselves. This method of manufacture was eminently suitable for the large-scale production of glass suitable for photographic lenses, field glasses, spectacles, etc. For instruments of highest precision, the ordinary process of cooling the glass in the pot must be used.

The method of manufacture and inspection of the glass and the manner of forming the glass into blanks for lenses and prisms were described in detail and illustrated by diagrams. The following casting and annealing temperatures were given:—

Type of glass.	n_p	Casting temperature.	Annealing temperature.
Ordinary crown ...	1.52	1205°	570°
Barosilicate crown ...	1.515	1205°	590°
Borium crown ...	1.57	1175°	580°
Ordinary flint ...	1.61	1205°	600°
	1.575	1220°	465°
Barium flint ...	1.616	1190°	455°
	1.65	1150°	445°
	1.61	1175°	—

F. W. H.

279. **A Method for Determining the Annealing Temperature of Optical Glass.** J. T. LITTLETON and E. H. ROBERTS (*J. Optical Soc. Amer.*, 1920, 4, 224).—The author assumed that the rate of annealing of a glass was proportional to its viscosity, and, having ascertained the annealing temperature of a standard glass and its viscosity at this temperature, he further assumed that the annealing temperature of any glass was the temperature at which it had this viscosity. The annealing temperature of the standard glass was determined in the usual way by observing the rate at which the strain picture, presented by the glass when viewed between crossed Nicols, disappeared. The rate of annealing was found to follow the logarithmic law, $T = 10^{0.0239(602-t)}$, where T is the time (in seconds) for complete annealing at t° . For this glass, 550° was selected as being the annealing temperature, little strain being appreciable after fifteen minutes. A method was described for measuring the relative viscosities of glasses at various temperatures. By means of a pulley, a shearing couple was applied to one end of a rod of the glass under test, the other end being incapable of rotation, and the rate at which the pulley moved was taken as a measure of the viscosity. The glass could be heated in an electric furnace. For example, at 550°, a rate of 16 cm. per minute was obtained with the standard glass. Hence the annealing temperature of any glass was that temperature at which it also gave this rate of motion. It was shown that the logarithm of this rate was proportional to the temperature, and, by comparative measurements on the standard glass, the authors were able to obtain, in addition to the most practical annealing temperature, the minimum and the maximum safe annealing temperatures from their viscosity measurements. They found the assumptions made to be justified in practice, and to give satisfactorily the annealing temperatures of some optical glasses made at the Corning Glass Works. J. R. C.

280. **Classification and Nomenclature of Optical Glass.** G. W. MOREY (*J. Optical Soc. Amer.*, 1920, 4, 205).—An extract

from the report of a Committee appointed by the Society to consider this subject. The system of nomenclature proposed was based on the crown-flint series of barium-free glasses. The dividing line between flints and crowns was at a v value of 56. The crowns were divided into fluor-crowns (v greater than 68), borosilicate crowns (v greater than 61), and ordinary crowns (v between 56 and 61). The flints were divided into extra light (v from 56 to 50), light (v from 50 to 38), medium (v from 38 to 34), dense (v from 34 to 31), and extra dense flints. Glasses falling outside the crown-flint series were grouped with the barium crowns and barium flints. The barium crowns had n_D higher than 1.60, and the light barium crowns had n_D between 1.60 and 1.54. There were also light (n_D less than 1.60), medium (n_D between 1.60 and 1.64), and dense barium flints.

J. R. C.

281. Evolution and Absorption of Gases by Glass.

D. ULREY (*Phys. Review*, 1919, 14, 160).—It was found that there was a large variation in the quantity of gases evolved per square cm. of surface from different samples of the same kind of glass. Annealing at atmospheric pressure always reduced the quantity of gases evolved on subsequent vacuum heat treatment. At a given temperature and pressure, glass was in equilibrium with a definite amount of water vapour. At temperatures up to the softening point, diffusion of the atmosphere through glass did not take place.

J. R. C.

282. A Factory Method for Measuring the Viscosity of Pot-made Glass during the Process of Manufacture, together with some Discussion of the Value of Viscosity Data to the Manufacturer. E. W. WASHBURN (*J. Amer. Cer. Soc.*, 1920, 3, 735).—The most satisfactory method for measuring the viscosity of glass over a wide range of temperature was the "stirring" method. In the laboratory apparatus described, the pot, cover, and stirring rod were of porcelain and the heating coils of platinum. The stirring cylinder was operated directly by a motor, the power consumption of which, P , where the angular velocity of the stirring cylinder was ω , could be determined. If k were the calibration constant of the pot and P_0 the power used in overcoming any mechanical and electrical friction in the driving mechanism, the viscosity, η , was given by the equation

$$\eta = \frac{k(P - P_0)}{\omega^2}.$$

The author suggested that, by the use of a wattmeter and speed indicator with the factory mechanical stirrer, the necessary data for computing the complete viscosity-temperature curve of the glass could be obtained during the ordinary stirring operation. Though the results obtained might not be very accurate, certain improvements in the design of the stirring equipment would improve the standard of accuracy very considerably.

An arrangement for measuring the temperature of the metal throughout the stirring operation was described and illustrated and the method of calibrating the whole apparatus indicated.

The fining of glass was dependent, not only on viscosity, but also upon surface tension, vapour pressure, and density. However, for given values of these last three factors it might be possible to obtain, in terms of viscosity, the maximum temperature a glass should attain for satisfactory fining.

In the case of optical glass where the stirring was largely depended on to ensure homogeneity of the metal, definite stirring procedure might be obtained from the viscosity data. The author suggested that if the viscosity-temperature curves for a few representative glasses were determined, using an established definite and successful stirring procedure, it might be possible to give complete directions for stirring in terms of viscosity in such a way as to be largely independent of batch composition, if not completely so. Where diffusion and convection were employed instead of stirring for obtaining homogeneity, the viscosity data should give information as to the required heat treatment.

The "stirring" method was not convenient at annealing temperatures, and the author proposed to deal with this range later.

F. W. H.

III.—Lamp-worked and General Scientific Apparatus.

283. **A Direct Reading Overflow Volumeter.** H. G. SCHURECHT (*J. Amer. Cer. Soc.*, 1920, 3, 730).—The apparatus consisted of a glass bowl containing an overflow tube sealed through the bottom and extending into the interior. Underneath was placed a special burette graduated with reverse reading to receive and measure the overflow. This type of volumeter was not quite so accurate as the pyknometer type, but it was sufficiently so for clay testing and superior to the pyknometer type in speed of operation and simplicity of construction and manipulation.

F. W. H.

284. **Glass to Metal Joints.** E. C. MCKELVEY and C. S. TAYLOR (*J. Amer. Chem. Soc.*, 1920, 42, 1364).—Two types of joint were discussed, namely, direct glass to metal and platinised glass soldered to metal by an intermediate layer of tin.

In connection with the second type, a review of the work of Röntgen, Cailletet, Koenig, Callendar, and Kraus was given, followed by a description of the method followed by the authors in the laboratory of the U.S. Bureau of Standards.

The glass was slightly roughened with fine emery cloth and then coated with a thin film of a colloidal solution of platinum in lavender oil and Burgundy pitch. The glass was carefully heated and then taken to incipient red heat to drive off the organic matter and leave the platinum uniformly deposited on the glass in a finely divided state. This was then placed in a metal tube of suitable shape which had been well tinned and fitted fairly tightly on the glass tube. It was preferable for the glass to butt against a shoulder in the metal joint. The whole device was then gently heated until the tinning melted and flowed, making a sound joint. Zinc chloride was used as flux. Pyrex tubing was found to be specially suitable for this type.

An objection to these joints was their unsuitability in cases where mercury was to be used.

Two forms of direct joint were discussed, the one being the direct fusion of glass to platinum tubing, and the other the use of Kraus flux to join glass to a metal shell of suitable shape. The flux consisted of zinc oxide, borax, and powdered soda glass in equal amounts, and was melted and drawn into rods for use as convenient.

The metal shell was found to lend itself to various types of joint, for example, one member of a union to connect with a metal pipe system, or to incorporate a small metal valve of a diaphragm, or, better, of a needle type when the presence of packing was not objectionable.

For connecting up in such systems, the use of tin, asbestos, or fibre washers was advocated.

In making the glass-metal joint, the glass tube was flared on to a ring of glass, which was then placed in the metal shell. The latter was externally heated until the ring fused on to it.

Joints of this type with Pyrex glass or porcelain tubes had not yet been successfully made.

The mechanical strength of soldered joints was as high as that of the glass apparatus itself. The bursting point under test was found to be 100—200 atmospheres, and in certain cases up to 400 atmospheres, which were far above the safety point for the glass part of the apparatus. Further, the joints when heated to 200° and air cooled showed no signs of cracking apart.

The fused joints appeared weakest. They withstood pressures of 70 and in very few cases up to 360 atmospheres, but they were harder to make and considerably more fragile than the soldered joint.

Pressure tests were not made on the platinum tube-glass joints, but they were unharmed by heating to 445° or cooling to -190°.

M. P.

285. Apparatus for Determination of Melting Points. L. M. DENNIS (*J. Ind. Eng. Chem.*, 1920, 12, 366).—A modification of the Thiele tube. The side-arm was bent downwards from the main tube at an angle of 45° to the vertical, and then taken up in a curve and sealed into the main tube, as in the Thiele type. The

tube was heated at about the mid-point of the down bend of the side-arm. In the author's view, the new form facilitated both more uniform heating and more rapid rise of temperature.

M. P.

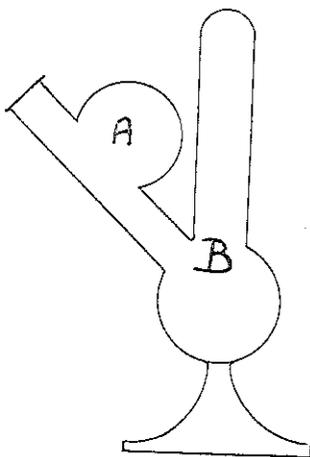


FIG. 161.

286. A Modified Form of Smith Fermentation Tube. A. V. FULLER
(*J. Ind. Eng. Chem.*, 1920, 12, 595).

—The tube was used in the investigation of organisms capable of causing fermentation in certain sugars. The bulb, A, was modified so that, instead of being symmetrical, it was trough-shaped on the underside to permit of the organism falling to the bottom of the gas tube proper, B. It was claimed that the speed with which results could be obtained was three times that with the Smith form.

M. P.

287. An Air-oven Thermo-regulator. H. M. ATKINSON
(*J. Soc. Chem. Ind.*, 1920, 39, 298).—A slightly loaded float carried at the top a small capillary, which, in conjunction with a small hole in the main body of the float, acted as a by-pass. Gas entering the float chamber from the main passed freely through the apparatus to the burner until the control bulb (two or three

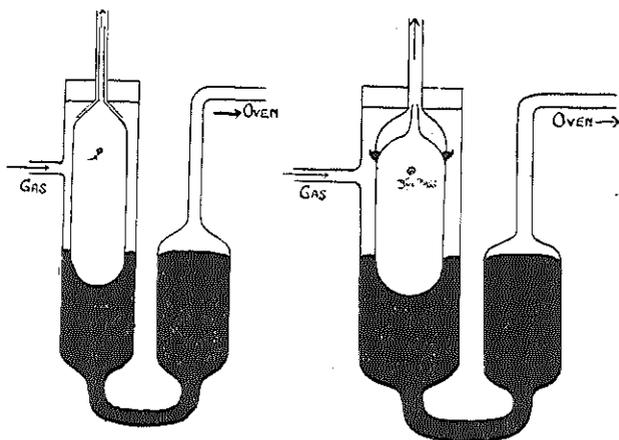


FIG. 162.

turns of 3/16-inch tubing) inside the oven was heated sufficiently to cause the expansion of the air to depress the mercury in one limb of the U-shaped chamber, with a consequent rise in the other limb which carries the float. The latter was thus driven

against the exit pipe from the float chamber to the burner, and, being ground to fit the latter, cut off all gas but that passing through the capillary.

An alternative form for the seal consisted, not of a ground-glass joint, but of a trough on the periphery of the float in such a position that when the float was raised it brought mercury placed in the trough into contact with the exit tube supplying the burner. The apparatus was small and compact—2.5 inches in length—and avoided troubles due to fouling of the mercury surface by the gas.

M. P.

288. An Effective Anti-splash Connecting Bulb. C. M. CLARK (*J. Ind. Eng. Chem.*, 1920, 12, 366).

The apparatus consisted of a bulb with inlet and outlet. The exit tube was sealed through the bulb, and on to the end inside the latter was sealed the baffle plate, *A*, in the form of a deep watch-glass extending to within 0.5 mm. of the side of the bulb. The vapours escaped by a small hole, *B*, blown in the side of that part of the exit tube which projected into the bulb. In a test against other forms of anti-splash still-heads, this type allowed no spray to pass over under conditions in which the others failed to hold the spray back.

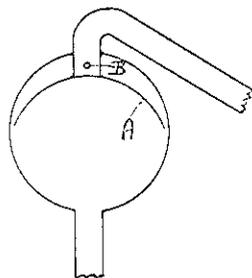


FIG. 163.

M. P.

289. A New Type of Condenser for Determination of Crude Fibre. C. A. CLEMENS (*J. Ind. Eng. Chem.*, 1920, 12, 288).

The condenser consists of a glass bulb, of which one side is so blown as to extend downwards. The lower surface of this projection is concave, furnishing a ring-shaped base on which the apparatus rests when not in use. Two tubes for inlet and exit water are sealed into the top of the bulb, which is designed to fit into the top of a lipless beaker. The condenser has an increased surface

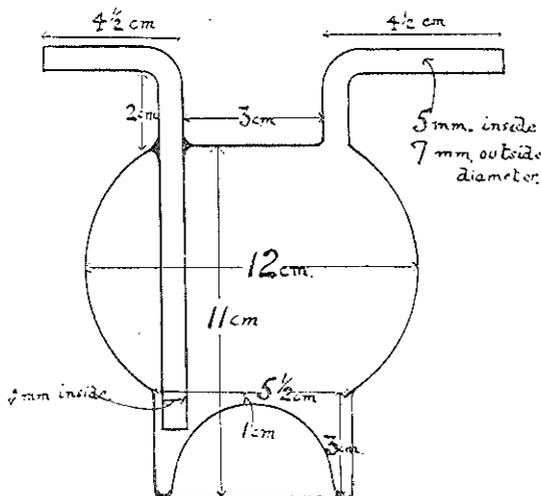


FIG. 164.

for condensation, and the construction reduces loss by evaporation to a minimum. It also effectually breaks up any foam that might otherwise froth over. The advantages claimed are wide application to various forms of lipless beaker, and ease in setting up and taking down.

M. P.

290. A Thermo-regulator. J. FITCH KING (*J. Amer. Chem. Soc.*, 1920, 42, 2058).—The purest mercury used in electrically operated thermo-regulators was oxidised by the minute spark at break of circuit, thus fouling the surface.

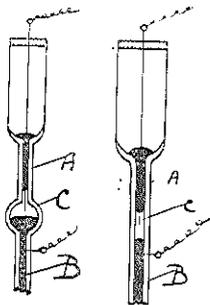


FIG. 165.

While this had been combated by displacing the air by some inert gas, the apparatus described effected a similar result by simpler means, namely, by trapping a small amount of air or inert gas by a thread of mercury, *B*, above the moving mercury column, *A*. The platinum wire, *C*, was so disposed that the spark occurred in this small space. The inert gas was introduced below the mercury surface by means of a capillary pipette, but air similarly introduced was quite satisfactory, since only a very limited amount of oxidation could take place.

The ordinary form of thermo-regulator was suitable enough for this modification, but a more favourable type differed only by having a small bulb blown at the point where the thread of mercury trapped the small gas space.

M. P.

291. A Glass Seal. L. W. FERRIS (*J. Ind. Eng. Chem.*, 1920, 12, 757).—This apparatus is for use when boiling liquids from which it is desirable to exclude the atmosphere. It consists of two bulbs blown on a tube, the lower end of which just fits the neck of the vessel to be sealed. The condensed vapour effectually completes the seal. Between the two bulbs the diameter of the tube is constricted to such a size that while the exit steam is well washed by the refluxing condensate, no mechanical loss by spattering takes place. The exit tube from the top of the upper bulb should be of a similar diameter, that is, about 7 mm. internal.

M. P.

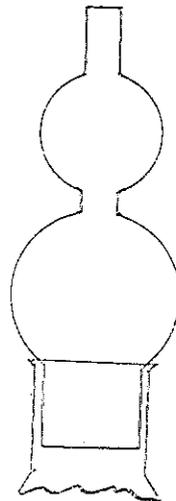


FIG. 166.

IV.—Decorated Glass.

V.—Optics and Optical Instruments.

292. **Dispersion in Optical Glasses.** F. E. WRIGHT (*J. Optical Soc. Amer.*, 1920, 4, 148, 195).—Usually the optical properties of glasses were graphically represented by plotting the mean refractive index (n_D) against the mean dispersion, $\frac{n_D - 1}{n_F - n_C}$. The author suggested that the latter quantity be replaced by the quotient $\frac{n_D - n_A}{n_G - n_F}$, which expressed the relative length of the red to that of the blue end of the spectrum. If partial dispersions alone were considered, it was found that if $n_F - n_D$ or $n_G - n_F$ were plotted against $n_G - n_A$, the result in each case for a series of optical glasses was a straight line. Thus if the dispersion curve for one typical glass was known, then the whole series of dispersion curves were fixed. This law held to one unit in the fourth decimal place, and, within this limit, a change in dispersion at one part of the dispersion curve carried with it definite changes in the curve throughout the visible spectrum. Hence, if for any substance two refractive indices were given, the dispersion curve could be written down. Dispersion formulæ containing two, three, or more constants could be built up which represented the data in the visible spectrum with great accuracy, and some of them were well adapted for computing purposes.

The second paper discussed the applicability of the Cauchy, Hartmann, and Nutting dispersion formulæ to computing. The usefulness of the last-named appeared to be less satisfactory than the two-constant Cauchy formula.

J. R. C.

293. **The Path of a Ray through a Prism.** J. P. C. SOUTHALL (*J. Optical Soc. Amer.*, 1920, 4, 283).—Two new solutions were described, one graphical, of the problem referred to in Abs. No. 26.

J. R. C.

294. **The Path of a Ray through a Symmetrical Optical Instrument.** J. P. C. SOUTHALL (*J. Optical Soc. Amer.*, 1920, 4, 294).—A paper of theoretical interest leading to an approximate method of calculating this path.

J. R. C.

295. **Special Cases in Lens Calculation.** C. W. WOODWORTH (*J. Optical Soc. Amer.*, 1920, 4, 286).—This paper deals with certain sources of error which are unavoidable in lens calculation owing to inevitable inaccuracy in the physical data. Such a case is the determination of the magnitude of the distant focus. Methods of surmounting some of the difficulties were described.

J. R. C.

296. **A Focal-length Equation.** C. W. WOODWORTH (*J. Optical Soc. Amer.*, 1920, 4, 243).—A general equation was

given for calculating the focal length of a lens system, and its application is illustrated by an example. In a note on this paper, J. P. C. Southall shows that the equation, though never previously published, is equivalent to two formulæ derived by T. Smith.

J. R. C.

297. Axial Aberrations of Lenses. E. D. TILLYER and H. I. SMULTZ (*Bull. Bur. Standards*, 1918—1919, **14**, 341).—The errors which affected the definition of a lens were discussed, and methods of representing graphically the central errors were described. A new method was given whereby all the important central errors could be determined by one set of measurements.

J. R. C.

298. The Photographic Absorption of Lenses. G. W. MOFFITT (*J. Optical Soc. Amer.*, 1920, **4**, 83).—The axial photographic transmission coefficient of a lens system was defined as the ratio of the light flux of photographic quality in the image of a small object on the axis of the system to the light flux of photographic quality that would reach the image were there no losses in the system. Apparatus was described by which this coefficient could be measured. Preliminary results showed good agreement with visual determinations and with those theoretically obtained.

J. R. C.

299. Invisible Light. R. W. WOOD (*Proc. Phys. Soc.*, 1919, **31**, 232).—Reference was made to a glass coloured by nickel which only transmitted ultra-violet light.

J. R. C.

300. The Cemented Telescope Objective of Barium Crown and Flint. I. C. GARDNER (*J. Optical Soc. Amer.*, 1920, **4**, 274).—Data and graphical representations were given which show the possible combinations of values of the three aberrations which may be obtained by the use of barium crown (n_D between 1.57 and 1.59) and ordinary flint (n_D between 1.60 and 1.66).

J. R. C.

301. The Light Transmission of Various Substances. W. W. COBLENTZ, W. B. EMERSON, and M. B. LONG (*Bull. Bur. Standards*, 1918—1919, **14**, 653).—The transmission curves of a very large number of glasses were determined, chiefly in the infra-red region of the spectrum. The glasses were classified according to their colours. Red glasses included (1) copper ruby, both flashed and homogeneous, (2) gold ruby, and (3) selenium-red. The orange glasses were coloured by selenium and some other, unknown, substance. Under the heading "Yellow glasses," there were two uranium glasses, and Corning Noviol and Noviweld, the latter being eye-protecting glasses. The green glasses were Schott's copper oxide (431 III), two Corning green glasses, Crookes' sage-green and bluish-green, and a light yellowish-green, conspicuous for its transmission in the infra-red. Several bluish-

green glasses, opaque to the infra-red, and thus heat-absorbing, were also examined. Sixteen curves were given for blue, purple, and amethyst glasses, and four for black or smoked glasses. Two of Crookes' neutral-tinted glasses were found to have a high transmission in the visible, but also fairly high in the infra-red. Amongst other glasses examined were Pyrex, Fienzal, Hallaner, Euphos, and Akopos green glasses, the last four being eye-protecting glasses from various sources.

In an appendix to the paper the authors gave the percentage transmissions of fifty-three glasses with respect to (1) gas-filled tungsten lamp; (2) quartz mercury vapour lamp; (3) magnetite arc; (4) solar radiation. They also discussed the injurious effects of radiation on the eye.

The investigations showed that in glasses which have a high absorption in the violet and ultra-violet, the effect of the colouring matter did not, as a rule, extend into the infra-red. Such glasses usually absorbed little more than colourless glass in the infra-red. Glasses which had a wide absorption band in the red and yellow usually had a marked absorption in the infra-red. J. R. C.

302. Report on Lenses and Optical Instruments.

C. W. FREDERICK (*J. Optical Soc. Amer.*, 1920, 4, 236).—This report was the first made by a Standards Committee, and dealt with single lens combinations only. It covered the classification of the various types of lenses, the limits of performance specifications, standards of performance, and tolerances. J. R. C.

303. Projection Screens. C. W. GAMBLE (*Trans. Optical*

Soc., 1919—1920, 21, 34).—Experiments were carried out with the view of ascertaining the best screen on which to project a cinematograph picture. One screen consisted of metallic silver deposited on a thin sheet of ground glass, the natural surface of the glass facing the projector. A good image was obtained, but the brilliancy was low. Following P. G. Nutting, a glass mirror, silvered on the back and ground on the remaining surface, was also tested. Ordinary 21-oz. sheet glass was used, and this screen proved entirely successful. A similar screen was made of glass 0.25 inch thick, in order that its suitability for large screens might be tested; this was also satisfactory. Etching with hydrofluoric acid instead of grinding was also tried, but proved not to be so efficient. J. R. C.

304. Preparing Lenses, etc., for Grinding and Polishing.

W. TAYLOR and F. W. PRESTON (*Brit. Pat.*, October 14th, 1918, No. 141395).—Relates to a method of, and means for, preparing lenses, etc., for grinding and polishing, and comprises the application of a pitch, etc., backing to the lens by means of a mould, the backing either having a central depression on the side remote from the lens, or being free from the lens at the centre, a number of lenses so prepared being then applied to a holder to form a block for grinding. The pitch is heated and mechanically stirred

in a closed steam-jacketed vessel, 11, the heat being so regulated that deterioration of the pitch or loss of volatile constituents is avoided, and the stirring is accomplished by means of rotary paddles, 18; the pitch is delivered by a steam-jacketed nozzle, 21, to a mould, *A*, comprising a base, 23, supporting the lens, 21, on a rim, 24, and having a cap, 26. A number of moulds are

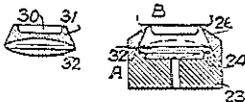
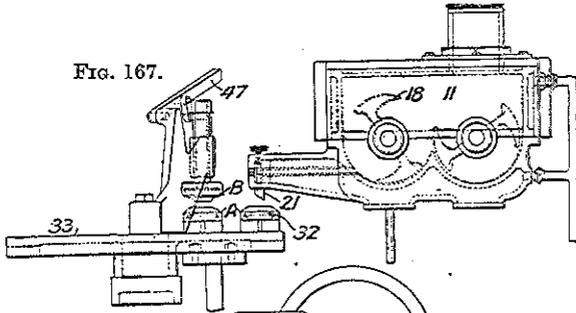


FIG. 168.

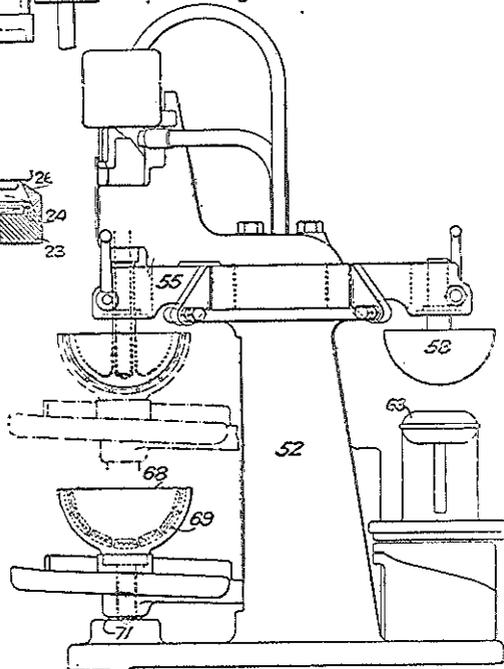


FIG. 169.

mounted on an intermittently rotated table, 33, and are positioned first under a nozzle, which sprays the lens with material to make the pitch adhere thereto, then under the pitch delivery nozzle, and finally under a plunger, *B*, adapted to be depressed by means of a lever, 47, which produces a recess, 30 (Fig. 168), in the backing, 31, surplus pitch being squeezed out between the cap and the

plunger. The lenses are then placed with their unbacked face against a tool, 68 (Fig. 169), the surface of which, 69, conforms to that of the unground lenses, mounted on a ram, 71, adapted to be raised by elastic fluid to bring the pitch backings into contact with the heated surface of a holder, 58, supported on one of a pair of arms, 55, rotatably mounted on a turret on the base, 52; the other arm carries another holder, 58, which may be heated by a gas burner, 63, whilst the operation of attaching the lenses to the first holder is taking place. The holder in contact with the backings is then cooled by water, the lens backings adhering to the holder. Stops and witness-marks may be provided to indicate when the tool and holder have reached their correct relative positions. In place of forming a recess in the pitch backing, a disk of paper, or material soluble in water, may be placed over the centre of the lens surface before the pitch is introduced into the mould. The foregoing method and apparatus may be employed with backings of material other than pitch, for example, plaster of Paris or other cements. According to the Provisional Specification, the process may be used for forming lens polishers of pitch, wax, etc., attached to a metal, etc., holder.

H. G. C.

VI.—Illumination and Illuminating Ware.

305. The Effect of Temperature on the Infra-red Transmission of Various Glasses. G. ROSENGARTEN (*Phys. Review*, 1920, 16, 173).—A continuation of Coblentz's work on infra-red transmission. The experimental errors were large, but the results seemed to show that to within ± 8 per cent. there was no change in the transmission of the infra-red through the glasses observed for the region 1μ to 5μ .

J. R. C.

VII.—Fuels, Refractories, and Furnaces.

306. The Causes of Coal Waste (BRITISH CLAYWORKER, 1920-21, 29, 62).—The causes were summarised as:—areas of firegrates and outlets at the rear of the boiler furnaces, and kiln flues out of proportion to the area and height of the chimney; fires too thin; stoking at the wrong time; stoking too heavily; fires given too much or too little air; dampers not air-tight; coal left in the ashes; fires too low before cleaning; drag used too much; lack of draught gauges to enable a battery of boilers or kilns each to secure the same draught; boilers badly seated or covered; side to bottom flues too small; uncovered boilers or steam pipes; damp and dirty coal; wet foundations and faulty design.

F. W. H.

307. Pulverised Coal as Fuel. (BRITISH CLAYWORKER, 1919-20, 28, 200).—The use of pulverised coal for boiler firing was fully discussed, and its efficiency compared with that of boilers equipped with mechanical stokers. The author states that in flexibility, pulverised fuel approached oil or natural gas; practically every grade of coal could be used in this form; the ash was in much better condition to handle; no grates were used, and hence there was no clinkering of grates; considerably less excess air was necessary for complete combustion; all the combustible in the coal was consumed, and there was practically no smoke. Pulverised coal was fired dry, containing less than 1 per cent. of moisture, and the lack of moisture resulted in decreased erosion due to sulphur where high sulphur coals were used. Costs were probably less on boilers using pulverised fuel than on those stoker-fired, and the efficiency was greater. F. W. H.

308. Pulverised Fuel. Its Uses and Possibilities. (BRITISH CLAYWORKER, 1920-1921, 29, 72).—A review of a pamphlet issued by the Canadian Commission of Conservation giving the history of the development of pulverised coal as a fuel. In the United States it was estimated that 10,000,000 tons of coal were pulverised annually for use in the cement industry alone. All firms quoted considered the use of pulverised fuel most economical and satisfactory. F. W. H.

309. The Control of Fuel Consumption (BRITISH CLAYWORKER, 1919-1920, 28, 239).—Laboratory tests of heat value, coke value, percentage of ash, and moisture content of coal were regarded as essential. The percentage of clinker was greater than the percentage of ash, owing to some unburnt fuel being included. As the percentage of ash increased the thermal efficiency decreased, and with 35 to 40 per cent. of ash, the heat value of the coal became nil. High water and sulphur contents were also serious disadvantages. When buying coal, a detailed specification should be employed showing the approximate analytical results expected. The price should be fixed on the number of B.T.U.'s per penny. F. W. H.

310. Coal and the Gases Resulting from its Distillation. L. VIGNON (*Ann. Chim.*, 1920, 13, 284).—Unsaturated hydrocarbons were usually given off at temperatures below 600°. Methane and other saturated hydrocarbons were evolved in considerable quantity up to 800°, but then the proportion decreased rapidly with rise of temperature. Up to 600°, hydrogen was present in only small amounts, and was highest in proportion between 1000° and 1200°. Carbon monoxide was evolved in quantity above 1000°. The relative proportions of carbon monoxide and carbon dioxide given out varied with the distillation conditions, but the higher the oxygen content of the coal the greater was the volume of these gases obtained. F. W. H.

311. **Diatomaceous (Infusorial) Earth.** W. C. PHALEN (*British Clayworker*, 1920—1921, 29, 148).—Known as *kieselguhr* and erroneously as “tripoli,” this substance was a hydrous silica or opal containing varying quantities of impurities. The following analyses of various samples of *kieselguhr* were given:—

	1.	2.	3.	4.	5.	6.	7.	8.
Silica (SiO ₂)	80.53	80.66	81.53	75.68	65.62	86.92	72.50	86.89
Alumina (Al ₂ O ₃)	5.89	3.84	3.43	9.88	—	4.27	11.71	2.32
Iron Oxide (Fe ₂ O ₃)	1.03	—	3.34	2.92	—	—	2.35	1.28
Lime (CaO)	0.35	0.58	2.61	0.29	—	1.60	0.32	0.43
Magnesia (MgO)	—	—	—	0.69	—	Trace	0.83	Trace
Potash (K ₂ O)	—	—	1.16	0.02	—	2.48	1.88	3.58
Soda (Na ₂ O)	—	—	1.43	0.08	—	—	—	—
Water (H ₂ O)	12.03*	14.01*	6.04*	—	11.00	5.13	9.54	4.89
Nitrogenous matter and moisture	—	—	—	9.21	—	—	—	—
Total	99.83	99.09	99.54	98.77	—	100.40	99.13	99.39

* Water and organic matter.

It was a most effective non-conductor of heat, and hence was used, alone or with other substances, for covering boilers, steam pipes, furnaces and stoves, and in fireproof cements.

F. W. H.

312. **The Commercial Application of Electrical Osmosis.** J. S. HIGHFIELD, W. R. ORMANDY, and D. NORTHALL-LAURIE (*J. Roy. Soc. Arts*, 1920, 68, 514).—Particular reference was made to the application of the principles of electrical osmosis to the purification of clays and similar materials. The addition of traces of alkali to a clay suspension produced a high mobility, the clay particles remained in suspension a long time, whilst particles of pyrites, mica, felspar, free silica, and other impurities tended to settle through the suspension. The clay could then be flocculated by the addition of acid to the suspension. The disadvantages of this method of coagulation were that certain fine impurities remaining in suspension were carried down by the clay, only partial purification was obtained, the physical state of the clay was entirely altered, and it was left in a form difficult to collect and dry.

If, however, two electrodes were immersed in the suspension, the clay particles moved towards the anode and adhered to it as a coagulated mass, whilst the water was driven towards the cathode, leaving the clay in a semi-dry state. The fine particles of impurities either moved to the cathode or were washed away by the water stream moving towards the cathode. The electrical osmosis method of purification therefore removed the more finely divided impurities. Sintering occurred with osmosed clays at lower temperatures than with raw clays, thus saving fuel. The lower sintering temperature and higher melting point resulted in articles showing little further contraction after burning. The reduction of the sintering temperature was stated to be as much as 300° for low-

grade clays, whilst bricks from some clays after osmosis were better burnt at 1100° than from the raw clays at 1300°.

A description was given of the apparatus for the commercial purification of clay. A machine with an anode in the form of a cylinder 2 feet in diameter and 5 feet long was said to produce about 1000 tons of pure clay per annum. The clay left the machine in the form of a blanket from one quarter of an inch to one-half of an inch in thickness containing only 25 per cent. of water, and in a form which readily admitted of drying. The cost of working varied with the class of clay. The current used varied from 20 to 70 units per ton of machine product.

A number of photomicrographs were reproduced. F. W. H.

313. *The Art of Pot Making.* C. O. GRAFTON (*J. Amer. Cer. Soc.*, 1920, 3, 652).—The author had not discovered a single American clay which was a perfect substitute for the German clay used in pre-war days, but a blend of three American clays provided a substitute superior in many ways. After mixing the clay with clean pot shell from which all glass and vitrified material had been removed, it was transferred to a pug mill, and afterwards taken to ageing pits and left for twelve weeks. The ageing pits were covered with canvas, over which were placed heavy sacks, and the sacks were kept damp throughout the twelve weeks. No material advantage was gained by ageing the clay more than twelve weeks. When removed from the pits, the clay was again pugged, and finally tramped with the feet.

The bottom of the pot was made in four layers, 1.25 inches thick, each succeeding layer being laid at right angles to the previous layer. Rolls of clay 12 inches by 3 inches diameter were wedged out on the board to the proper thickness for each layer, about thirty such rolls being needed for each layer, and the total thickness of the pot bottom when dry was 4.5 inches. The bottom was then turned over so that it had the bevel side uppermost, and a "filling-in" spell put on, 12 inches in height, and consisting of seven hand courses and five finger courses. In putting on the hand courses, they were arranged alternately on the inside and the outside, the pot beaten up, the working being wedge-shaped. The working of the finger courses was an upward motion, the reverse of the downward worked hand courses, but alternated inside and out as the hand courses. After standing for several days to allow the clay to stiffen sufficiently to hold the next working, four 6-inch workings were put on with hand and finger courses, the same drying period being allowed between each working. The shoulder was then worked and allowed to stand for a week. For the crown the author used a little stiffer clay than that used for the pot sides, and finished the crown in one working by building the pot up a foot higher than required, and then using a glass beater to bring it down to the proper shape. Considerable skill was required to beat down the crown without caving in the entire pot. The hood was next put on and the mouth cut out, and then the inside of the crown was trimmed off to the

proper thickness and smoothed, a boy of small stature being put inside through the mouth of the pot to assist in the process.

After standing on the board several weeks, the pot was thrown off and allowed to rest on the hood and front part of the bottom in order to dry the bottom. Final drying took place in a warm room.

A pot made from German clay had become thinned to less than 2 inches after seven melts of flint glass and forty-three melts of opal, and could not be taken whole from the furnace. A pot made from American clay, operated under similar conditions, gave ninety-nine fillings of opal glass.

The paper was illustrated by photographs of the process.

F. W. H.

314. Refractories. P. S. DEVEREUX (*Chem. News*, 1920, 120, 235).—In the author's view, resistance to high temperature was largely a problem in physical chemistry, involving the application of the phase rule and the laws of solution. Various formulæ given in text-books for calculating the softening point of a mixture from its components appeared to have been formulated without any due attention to physico-chemical laws.

F. W. H.

315. Refractory Recuperator Bricks. C. MUSGROVE, Horsforth, near Leeds (Brit. Pat. No. 136727, March 5th, 1919, No. 5419).—Refractory tubular recuperator bricks have squared ends forming walls, the walls being jointed by flutes or grooves, *C*, spigots and recesses forming the sealing joints for the tubular portions.

H. G. C.

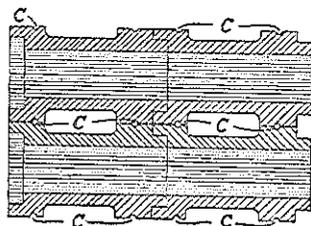


FIG. 170.

316. The Finishing Temperature of Refractory Bricks (BRITISH CLAYWORKER, 1920—1921, 29, 16).—A silica brick in which the quartz had been completely converted into tridymite by very prolonged heating at 1400° would expand much less than a brick fired at 1600°, but in which the whole of the quartz had not been so converted. During tests by H. M. Howe, of the Mellon Institute, Pittsburgh, U.S.A., bricks of reputed high quality were heated under a pressure of 25 lb. per square inch from 1100° to 1450°, and the change in volume measured for every 50° increase of temperature. Up to 1200° no change occurred, but there was a slight contraction between 1250° and 1400°, and a slight expansion at 1450°. This showed that firing these bricks at 1250° was sufficient, even if they were to be used at 1500°, and it was not necessary, therefore, in every case to fire bricks at a temperature as high as that to which they would be exposed in use. The shrinkage or expansion in use depended less on the temperature of firing than on the duration of the firing.

F. W. H.

317. The Ultramicroscopic Examination of some Clays.

J. ALEXANDER (*J. Amer. Cer. Soc.*, 1920, **3**, 612).—The properties of clays were influenced by chemical constitution and the degree of subdivision or aggregation of the clay particles.

Experiments were carried out by the author with the view of collating the properties of a clay with the size of its particles and the activity of motion of the colloidal matter. The observations were tabulated, the clay particles being classified as large (about 0.025 mm. diameter), small (about 0.005 mm. diameter), or colloidal. Reticulated particles were large particles formed of smaller individuals united by coagulation, dehydration, heat, pressure, or some combination of these factors. Colloidal motion, crystalloidis, order of acidity with litmus, ease of mixing with water, feel, and appearance were other points noted.

The author observed that the comparative freedom of the English kaolin from large particles demonstrated the care with which the washing and flotation had been accomplished. The activity of the colloidal motion indicated absence of coagulating agents, and perhaps addition of deflocculators, either intentionally or in the local water used. The tensile strength of the dry clay was about 30 lb. per square inch, compressive strength about 200 lb., and transverse strength about 70 lb. per square inch. It appeared that the relative weakness of the dry clay was due to the uniformity of its particles, and also their hydration.

F. W. H.

318. Recuperative Glass Furnace. J. S. ATKINSON, MESSRS.

STEIN AND ATKINSON, and T. C. MOORSHEAD (Brit. Pat., October 11th, 1919, No. 141617).—In a glass furnace of the kind in which a rotating table, 2, and trough, 3 (or pots), for the most

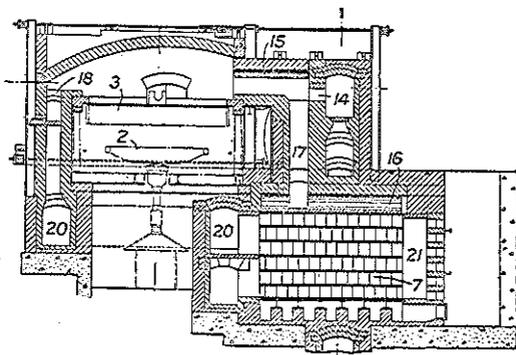


FIG. 171

part within the furnace, carry the glass to a gathering or removal point just without the furnace, a gas and/or air recuperator, 7, is employed in which the waste products flow horizontally to the outlet chamber, 21, and the air or gas to be heated flows vertically

without change of direction. As shown, air flows upwards through the recuperator to the chamber, 16, and thence by flues, 17, to the passages, 15, where it meets gas from the ports, 14. The flames, etc., flow direct to the outlets, 18, which are either in the opposite or the adjacent wall, and thence by flue, 20, to the recuperator.

H. G. C.

319. Regenerative Furnaces. S. G. CURD (Queenborough, Kent (Brit. Pat. No. 135636. May 5th, 1919, No. 20306/18).

—In a regenerative glass-melting furnace fired with producer gas, the producer gas is passed over a mixture of iron and carbon before entering the furnace to enrich and improve the heating qualities of the gas, and it is further enriched by mixing it with gaseous products, such as hydrogen and carbon monoxide,

obtained by passing superheated steam over a similar mixture of iron and carbon.

Figs. 172 and 174 show transverse and longitudinal sections of a glass-melting furnace with the invention applied thereto. The furnace comprises a melting tank, 1, separated by a perforated partition, *H*, and wall, 6, from a reservoir, 2. Holes, *G*, permit glass to flow from the tank to the reservoir. Gas and air ports controlled by valves are arranged on each side of the melting tank,

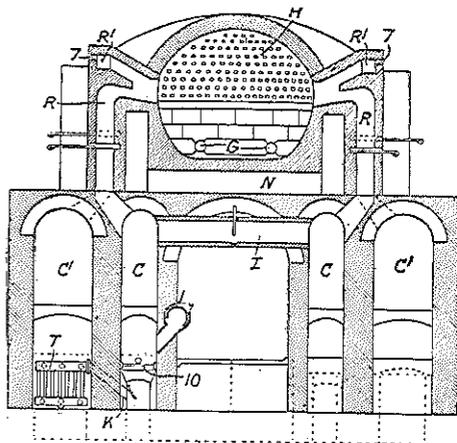


FIG. 172.

the air ports being in communication with reversible air regenerators, *C*¹, and being provided with inspection openings, 7. Air channels, *N*, below the melting tank and vertical channels are provided for cooling the hearth and side walls. The lower part of each air regenerator, *C*¹, is provided with a steam superheater, *T*, which supplies steam through the pipe, *K*, to the chamber beneath a grate, 10, supporting a mixture of iron and carbon. When gas and air are being supplied through the left-hand ports of the melting tank shown in Fig. 172, air passes to the furnace through the regenerator, *C*¹, and ports, *R*¹, and waste gases escape through the opposite regenerator. Gas enters beneath the grate, 10, and passes up through the mixture of iron and carbon to a gas chamber, *C*, communicating with the ports, *R*. The waste gases passing through the opposite regenerator, *C*¹, superheat the steam in the superheater, *T*, and the steam passes up through the

mixture of iron and carbon and is dissociated, hydrogen and carbon monoxide being produced in the chamber, *C*, and passing through valve-controlled pipes, *I*, to the opposite chamber, *C*, and to the

FIG. 173.

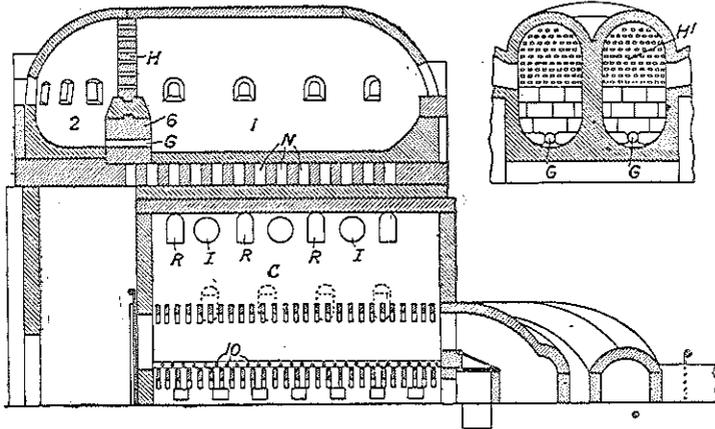


FIG. 174.

furnace with the producer gas. A modified form of glass-melting tank having a central partition, *H*¹, with or without perforations, is shown in Fig. 173. H. G. C.

320. Gas-fired Furnaces. J. R. C. AUGUST (Brit. Pat. February 12th, 1919, No. 139276).—In a gas-fired furnace for

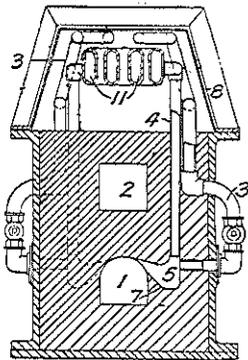


FIG. 175.

hardening or tempering steel tools, or for heating or annealing metals, glass, pottery, etc., regeneratively heated gas and air are supplied through pipes, 3, 4, respectively, to a combustion chamber, 5, having inclined sides, and floor, 7, inclined upwards towards the outlet leading into the pre-heating chamber, 1, which is in communication with the hardening chamber, 2. The roof of the combustion chamber is rounded, and serves to deflect the gas downwards. The combustion products from the furnace escape into a hood, 8, which encloses the air regenerator tubes, 11, cast integrally with headers and with the hood. The gas is heated in pipes arranged as shown above the air conduits. A similar combustion chamber, 5, is arranged on the opposite side of the chamber, 1.

H. G. C.

321. Gas-fired Tank Furnace. Soc. C. BOUCHER ET FILS, France (Brit. Pat., February 12th, 1920, No. 138933).—In a

gas-fired tank furnace for melting glass, the furnace proper and the gas producer are built respectively above and below the ground-level, and the air supply for combustion is heated in passages beneath the tank, in the double roof, and in proximity to the producer and its associated flue. In the construction shown, gas and air are supplied through ports in or near one end wall of the furnace, while the combustion products are exhausted at the opposite end through flues, *D*, to an underground main flue. Air-heating passages, *C*¹, *C*², are arranged beneath the hearth and

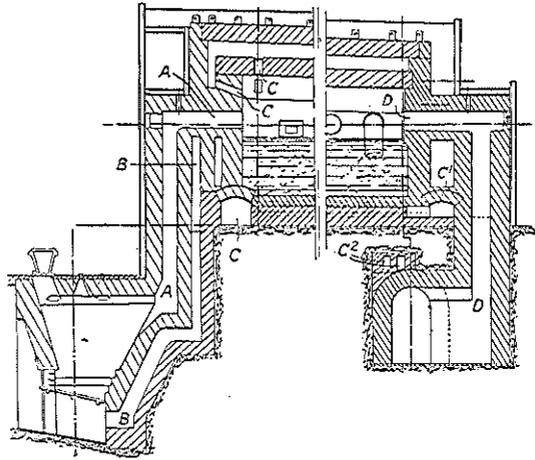


FIG. 176.

adjacent to the main flue, respectively, and communicate with a roof flue, from which the heated air is delivered through ports, *C*, *c*, opening through the roof and the end wall of the furnace. A further supply of air from the ash-pit of the producer is heated in the flue, *B*, and delivered through openings on both sides of the gas ports, *A*.

H. G. C.

322. Gas-fired Annealing Lehr. H. M. THOMPSON, Washington, Pa., U.S.A. (Brit. Pat., March 26th, 1920, No. 140817).—A gas-fired annealing Lehr, comprising a muffle chamber, 4, with a flat floor and roof formed of tiles, 8, is heated by a combustion chamber, 7, above the roof at the forward end, and a series of flues leading to a regenerator chamber containing the gas and air supply pipes. The gas is supplied through a downtake, 24, having at its lower end a dust pocket, 27, and cleaning door, 29, and a pipe, 22, into which opens the air-supply pipe, 23, at a point near the partition wall, 17, between the combustion and regenerator chambers. The heating gases from the chamber, 7, pass downwards through side flues, 11, to transverse flues, 12, beneath the floor, leading to longitudinal flues, 13, and thence through a second set of transverse flues, 14, and side uptakes to

the regenerator chamber and the stack flue. The side walls of the muffle chamber may have inset tubes, 20. Burner ports, 21,

FIG. 177.

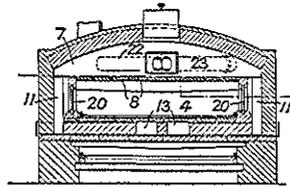
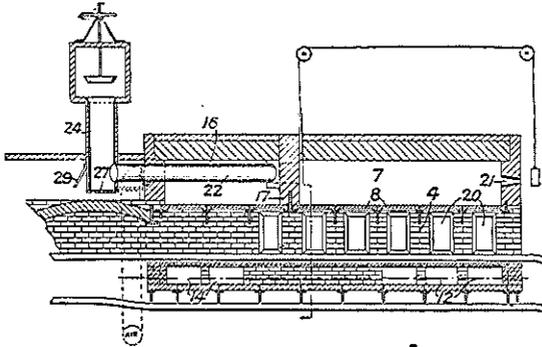


FIG. 178.

21, are provided in the front wall of the combustion chamber, 7, for use when oil, clean producer gas, or natural gas is used as fuel.

H. G. C.

323. Rotary Tube Lehr. CORNING GLASS WORKS, Corning New York, U.S.A. (Brit. Pat., January 17th, 1920, No. 140374).
—In the heat treatment of articles, for example, electric lamp

FIG. 179.

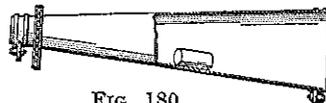
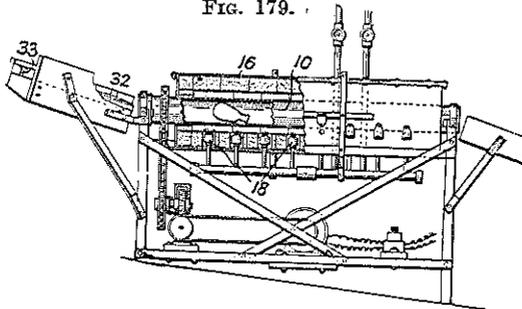


FIG. 180.

bulbs, the furnace or lehr is in the form of a rotary-heated tube, along which the articles move either by reason of the conoidal shape of the articles or the conoidal shape of the tube. As shown in Fig. 179, the rotary tube, 10, enclosed within a refractory lined chamber, 16, and heated by burners, 18, is inclined to the horizontal, and the bulbs are fed in at the lower end, smaller end first, and move up the tube, while broken pieces, not being of the correct shape, can only slide down the tube and drop out at the lower end. The feed-trough has a central guide channel, 32, and a slot, 33, for the escape of broken pieces, and, as seen in plan, is preferably inclined to the axis of the tube. Fig. 182 shows a modification in which the articles are cylindrical and the tube conoidal.

H. G. C.

324. Crucible Furnace. E. C. R. MARKS, London (FOURS ET

PROCÉDÉS MATHY., 2, Rue des Dominicains, Liège, Belgium) (Brit. Pat. No. 135115. April 14th, 1919. No. 9496). — A crucible glass furnace or oven is constructed with a number of separate chambers arranged in rows, each chamber containing a crucible, 1, surrounded with fragments of porous refractory material, and being formed at its base with cavities, 12, likewise filled with such fragments, to which gas and air are supplied for flameless combustion. Beneath each chamber is a regenerator, 6, for the air. Gas is supplied through ducts, 4 (Fig. 182).

FIG. 181.

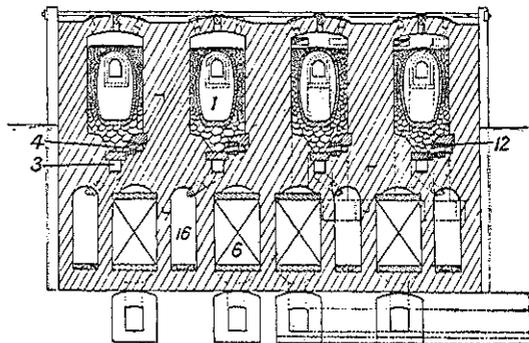
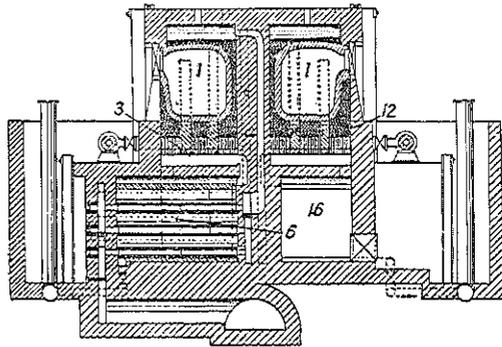


FIG. 182.

Molten glass escaping from a broken crucible flows down into the air passage, 3, and thence into a chamber, 16, at the side of the regenerator through a passage which is normally closed by a thin plate of fusible alloy.

H. G. C.

325. Report on Pyrometry. W. E. FORSYTHE (*J. Optical Soc. Amer.*, 1920, 4, 305).—This first report of a Standards Committee was made in the form of a summary of existing methods and data. The data were: (1) The temperature scale and fixed points, including methods for establishing and maintaining the high temperature scale, and methods recommended for calibrating and intercomparing technical pyrometers. (2) The brightness of a black body at various temperatures and related data. (3) Spectral energies of the black body at various temperatures. (4) The constants of the black-body laws. (5) The emissive powers of various metals. Optical pyrometers were chiefly considered, and a large section of the report was devoted to the precautions necessary when using these instruments. J. R. C.

VIII.—Chemical Analysis.

326. A Comparison of Ten Different Methods of Estimation of Calcium. G. E. EWE (*Chem. News*, 1920, 121, 53).—The standard material used was a practically white, doubly refractive calcite. Careful preliminary determinations of the impurities led to the conclusion that the sample contained 99.959 per cent. of calcium carbonate.

The methods compared and the results obtained were as follows:—

No.	Method.	Average results.
1	Precipitation as oxalate and weighing as carbide.....	99.57
2	Precipitation and weighing as carbonate	100.07
3	Liberation of CO ₂ by HCl and absorption in KOH.....	100.03
4	Precipitation as oxalate and weighing as oxide	99.86
5	Precipitation and weighing as sulphate	99.68
6	Precipitation as oxalate and weighing as sulphate	100.39
7	Precipitation as oxalate and titration with permanganate	99.68
8	Precipitation as oxalate from slightly acid solution	99.87
9	Liberation of CO ₂ by HCl and calculation of CO ₂ loss to CaCO ₃	99.80
10	Residual titration	99.75

F. W. H.

327. Electro-analytical Separation of Nickel and Cobalt from Arsenic. W. H. FURMAN (*J. Amer. Chem. Soc.*, 1920, 42, 1769).—In the deposition of cobalt from solutions containing arsenic or of nickel from solutions containing a fair amount of cobalt and some arsenic, the metal was always contaminated with arsenic. A quantitative separation was, however, possible if the cobalt was only present in small amount.

Actually, with static electrodes and a solution volume of 100—125 c.c. containing 29 grams of ammonium sulphate and 15 c.c. of concentrated ammonia, a current of 0.4—0.6 ampere per

square decimetre at a voltage of 3.3—4.2 gave a complete deposition of nickel in from ten to twelve hours. With rotating electrodes the conditions were, for similar solutions:—current density, 1.25—3.75 amp./100 cm.²; voltage, 3.6—8.6; time, 75—25 minutes; revolutions per minute, 600—800. M. P.

328. The Determination of Lead in Acid Solution. N. EVERS (*Pharm. Journal*, 1920, 105, 85).—Since the colours due to the sulphide were not comparable unless the concentration of the hydrogen ions in solution were similar, the test and standard solutions should be neutralised before the addition of hydrogen sulphide. The indicator used by the author was bromophenol-blue. If iron were present, it did not interfere with the colour under such conditions. Addition of cyanide removed the influence of copper if present. Where both iron and copper were present, the author recommended that alum should be added to the test solutions, precipitated by ammonia, filtered off, and dissolved in dilute acid. Since the aluminium hydroxide contained the lead and the copper remained in the ammoniacal solution, the solution of the precipitate in dilute acid could be used for the lead determination, as previously indicated. F. W. H.

329. The Estimation of Potassium and its Separation from Sodium by means of Sodium Cobaltinitrite. P. WENGER and C. HEMEN (*Ann. Chim. anal.*, 1920, 2, 198).—The potassium was precipitated by means of sodium cobaltinitrite solution, filtered off and dissolved in hydrochloric acid, and the cobalt content determined. Since the precipitate had the composition $K_2NaCo(NO_2)_6$, the percentage of potassium could be calculated from the weight of cobalt. F. W. H.

330. The Estimation of Minute Quantities of Arsenic by Titration. H. H. GREEN (*J. S. African Assoc. Anal. Chem.*, 1920, 3, 3; from *J. Chem. Soc.*, 1920, 117 and 118, [ii], 634).—The solution containing the arsenic was treated in the usual way in a Marsh apparatus, and the evolved gases were passed through a solution of lead acetate and through three vessels containing dilute silver nitrate solution. The whole of the silver nitrate solution was then treated with sodium bicarbonate, potassium iodide added until the precipitated silver iodide dissolved, and finally titrated with *N*/500-solution of iodine (1 c.c. = 0.1 milligram As_4O_6). The method was serviceable for estimating quantities of arsenic from 0.05 to 5 milligrams. F. W. H.

IX.—Machinery for the Working of Glass.

331. Making Narrow-necked Bottles. J. PULLON and A. E. CLEGG (*Brit. Pat.*, April 7th, 1919, No. 139654).—Relates to machines of the "Schiller" type for making narrow-necked

bottles, and particularly to means for sucking the molten metal

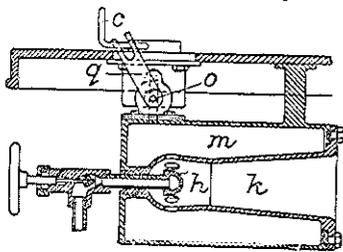


FIG. 183.

down into the neck mould. Compressed air escapes from a nozzle, *h*, into a conical orifice, *h*, and produces a partial vacuum in a chamber, *m*, which can be placed in communication with the neck mould by a tap, *O*. A handle, *C*, is arranged to operate the tap, *O*, through a forked lever, *g*, and also the tap for the blowing air. Instead of the ejector shown, a pump may be employed to produce the vacuum. Several machines may be connected to the chamber, *m*.

H. G. C.

332. Machine for Making Narrow-necked Bottles.

NAAMLOOZE VENNOOTSCHOP GLASFABRIEK LEERDAM VOORHEEN JEEKEL, MIJNSSSEN, & Co., Leerdam, Holland (Brit. Pat. No. 136518. March 31st, 1919, No. 8051).—In a machine for making narrow-necked bottles, the parison and finishing moulds are arranged in pairs, so that two bottles are blown at a time, the metal is forced down into the ring mould by compressed air, and the parisons are blown up against bottom moulds, or covers, to the parison moulds, which covers also serve for the introduction of the compressed air into the parison moulds. The machine, as shown in Fig. 184, has parison moulds, 3, and finishing moulds, 4, of the usual construction, except that each mould has spaces for the formation of two articles. The parison mould is recessed for the reception of ring moulds, 10 (Fig. 185), of the scissors type, and plungers, 17, secured to a rod, 19, and operated by a treadle, 21 (Fig. 184), enter through apertures in the table, 1, to assist in the formation of the mouths of the bottles. A duplex blow-head, 25, of any suitable construction is positioned above the parison mould. It is lowered on to the parison mould by a handle, 26, and the arrangement is such that the blowing-head acts only as a mould cover until springs, 27, are compressed, when air

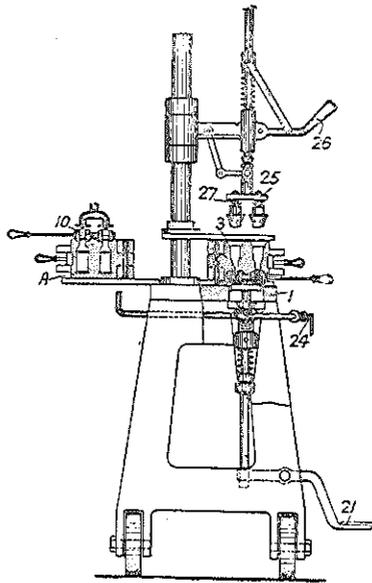


FIG. 184.

is admitted to the parison mould. In use, metal is dropped into the parison mould, and the handle, 26, drawn down to cover the moulds. Continued movement of the handle compresses the springs, 27, and admits compressed air into the moulds, so as to force the metal into the ring moulds. The handle is then raised slightly to cut off the air supply, and the parisons are then blown up against the mould covers by air admitted to the ring moulds by a valve, 24. Finally, the ring moulds and parisons are transferred by hand to the finishing moulds for the completion of the bottles.

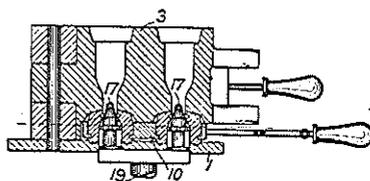


FIG. 185.

H. G. C.

333. Mechanism for Shaping Bottle Necks.

G. E. BATESON and H. A. BATESON, Liverpool (Brit. Pat. No. 134801. August 27th, 1919, No. 20999).—Relates to a modification of the bottle neck-shaping mechanism described in Specification 8430/14. The plunger, 21, is yieldingly operated by an eccentric, 16, and spring rod, 15, 15^b. On its descent, the coned surface, 20, disengages itself from inclined surfaces, 19, on the outer formers, 3, which are then closed by a spring (not shown) on the neck of the bottle, which is held in a socket, 2.

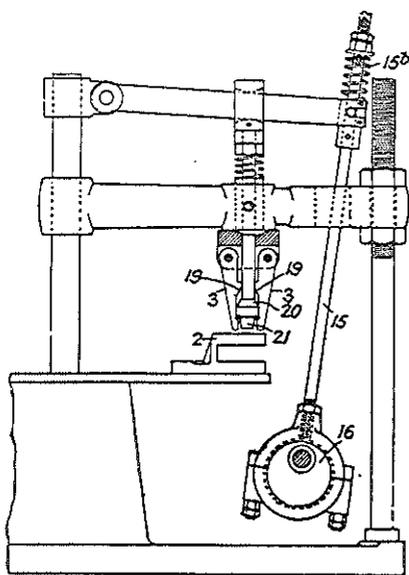


FIG. 136.

H. G. C.

334. Automatic Glass-blowing Machine. W. J. MILLER, Pa., U.S.A. (Brit. Pat., October 30th, 1918, No. 142156).—In a machine for blowing glass articles, and of the particular kind comprising a series of blank and blowing moulds movable step by step to different stations for successive operations, means for blowing the glass in the moulds, for transferring the blank, by turning it over independently of the blank mould, to the blowing mould, and for sucking down the gather by vacuum into the blank and neck moulds, are provided. A series of blank moulds, *J* (Fig. 187), adapted to receive gatherings of glass in succession, and a series of blowing moulds, *K*, each in vertical alignment with the corre-

sponding blank mould, are mounted on supports, *H*, *D*, which are intermittently rotated around a hollow pillar, *B*, and a suction and blowing mechanism, *M*, mounted between each blank mould and the corresponding blowing mould to rotate therewith, includes neck-forming elements, 99, and is reversible independently of the blank mould, so that the glass is subjected to suction and blowing actions in the blank mould, and then to a final blowing action in

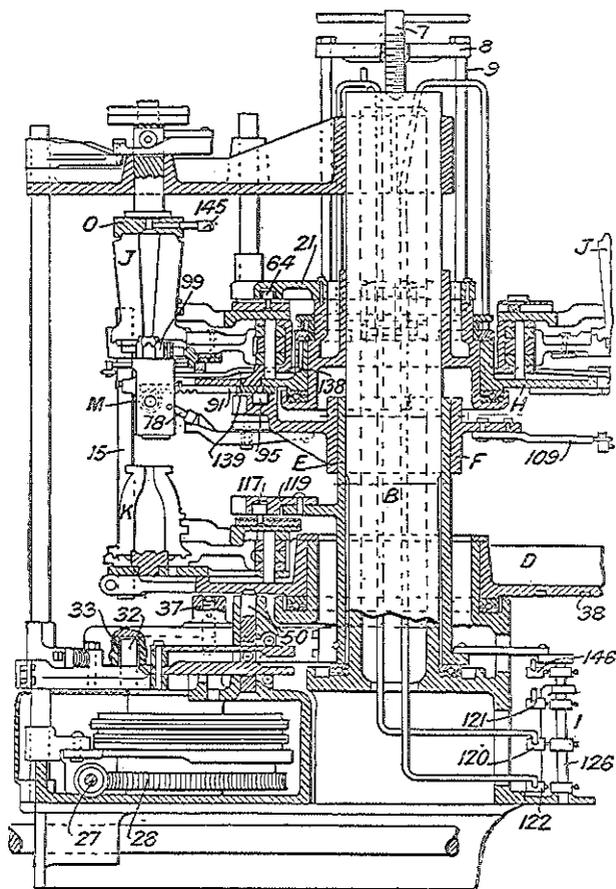


FIG. 187.

the blowing mould, from which the finished article is removed by grippers. The supports, *H*, *D*, are aligned by vertical bars, 15, to which they are adjustably connected, and screw mechanism, 7, 8, is connected by rods, 9, to the support, *H*, for adjusting this support to permit moulds of different heights to be used. A sleeve, *E*, on the pillar, *B*, is oscillated by an attached arm, in which slides a member, 33, engaging a crank-pin, 32, on a wheel rotated

by worm gearing, 27, 28, and the sliding member, 33, has a cam groove adapted to project and retract a pin, 37, into and from engagement with recesses, 38, in the support, *D*, so that the support is moved forwards and then freed, the arm at the end of its forward movement actuating a pin, 50, to lock the support during the reverse movement of the arm. The blowing mechanism includes a cylinder, 72 (Fig. 189), containing a plunger, 76, the outer end of which is initially extended to form a depression in the neck end of the gather in the blank mould, and is subsequently retracted by an arm, 78, and a cam surface to permit the entrance of pressure fluid to the cylinder by a pipe, 139, to act on the glass. The outer end of the plunger is screwed thereto, so as to be readily changeable. The pipe, 139, is connected to a passage, 138, which is brought successively into communication with a suction chamber and three pressure chambers connected by pipes passing down to valves, 120, 121, 122, respectively, the valves being controlled by a tappet shaft, 126, oscillated by connection with the sleeve, *E*. The arrangement is such

that the glass is forced down to the neck of the blank mould by pressure fluid entering a blow-head, *O*, through a pipe, 145, connected to a valve, 146, controlled by the tappet shaft, 126, is sucked into the neck mould when the suction chamber becomes operative, and has two blowings in the blank mould. This mould is then opened, and the device,

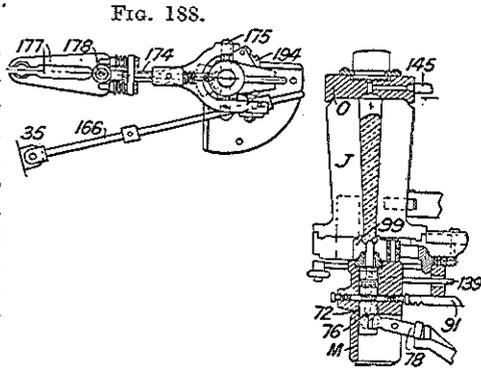


FIG. 188.

FIG. 189.

M, is reversed to carry the partly formed article into the open blowing mould, which is then closed, and the final blowing takes place. Each blank mould comprises two sections pivoted on a vertical pin and connected by links to a yoke yieldingly connected to a slide carrying a roller, 64, engaging a cam groove in a member, 21, whereby the sections are opened and closed as the support, *H*, is rotated. The blowing mould is similarly formed and operated, but its actuating roller, 117, engages a cam groove in a member, 119, on the oscillating sleeve, *E*. The neck mould also comprises two pivoted sections, which are closed by a toggle mechanism operated by the blank mould closing means, and are opened by a cam-striker, 109, on a member, *F*, on the sleeve, *E*, to release the neck of the article after it has been positioned in the blowing mould. The blowing mechanism, *M*, is mounted on the support, *H*, and is reversed by a pinion and a rack, 91, operated through a yielding connection with a slide carrying a roller, 95, engaging a cam groove in the member *F*. The articles are taken from the opened blowing moulds by gripping members, 177 (Fig. 188), pivoted on

a vertical axis, 178, on an arm, 174, movable about horizontal trunnions, 175, on a rotary supporting member. The members 177 are adapted to be depressed and closed to grip an article in the opened mould, then elevated to raise the article clear of the mould bottom and swung to remove it from the mould, then lowered and opened to release the article, and finally raised and returned to their initial position, the opening and closing and raising and lowering movements being effected by cam and roller devices mounted on the arm, 174, and on a relatively movable operating member connected by a rod, 166, to the arm, 35, that oscillates the sleeve, *E*, and adjustable in height to suit the size of the mould. At the termination of each swinging movement of the arm, 174, the supporting member of the trunnions is locked by catches, 194, which are released after the parts have moved relatively to cause the cam and roller devices to operate at the start of the next movement of the rod, 166. H. G. C.

335. Automatic Gathering and Pressing Machine. W. E. EVANS and M. J. OWENS (U.S.A.) (Brit. Pat., August 27th, 1919, No. 142007).—Relates to the type of automatic machine in which a number of complete units or working heads are carried by a rotating framework, and in which the metal is gathered from the tank, shaped, and the finished article discharged automatically by each unit as it rotates. According to the invention, gathering and pressing mechanism are combined in one machine. Each unit or working head comprises a suction gathering cup, 31, a mould, 45, a shearing blade, 40, and a pressing plunger, 61. When the cup, 31, arrives at the tank, 57,

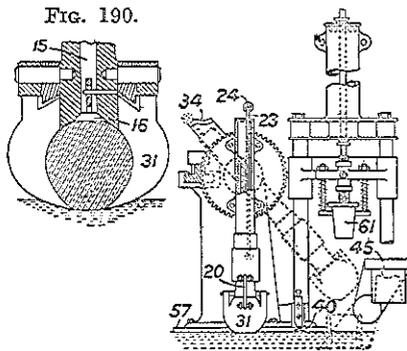


FIG. 191.

it is swung down into the molten metal and charged by suction, the mould, 45, being inverted, as shown in full lines, so as to pass over the tank. The cup, 31, then swings to the position shown in dotted lines, the excess of metal being cut off by the blade, 40, as the cup, 31, passes it. When the cup is clear of the tank, the mould, 45, is turned to the position shown in dotted lines, and

the cup, 31, is opened to allow the metal to fall into it. The cup, 31, is opened by a rod, 23, which is connected by links, 20, with the halves of the cup, and is provided with a roller, 24, which strikes a fixed cam, 34. The plunger, 61, then descends to press the ware, which is later discharged by the inversion of the mould. The suction tube, 15, leading to the cup is fitted with a loose mushroom valve, 16, which is raised, so as to close the tube, 15, by the metal as it rises and fills the cup. The operations of the

parts, including the fluid-pressure-operated plunger, 61, are controlled by fixed cams in the usual way.

H. G. C.

336. Automatic Machine for Blowing Electric Lamp Bulbs. E. LECOULTRÉ, Paris (Brit. Pat. No. 137544. January 9th, 1920, No. 813).—Gathering molten metal; blowing; forming electric lamp bulbs. Relates to a multiple-head rota-

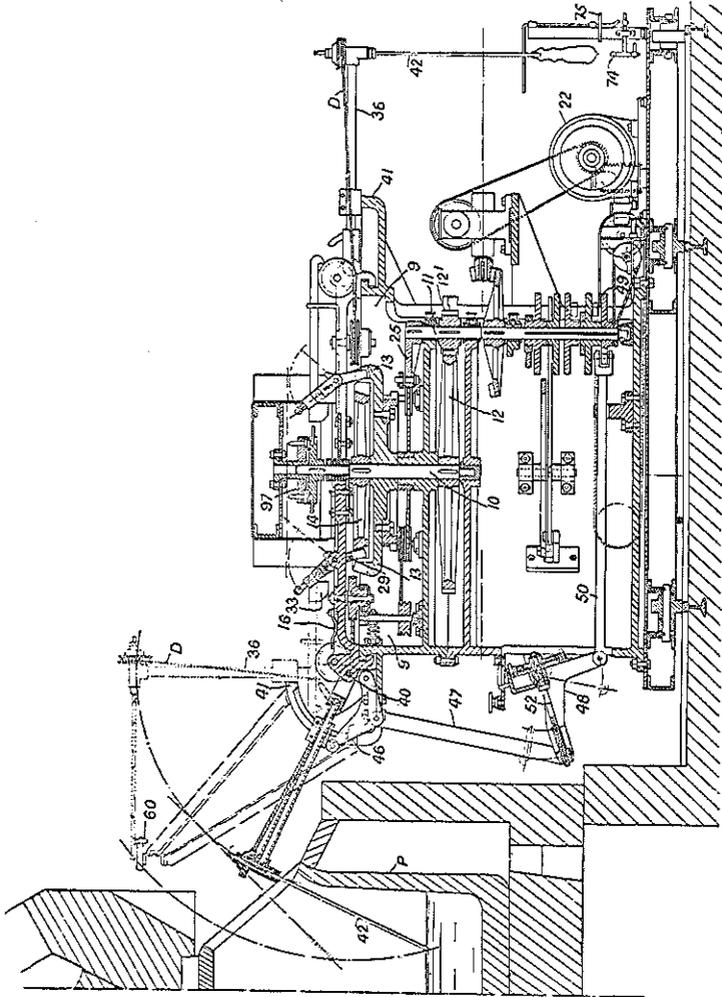


FIG. 192.

tory automatic machine for blowing electric lamp bulbs. A number of blowpipes, 42, are mounted on arms, 16, which rotate about a central shaft, 10. As each blowpipe makes one complete rotation round the machine, the following

operations are performed:—(1) The blowpipe is dipped into a tank, *P*, to gather the glass. (2) It is raised and the gathering is marvered. (3) It is lowered and swung to elongate the gathering. (4) The parison so formed is blown in a mould. (5) The pip of the blown bulb is drawn out for the attachment of the evacuating tube. (6) The bulb is severed from the tube. (7) The moil is removed from the end of the blowpipe. Each blowpipe, 42, is carried by an arm, 36, pivoted at 40 to one of the arms, 16, which are loose upon the shaft, 10, and supported at their outer ends by the casing, 9. A cam shaft, 11, is driven at a constant speed by a motor, 22, and, by means of a crank, 25, and ratchet device, rotates intermittently a toothed wheel, 13, loose upon the shaft, 10, and rotates the shaft, 10, continuously by means of gearing, 12, 12'. A detent, 29, pivoted to each arm, 16, and operated by a fixed cam, 33, engages the teeth either of the wheel, 13, or a wheel, 14, fixed to the shaft, 10, in the latter case causing the arm, 16, to swing round with the shaft, 10, and in the former case to remain at rest with the wheel, 13, or swing forward with it at increased speed. Each arm, 36, is supported and swung about the pivot, 40, by a fixed cam track, 41, which has a gap at the gathering station. At this point the arm, 36, is supported by a lever, 46, which is operated, through links, 47, 50, and a bell-crank lever, 48, from a cam, 49. The arm, 36, is lowered, as shown, for the gathering operation, and is then raised in time to continue its travel along the cam track, 41. The depth to which the blowpipe, 42, is lowered is automatically increased, as the metal in the pot is used up, by a screw, 52, which alters the effective length of one arm of the lever, 48. The gathering is marvered on a fixed plate, 60, the blowpipe, 42, being rotated by a rope drive, *D*. The blowpipe, 42, is then swung down to a vertical position and oscillated, so as to elongate the blank. The latter motion is produced by giving the cam track, 41, a sinuous form for part of its length. During a period of rest which follows the swinging operation, an ordinary two-part mould is closed round the blank, which is blown by air conveyed to the blowpipe, 42, from a central distributing device, 97, by a flexible tube.

The neck of the bulb outside the mould is cooled by an air blast during blowing. The mould is then opened, and, at the next halt, the bulb is pierced by a flame, 74, provided with an automatic re-lighting device, 75. The finished bulb is then cracked off and the moil removed from the blowpipe by cam-operated grippers. A jet of water or air may be directed upon the end of the blowpipe during this operation. Some of the operations may be controlled electrically, and suction gathering may be employed.

H. G. C.

337. Machine for Making Incandescent Lamp Stems.
C. EISLER, assignor to WESTINGHOUSE LAMP Co. (U.S.A. Pat., April 27th, 1920, No. 1338500. Filed June 6th, 1916, No. 101926).—This machine consists essentially of a pair of parallel endless belts carrying a considerable number of work-holding jaws,

which are caused to advance by successive short steps between two sets of stationary burners. The clamping jaws are opened and closed by passing between two fixed cam plates, one at the end of the machine. The glass arbor and the tube with the flared end, together with the leading-in wires, are gripped in the jaws, and are not rotated as they pass through the flames, the burners on both sides being sufficient to give the necessary even heating. When the glass is sufficiently heated, the next movement of the jaws operates a cam, which causes two pressure plates to come together, and thus press the heated portions of the glass rod and tube together. This operation forms a flattened seal between the arbor and the flared tube, thus producing a firm joint, through which the sealing-in wires pass. After the release of the pressure plates, the jointed stem passes in between two burners, and then through an annealing zone, before the jaws are opened to permit of their removal.

S. E.

338. Machine for Making Filament Supports for Incandescent Lamps. C. EISLER, assignor to WESTINGHOUSE LAMP Co. (U.S.A. Pat., April 27th, 1920, No. 1338499. Filed November 12th, 1915, No. 61090).—This machine consists essentially

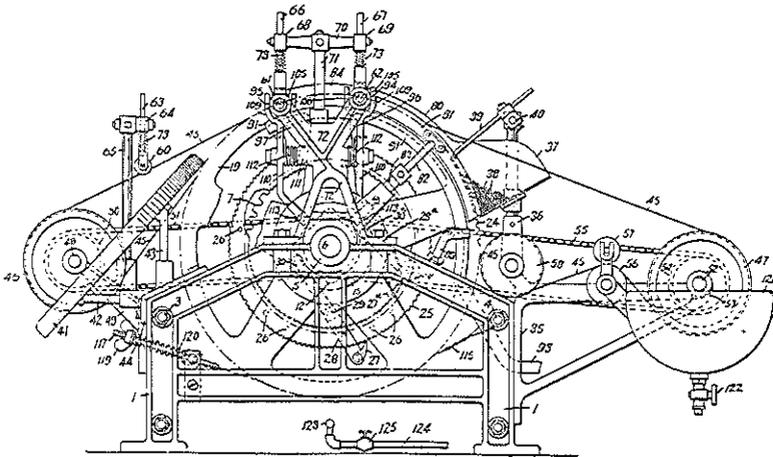


FIG. 193.

ally of a drum intermittently rotated upon a horizontal axis and provided with peripheral slots, which are adapted to receive short lengths of glass rods and to carry them into contact with gas flames. When the parts of the rods passing through the flames are hot enough, the ends of the rods are subjected to pressure, thus forming the hot portions into "buttons."

The drum is composed of a series of discs, 17, 18, and 19 (Fig. 193), the distance between the discs, 17, 19, being adjustable, thus permitting of the handling of rods of different lengths. Each of

the discs is provided with a peripheral flange, which is transversely slotted at intervals, the slots in the several discs being disposed in line with each other, so that each set of slots forms a receptacle for receiving one piece of glass and carrying it through the several operations. The step-by-step movement of the drum is obtained by means of the pawl, 27, operating on the ratchet teeth on the ring, 25. This pawl is carried on one end of a lever, 28, which is pivoted at 29, and the other end of this lever is operated by the cam, 12, which carries four projections. The glass rods are fed into the slotted discs from the hopper, 37, and a set of adjustable fingers, 39, ensures that only one rod is carried forward in each set of slots. During their passage round the drum the rods are constantly rotated by means of endless steel bands, 45, one of which is provided for each of the discs. These belts are driven by passing

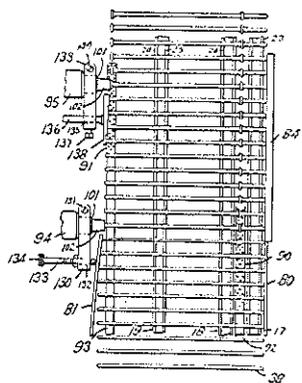


FIG. 194.

round the driving rollers, 46, 47, and are kept taut by passing between tension rollers, 56, 57. The steel bands are passed over the top of the drum, and so arranged that the glass rods come under the bands passing in one direction and over the bands passing in the opposite direction; thus the rods are caused to rotate in their several slots so long as they are gripped between the steel bands. As soon as the rods begin to rotate, they pass over a set of flames, and then, on being carried further round the drum, one end comes up against an inclined plate, 81, which begins the compression of the rods. This compression is completed by a plunger, 94, which is operated by a lever, 110, with one end in contact with a cam disc, 15. The end button is made by suitably heating the rod, and then subjecting it to pressure by the plunger, 95.

To control the movement of the drum, and especially to prevent it moving backwards, a brake, 115, in the form of a band, is provided, and acts on the lower half of the drum. Fig. 194 shows diagrammatically the progress of a number of rods through the machine.

S. E.

339. Bulb-blowing Machine. O. A. HANDFORD, assignor to EMPIRE MACHINE Co. (U.S.A. Pat., January 29th, 1918, No. 1254904. Filed November 11th, 1914, No. 871562).—The invention consists of a semi-automatic machine for blowing thin, hollow glassware, such as electric lamp bulbs, and is of that type in which the metal is gathered by hand on a blow-iron, which is then placed in the machine, the marvering and blowing being performed automatically by the machine.

As shown in sectional elevation in Fig. 196, the machine comprises a central vertical column, 1, enclosing within its base an

electric motor, 3, which drives, by means of a shaft, 5, a driving drum, 9, which rotates on the column, 1. The motor also drives an air pump, 12^a, which delivers air under pressure to a storage chamber, 14, formed in the top of the column, 1. Each of the glass-working units consists of a carrier formed of a rectangular frame, 15 (Fig. 195), provided with rollers bearing on the top and bottom edges of the drum, 9, and with a clutch, 16^c, operated by an electromagnet, 25. Thus, when the clutch is disengaged, the frame, 15, is free to remain stationary while the drum, 9, revolves, but when the clutch is engaged, the frame and the carrier are forced to revolve with the drum. In the machine shown, there are three positions at which a carrier stops during one revolution around the column, 1, and it is preferable to have four carriers on the machine.

The blowpipe frame, 41, is secured to one end of a trunnion, 40, which turns in a bearing formed at the top of the carrier frame, 15. Crank arms, 42, secured to the inner end of the trunnion, 40, carry rollers, which engage in cams formed on the enlarged upper portion of the column, 1. In the starting position, the blowpipe frame is horizontal, as shown in Fig. 195, but the cams are so shaped that as the carrier moves forward, the gather end of the blow-iron is first lifted and then lowered until the frame end, 41, is vertical. The frame, 41, is provided at one end with a blowpipe chuck, 45, which is rotated through gearing, 46, from a stationary gear, 55, formed on the enlarged head of the column, 1, through the medium of a bevel gear sleeved on the trunnion, 40. The chuck, 45, is movable backwards and forwards by a hand lever, 60, and also operates a pair of levers, 62, pivoted to the other end of the frame, 41, which support the lower end of the blow-iron.

The marvering device consists of an arc-shaped plate, 72 (Fig. 195), secured to an arm, 71, which is pivoted to a head, 70, rising from the upper end of the carrier frame, 15. The arm, 71, is connected to the frame, 15, by a telescopic link, 73, which is fastened on the extended position shown by a latch. When the frame, 15, commences to move, the gather

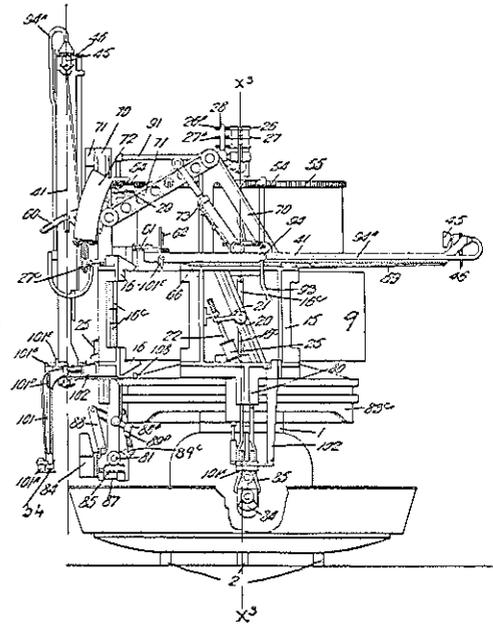


FIG. 195.

is swung upwards, as previously explained, so that it is rolled along the plate, 72, and is marvered. At the top of this movement, the latch holding the link, 73, extended is tripped by the frame, 41, so that the link collapses and the plate, 72, swings down out of the way of the gather as the frame, 41, swings into the vertical position. The link, 73, is again extended when the frame, 41, moves back to the horizontal position.

The mould sections, 88, are pivoted at the lower end of a leg, 80 (Fig. 196), which extends downwards from the lower end of the carrier frame, 15. The mould normally hangs down into a

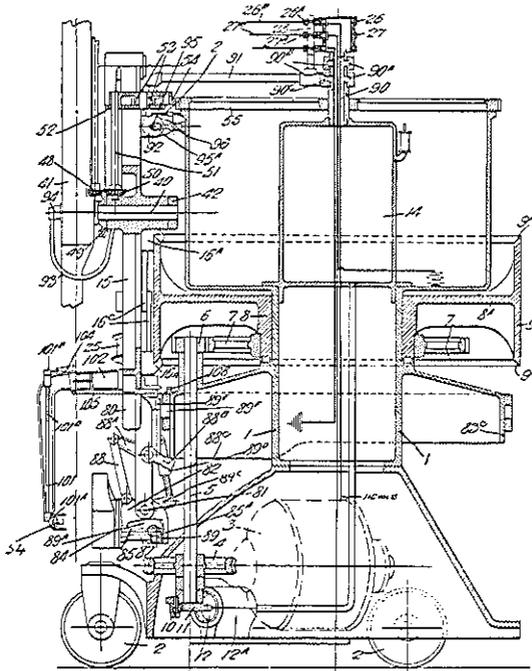


FIG. 196.

water-box surrounding the base of the central column. The moulds are raised out of the water by levers, 88, 88^a, actuated by a cam, 88^c, forming the lower edge of a flange, 83^c, surrounding the central column. Another cam, formed on the face of the flange, 83^c, opens and closes the mould.

Air for blowing the gather is supplied from the storage chamber, 14, by a pipe, 91 (Fig. 196), to a valve, 92, on the carrier frame, 15, and thence by a flexible pipe, 93, to the blowpipe chuck, 45. The valve is opened at the proper intervals to admit air by cam projections on the enlarged head of the column, 1.

In commencing operations, the parts of the machine are in the position shown in Fig. 195. A blow-iron with a gather is placed

in the frame, 41, and the hand lever, 60, moved to close the chuck, 45, and the levers, 62, on to the blow-iron. Movement of the hand lever closes the circuit of the electromagnet, 25, which clutches the carrier frame, 15, to the rotating drum, 9, and the carrier then commences to move around the column, 1. The frame, 41, swings the gather upwards across the marver, 72, and then moves downward to the vertical position, and at the same time the valve, 92, admits puffs of air to blow the parison. When the frame, 41, is in the vertical position, the frame is declutched from the drum, and therefore stops while the parison is elongating. Positioned adjacent to the parison is a thermostatic device, 34, which is described in U.S.A. Pat. No. 1066270. Such a device is also described in Brit. Pat. No. 5795/1911. This device, when the parison has elongated by the desired amount, automatically closes the circuit, so that the frame, 15, moves onwards again. The mould now closes about the parison, the blowing is completed, and the carrier stops in a reserve station close to the loading position. The blow-iron with the bulb attached can now be removed, and the frame, as soon as a new gather is inserted in the preceding carrier, automatically moves onward to the loading station.

G. D.

340. Machine for Making Pressed Glassware. W. J. MILLER, Swissvale, Pennsylvania, U.S.A. (Brit. Pat. No. 136816. December 10th, 1919, No. 30955).—Relates to a machine for the

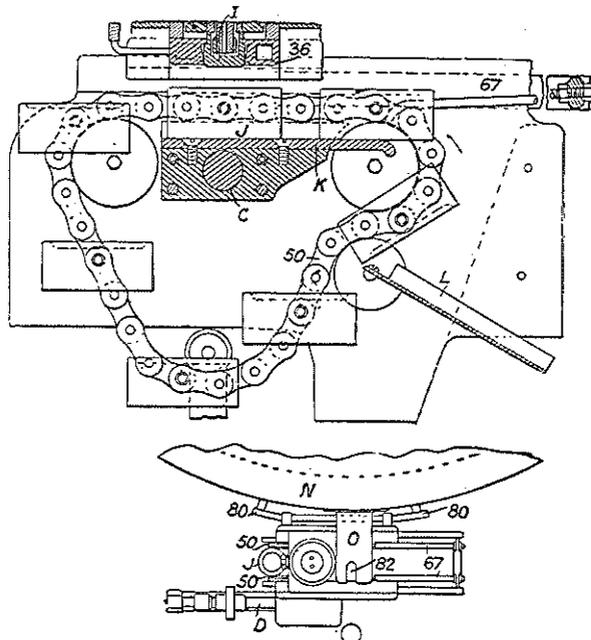


FIG. 197.

manufacture of pressed glassware. The machine is shown in plan in Fig. 197, hooked on to a rail, 80, in front of the hole in a tank furnace, *N*. A belt-driven shaft, *D* (Fig. 198), drives the main shaft,

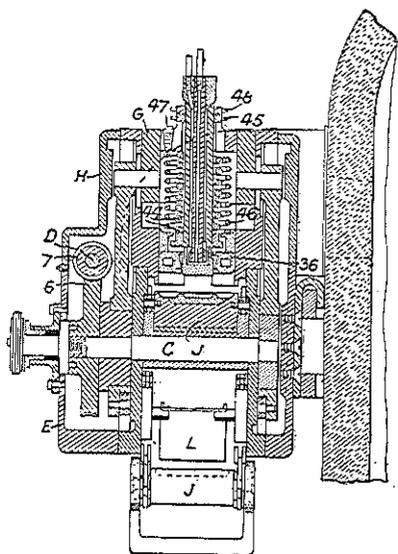


FIG. 198.

C, through worm gearing, 6, 7. The moulds, *J*, are hung at intervals between a pair of chains, 50 (Fig. 197), which are moved intermittently by cam-operated push rods, 67. Each mould, *J*, is charged by the gatherer, who inserts his punty through a hole, 82 (Fig. 197), in a shield, *O*, and passes on beneath the plunger, *I*, which descends during the interval of rest of the mould and presses the charge. The mould, *J*, then moves off the supporting plate, *K*, and travels with the chains, 50, as shown in Fig. 197, until it is tilted by striking a discharge shoot, *L*, down which the finished article slides. The plunger, *I* (Fig. 197), and follower ring, 36, are slidably mounted in a reciprocating cross-head, *G*,

and are pressed downwards by a strong spring, 44, and a weaker spring, 46, respectively. The tension of these springs is adjusted by nuts, 48, and the height of the plunger, *I*, and follower, 36, is then adjusted by moving vertically in the cross-head, *G*, a ring, 45, against which the springs, 44, 46, abut. The ring 45 is then clamped by a tapered plug, 47. The plunger, *I*, and follower, 36, are water-cooled. Casings, *E*, *H*, are provided for the protection of the mechanism and the retention of lubricant. Cam-operated shears are provided to sever the charge as it hangs from the punty. The Specification states that the machine can be used in conjunction with an automatic gathering apparatus. H. G. C.

341. Machine for Blowing Small Electric Bulbs. H. E. QUACKENBUSH and C. L. QUACKENBUSH, assignors to GENERAL ELECTRIC Co. (U.S.A. Pat., August 12th, 1919, No. 1313205. Filed May 13th, 1916, No. 97218).—This invention relates to a machine for blowing small electric lamp bulbs from a glass tube. Mounted above the base plate, 10, are two tubes, 14, which act as tracks, and on which are mounted the slidably carriage, 101, and the movable chuck. Two shafts, 38, 39, and a covering sleeve, 40, are mounted through the central part of the carriage. At the projecting ends of the shafts are double cranks, 43, which have the same throw as the cranks, 44, which are mounted

at the outer ends of the chuck barrels, 27, 37. By this means, a tube of glass mounted in the two chucks receives a positive rotation, and is not subjected to any torsional strain. The two chucks are opened together by means of the two chains, 53, attached to the two bell crank levers, 52. The inner ends of the chucks are provided with rubber blocks, so as to make a cushion, against which the ends of the glass tube are pressed. Through the fixed chuck an air passage is arranged, enabling air under a small pressure to be delivered through the rubber block to the interior of the glass tube. The carriage on which the burners are supported is brought up to the part of the tube it is desired

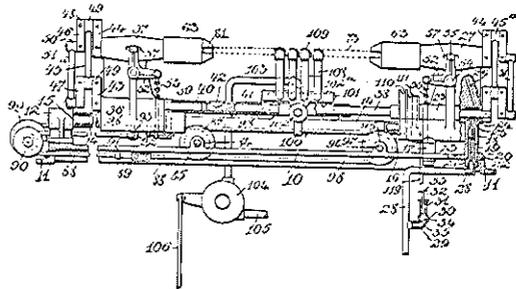


FIG. 199.

to heat, and when the tube is hot enough, a half-mould is brought up to one side of the tube and compressed air is admitted through the chuck. The half-mould is adapted to facilitate the correct formation of the bulb, and also to act as a gauge of its diameter. When one bulb has been blown, the burner and mould carriage can be moved along to the next position at which it is desired to blow another bulb.

S. E.

342. Mould for Blowing Bent-necked Bottles.

J. MACLUSKIE (Brit. Pat., March 24th, 1919, No. 139322).—Relates to a mould for blowing bent-necked bottles. The body part, *a*, is of the usual two-part hinged type, and closes upon a disc, 6, projecting from the base-plate, 1. The neck, *f*, of the

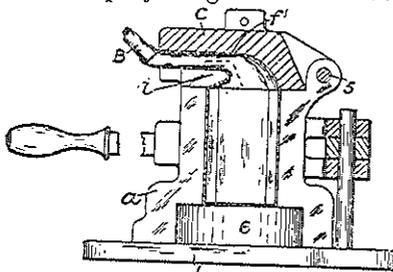


FIG. 200.

bottle is formed partly by the upper part, *i*, of the body mould, *a*, and partly by a top segment, *c*, which is hinged at 5 to one of the body segments, *a*. The gather is first placed in the mould, *a*, and partly blown, the blowpipe, *B*, being then drawn out and the top segment, *c*, closed. In a modification for machine use, the segment, *c*, is in three parts hinged together

H. G. C.

343. Pressing Plunger Mechanism. W. J. MILLER (U.S.A. Pat., December 30th, 1919, No. 1326365. Originally filed August 11th, 1917, No. 185647. Divided, and this application filed June 22nd, 1918, No. 241431).—Detailed methods are

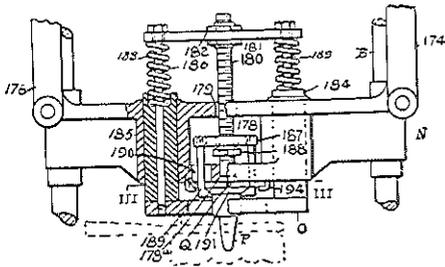


FIG. 201.

given for mounting a plunger in a pressing machine in such a way that it can easily be adjusted so as to centre properly with the mould.

The sliding cross-head, N, which carries the plunger mechanism is provided with a transverse horizontal opening, 178. A threaded shaft, 180, passes through a

hole in the upper part of the cross-head, and its lower end is screwed into the floor of the horizontal opening. The upper end of the shaft is fixed to a cross-bar, the ends carrying bolts, to which is attached a spring-pressed plate fitting on the top of the mould. A horizontal yoke is adjustably supported on the lower portion of the threaded shaft, and to its ends are pivoted two gripping fingers, which engage the bevelled flange of the plunger and keep it in place. The plunger is further secured in position by screwing up a ring, which is floatably supported from the cross-head.

The office of the spring plate is to engage resiliently the top of the mould as the plunger is depressed, and to lag behind the rising plunger, thus stripping the glass from the emerging plunger.

S. E.

344. Means for Conveying Ware to Lehrs. R. W. NIVER, assignor to OWENS BOTTLE MACHINE Co. (U.S.A. Pat., October 19th, 1920, No. 1356157. Filed August 19th, 1918, No. 250424).—According to this specification, bottles are taken from a blowing machine and placed in an upright position on a conveyor table, 12, at a point, 13. An endless, horizontally rotating chain, 15, running on sprockets, 17, 18, carries at equal intervals a number of laterally extending hooks, 21. These hooks engage the bottles at 13 and carry them along the table until they are arrested by a stationary stop, 22. Here the hooks are pressed backwards approximately 90°, and thus are enabled to pass on, leaving the bottle standing. An extending arm, 24, on coming into contact with lugs, 26, on the hooks, returns them to their projecting positions.

Driven from the same shaft that drives the conveyor chain is a short, endless chain passing round the gear-wheel, 421, which carries an extending arm, 45. This arm is connected by a curved rod, 46, to a pusher, 48, so that for each rotation of the gear, 421,

the pusher is reciprocated once. At the end of the push rod is a bottle-gripping device with spring arms, 52, so arranged that the first portion of the movement of the pusher rod closes the spring arms, thus gripping the bottle securely, while the latter part of its movement carries the bottle forward into the lehr. On the return movement, the gripper is first released and then the pusher is withdrawn. The trough, 88, which is rigidly attached to the end of the conveyor table, passes through a slot in the lehr

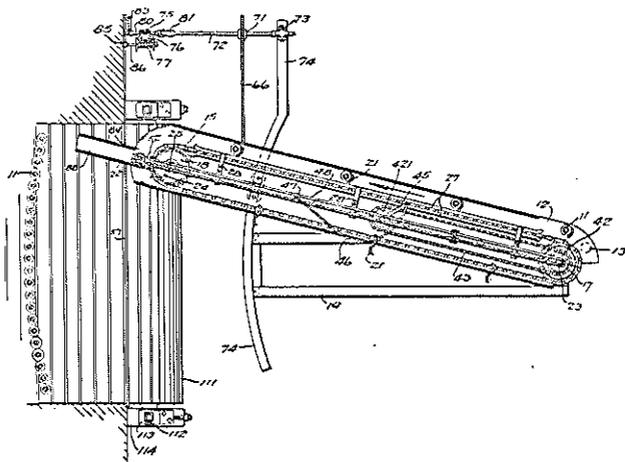


FIG. 202.

door, 57. This door has an intermittent motion across the front of the lehr, and thus carries with it the conveyor table. When one row of bottles has been placed on the lehr pans and the conveyor table has come to the limit of its movement, a commutator automatically closes the circuit for the motor that operates the lehr conveyor, 111, and causes it to move forward a sufficient distance to allow another row of bottles to be placed thereon without coming into contact with those already in place. S. E.

345. Automatic Conveyor and Lehr. W. S. MAYERS (U.S.A. Pat., April 27th, 1920, No. 1338240. Filed December 11th, 1917, No. 206666).—In this device the ware is taken hot from the moulds and quickly placed in a heat-insulating chamber, 1 (Fig. 203), from which it passes forward through the cooling sections, 2, 3, and 4. The walls of the chamber, 1, are made of refractory heat-insulating materials of sufficient thickness to reduce loss of heat by radiation. The walls of sections 2, 3, and 4 have less insulating properties than the walls of section 1. The cooling sections, 2, 3, and 4, are just large enough to house the upper run of the main conveyor and the largest ware to be annealed. Cold air is prevented from entering the cooling chambers by the seal,

A metal feeding chute, 15, is fitted through the end wall of the receiving chamber, and is inclined at such an angle that the ware will just slide down it on to a small single-chain conveyor, 48, which runs across the front of the main conveyor. This cross conveyor has an intermittent motion, the extent of each movement being rather more than the width of the ware being annealed. This movement is timed to take place a short time after each article has been deposited on the conveyor from the chute, 15. A multiple pusher-bar is riveted to rock rods, 92 and 93, which mesh with segmental spur gears, 90x and 91x. These, in turn, are keyed to the rocking shaft, 87, so that when this shaft is rocked from its position of rest, the pusher-bar moves forward and pushes the ware from the cross conveyor on to the main conveyor. The speed of the lehr conveyor is controlled so that it moves forward a distance slightly greater than the diameter of the ware being annealed during the interval between the operations of the pusher-bar.

S. E.

346. Conveyors for Glassware. J. L. HIATT, assignor to SCHRAM GLASS MANUFACTURING Co. (U.S.A. Pat., March 23rd, 1920, No. 1334453. Filed September 30th, 1918, No. 256198. Renewed August 9th, 1919, No. 316489).—This conveyor is

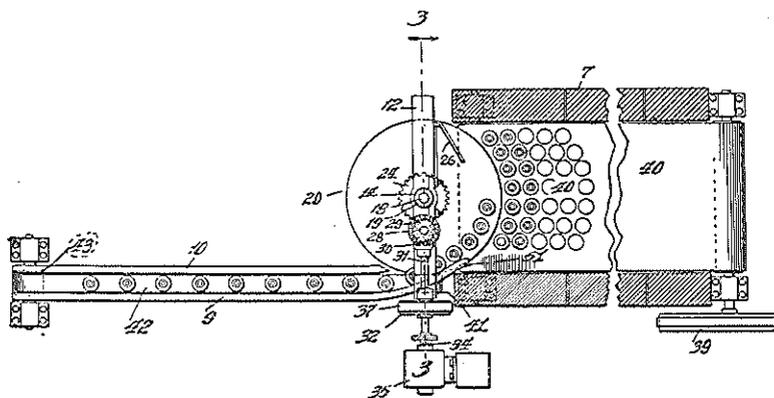


FIG. 205.

designed for carrying glassware from moulding or blowing machines and discharging it into a lehr automatically.

A horizontal frame with guide bars, 9 and 10 (Fig. 205), is erected in between the machine and the lehr, and over pulleys, 41 and 43, mounted at the ends of the frame, is passed a conveyor belt, 42. At the same level as the conveyor belt is a large horizontal table, 20, rotatably mounted on a vertical shaft, 18. Keyed to this same shaft, and above the table, is a gear wheel, 24, which meshes with and is driven by a smaller wheel mounted on the shaft, 28. Thus the table, 20, is continuously and slowly rotated.

The glassware is placed on the conveyor belt, which carries it towards the table, and the transfer to the table is made by the curved portion, 51 (Fig. 206), of the guide bar, 9. As the circumference of the disc, 20, has a slower speed than the belt, 42, the glass articles as they are transferred to the disc are packed closely round its edge.

The removal of the glass from the disc to the lehr pans, 40, is accomplished by the bent bar, 50, which is attached to the arm, 44. This arm is pivotally mounted on the sleeve, 25, and is

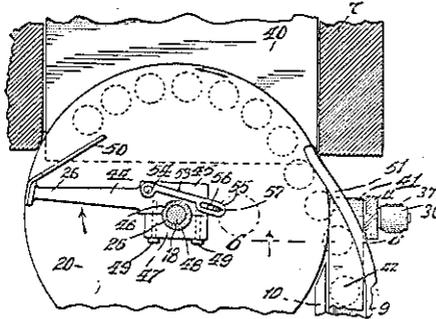


FIG. 206.

operated at intervals by the lever, 53, which is secured to the arm, 44, at 54. At its other end is a link, 56, through which passes a stud, 55, attached to the disc, 57. As this disc rotates, the bent bar, 50, sweeps over the table, pushing the glass articles off into the lehr, and then returns to its initial position and remains at rest until another batch of glass articles is ready to be transferred to the lehr pans.

S. E.

347. Glass-working Machine. F. L. O. WADSWORTH, assignor to Ball Bros. Glass Co. (U.S.A. Pat., December 30th, 1919, No. 1326235. Filed April 24th, 1914, No. 834233).—The invention is particularly intended for use with flow feeds, whereby a speeding-up is secured by reducing the time during which the feed is interrupted in order that a filled mould may be replaced by an empty one.

In the machine, the moulds, 4, rotate in a vertical plane about a horizontal shaft, 6, which is rotated intermittently to move the moulds from one station to the next. During the greater part of its movement, a mould moves in a circle about the axis of the shaft, 6, but from station VII to station I it moves vertically upwards. During this upward movement it receives a charge from the flowing stream, and is moved from beneath the stream, passing from station I to station II when the stream is severed by the shear blades, 23, 24. However, since there is always an empty mould beneath the one that is being charged, the interruption of the

stream during shearing is only necessary while the filled mould is moving through a distance about equal to half its diameter.

The moulds are made with trunnions, which are journaled in blocks, 10, that slide in slotted arms radiating from the hub of the rotating frame. The trunnions also carry rollers which engage, during the rotation of the frame, the edges, 16, of plates fixed alongside the frame, and with vertical guides, 18. At the various stations the glass in the moulds may be subjected to pressing, blow-

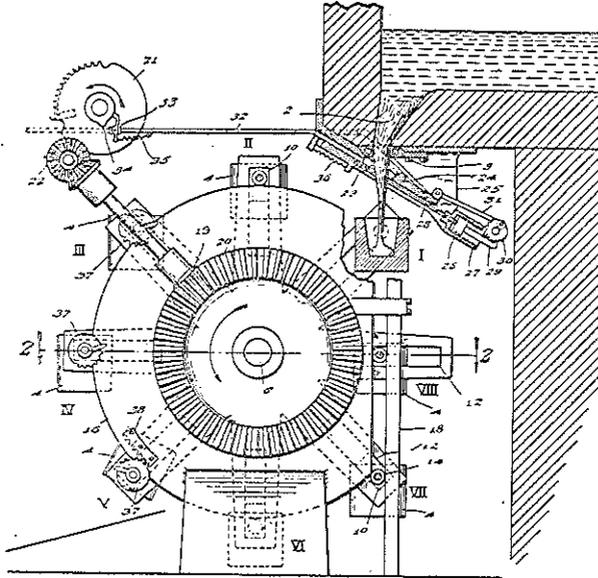


FIG. 207.

ing, etc., and they may be inverted by fixed racks, 38, at station V to discharge the finished ware.

The stream of metal flows from the tank, 1, through a water-cooled ring, 3, and is severed at the proper intervals by blades, 23, 24, moved by means of a piston, 26, in a cylinder, 27. The frame is rotated intermittently by an interrupted gear, 21, and this gear also actuates a valve, 33, that admits air or steam to the piston, 27, by means of a cam, 34, in its driving shaft. G. D.

348. Glass-drawing Apparatus. W. WESTBURY (U.S.A. Pat., December 30th, 1919, No. 1326241. Filed October 3rd, 1917, No. 194496).—This specification describes in a little more detail the drawing apparatus which is the subject of U.S. Pats. 1307943 and 1307946,* and claims the device for water-cooling the gear used for supporting and lifting the pots. G. D.

* This vol., Abs. No. 65.

349. Drawing Glass Cylinders. H. WADE, assignor to the

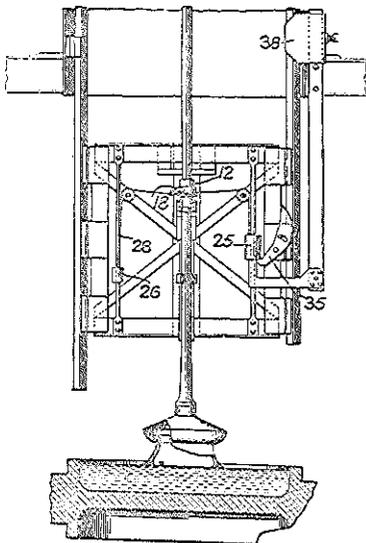


FIG. 208.

Empire Machine Co., Pittsburgh, Pa., U.S.A. (Brit. Pat., November 7th, 1919, No. 140029).—Relates to the automatic control of air admitted to the drawn glass cylinder during the formation of the cap. The air is vented from a valve, 12, having a large port and a small port. During the first 22 inches of the draw, while the cap is being formed, a weight, 26, attached by a cord, 28, to the valve lever, 18, keeps the small port open. A catch, 35, then strikes a projection, 38, and releases a heavier weight, 25, which pulls the lever, 18, to the right, and so opens the large vent port. This action reduces the air pressure in the cylinder for the main portion of the draw.

H. G. C.

350. Drawing Glass Cylinders. C. DONALDSON, J. J. BLOXSON, and J. K. BROOKS (U.S.A. Pat., July 29th, 1919, No. 1311804. Filed April 26th, 1917, No. 164774).—The invention consists of a

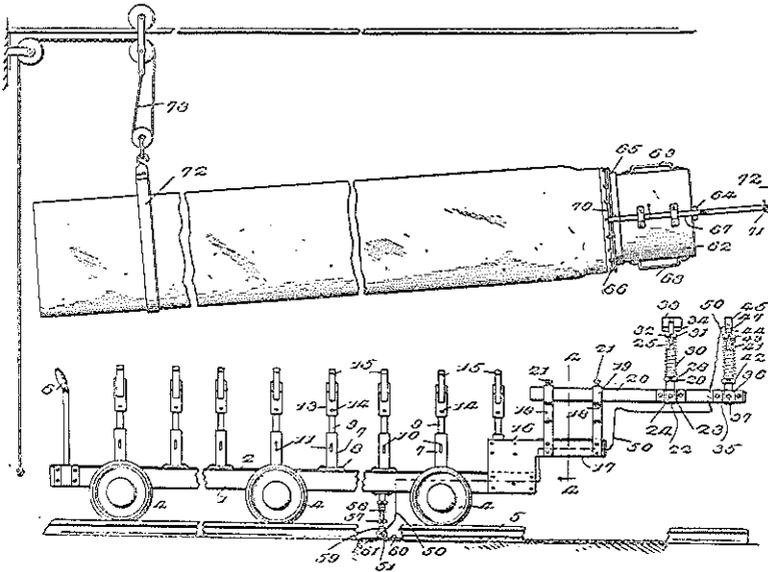


FIG. 209.

"horse" for supporting a cylinder while it is being cut up into suitable lengths for flattening, and comprises also a device for reheating the bait. The "horse" comprises a platform, 1, mounted to run on rails, 5, and provided with a number of spring-supported saddles, 15, for carrying the cylinder. The bait is supported when the cylinder is on the "horse" by spring-supported members, 33, mounted on bars projecting from the front end of the "horse."

The bait consists of a cylindrical body, 62, having its upper end closed and at its lower end a flange, 65. A ribbon, 66, of high electrical resistance is attached to, but insulated from, the flange, 65, and it is this ribbon to which the glass adheres. When the cylinder and bait are lowered on to the "horse," electrical leads, 67, connected with the ribbon rest in holders, 45, which are connected by wires, 50, with conductor rails, 60. Thus, as soon as the cylinder is placed on the "horse," the bait is electrically heated so as to maintain it at the desired temperature.

G. D.

351. Making Plate Glass. H. K. HITCHCOCK (U.S.A. Pat., June 24th, 1919, No. 1307357. Filed September, 26th, 1913, No. 79201I).—The invention consists of mechanism for automatically discharging a definite quantity of metal from a tank furnace on to a rolling table and distributing it evenly in front of the roller, the discharge of the metal being controlled by the movement of the table itself beneath the spout through which the glass is delivered. The gathering and discharging device is shown in cross-section in Fig. 210. The tank furnace, 1, has an extension, 2, through which the hot gases pass to a flue, 14, leading to the stack,

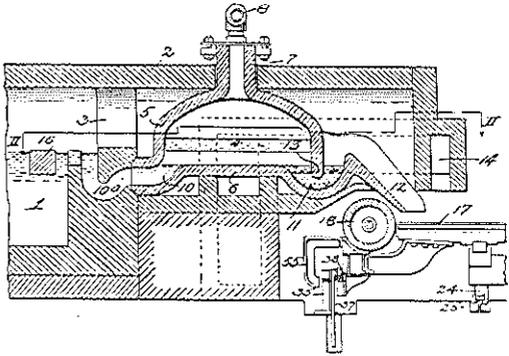


FIG. 210.

and this extension contains a dome-shaped shell, 4, which rests on the floor, 6, of the extension. The chamber, 4, is elliptical in plan and has a neck, 7, which is connected with an air pipe, 8. Gutters, 10, 11, are formed in the floor, 6, beneath the opposite ends of the chamber, 4; the gutter, 10, communicates by a passage, 10^a, with the body of the tank, and the gutter, 11, passes under the edge of the chamber and joins with a spout, 12.

The casting table, 17, is mounted on wheels, 24, which run on rails, 25, arranged across the front of the tank, the inner edge of the table passing beneath and close to the lip of the spout, 12.

In use, air is exhausted from the chamber, 4, through the pipe,

8, thus causing metal to flow from the tank into the chamber. After the desired quantity has entered the chamber, air under pressure is admitted through the pipe, 8, thus discharging the metal out of the spout on to the table, 17. At the same time, the table is moved along the rails so that the metal is deposited along the edge in front of the roller, 18. In order to make the machine automatic, the device for exhausting the air from, and compressing it in, the chamber, 4, is controlled by the table, so that movement of the table in one direction charges the chamber with metal, and in the other direction causes discharge of the metal. The device consists of a cylinder with its open end immersed in water. The

pipe, 8, leads into the interior of the cylinder, so that when the cylinder is raised out of water, air is sucked from the chamber, 4. Conversely, lowering the cylinder into the water compresses air into the chamber. The cylinder is connected by a cable with a lever moved by the table. Details of the roller gear are given in the specification. G. D.

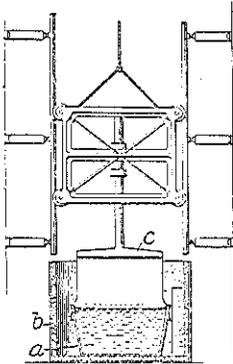


FIG. 211.

352. Drawing Sheet Glass. VIRGINIA

PLATE GLASS CORPORATION, U.S.A. (Brit. Pat., April 15th, 1920, No. 141737).—The pots, *a*, from which sheet glass is drawn are elliptical in plan and may taper downwards. The bait bar, *c*, is about equal in length to the major axis of the pot. The drawing chamber, *b*, is kept at the desired temperature by gas burners. H. G. C.

353. Drawing Sheet Glass.

A. L. FORSTER, West Smethwick, Staffordshire (Brit. Pat. No. 135697. January 28th, 1919, No. 2017).—In drawing apparatus of the kind in which sheet glass, *c*, is drawn up between endless asbestos belts, *d*, rows of short spring-pressed rollers, *l*, are employed to improve the grip of the belts, *d*, on the glass, *c*. By using short rollers, *l*, breakage of the sheet, *c*, is said to be avoided. One of the bottom rows of rollers may be replaced by a flat plate, *r* (Fig. 212), to assist in flattening the drawn sheet. Chain-mail may be incorporated in the belts, *d*, to increase their strength.

H. G. C.

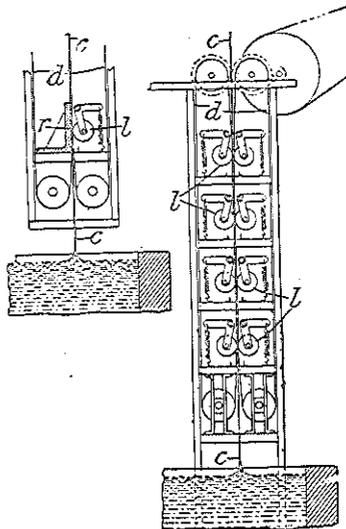


FIG. 212.

354. Making Sheet Glass. T. J. McCox, Shinglehouse, Pennsylvania, U.S.A. (Brit. Pat. No. 134807. October 11th, 1918, No. 21788/19). — Relates to apparatus for the production of sheet glass by allowing molten glass, 3, to flow continuously over a dam, 5, from a tank, 1. The front face of the dam, 5, is inclined slightly backwards, so that the glass sheet readily leaves it and is carried into the lehr, 23, by a conveyor, 24. The side walls, 4, shown in horizontal section in Fig. 213, are formed with projections, 10, which deflect the hot gases from burners, 11, on to the edges of the sheet, 3, and so prevent them from becoming unduly cooled. The temperature is also regulated by a damper, 8, and movable top and front stones, 6 and 7, respectively.

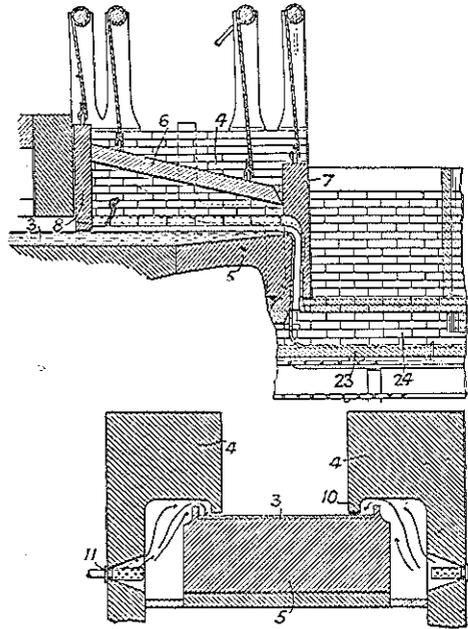


FIG. 213.

355. Drawing Sheet Glass. M. J. OWENS (U.S.A. Pat., June 6th, 1920, No. 1327405. Filed November 18th, 1918, No. 263024).—Relates to the process of drawing glass in flat sheets, and consists of means whereby the temperature of the metal at the

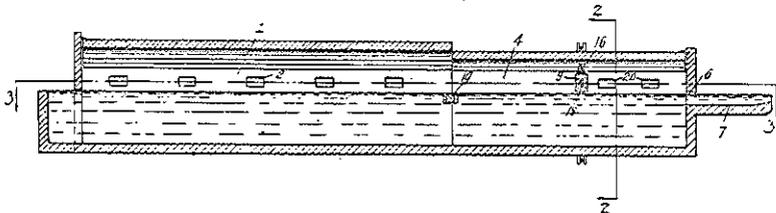


FIG. 214.

drawing point can be regulated to suit the thickness of the sheet being drawn. The tank, shown in longitudinal vertical section in Fig. 214, consists of the usual melting chamber, 1, a refining

chamber, 4, separated from the chamber, 1, by a floating bridge, 19, and a shallow cooling chamber or trough, 7, over which the metal passes into a drawing-pot. The width of the refining chamber, 4, is only slightly greater than the width of the sheet being drawn, in order to prevent the accumulation of cooler metal along the sides of the chamber.

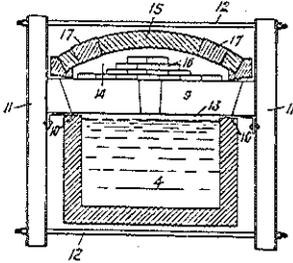


FIG. 215.

It is found that the temperature of the metal in the end of the chamber, 1, towards the drawing-pot should be varied to suit the thickness of the sheet being drawn, as a lower temperature is required when drawing thick sheet than when drawing thin. The

required regulation of temperature is accomplished by building across the chamber, 4, a "jack arch," 9, the lower surface of which is separated from the surface of the metal by a narrow space, 13. The opening, 14, between the top of the "jack arch" and the crown, 15, of the chamber can be varied by means of bricks, 16, placed in the arch through an opening, 17, in the crown. The "jack arch," 9, restricts the flow of hot gases from the chamber, 1, to the end of the chamber, 4, and by varying the space, 14, by means of the bricks, 16, the temperature of the metal in the drawing-pot can be regulated to suit the conditions of working.

G. D.

356. Cutting or Severing Glass Bars or Tubes. LIBBEY GLASS Co., Toledo, Ohio, U.S.A. (Brit. Pat., March 17th, 1920, No. 140440).—Relates to apparatus for continuously drawing a rod or tube of glass from a forming apparatus, and successively

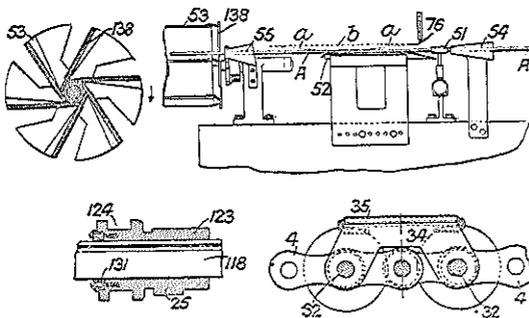
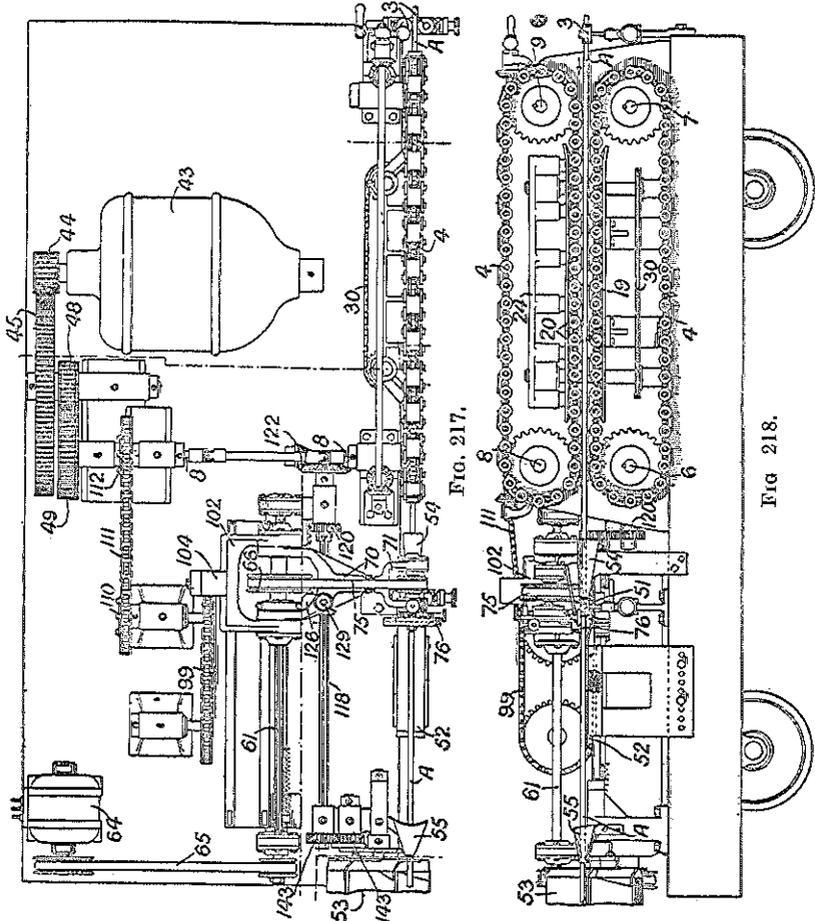


FIG. 216.

severing it into sections or predetermined lengths. The action of the cutting tool is illustrated in Fig. 216, the path of the rotating tool or disc, 76, relatively to the work, 4, being indicated in dotted lines. The tool moves forward at the same speed as the work, first downwards into contact and then upwards therefrom, as shown by

the line *a*, the line *b* indicating the non-cutting return stroke. The action of the cutter is stated to be two-fold: first, to groove or abrade the work, and, secondly, to set up a localised heating, and consequent strain, within the material at the point of contact. The section thus grooved and weakened is subsequently broken off from the main body of the rod or tube by the action



of plates or vanes, 138 (Fig. 216), on a rotating delivery wheel, 53 (Fig. 218). The general arrangement and operation of the machine is as follows. The work, *A* (Figs. 217 and 218), advancing from the furnace or other source of supply, passes between two horizontal spring-mounted guide-rolls, 3, and thence between two sets of feed chains, 4, 4. These are driven at the same speed through upper and lower driving shafts, 8, 6, and spur gearing, 44, 45, 48, 49, from a motor, 43. The upper shafts, 8, 9, are mounted

so that they can be adjusted vertically relatively to the lower shafts, 6, 7. The chains, 4, are held in yielding contact with the work by means of spring-pressed upper plates, 20, and a stationary platform, 19, below. The pressure of the plates, 20, can be simultaneously adjusted by means of a sprocket-chain, 30 (Fig. 218), which raises or lowers the supporting frame, 24. The work is actually gripped between pads, 35 (Fig. 216), mounted on U-shaped chairs, 34, carried on the links, 32, of the chains. The work passes from the chains through a guide, 54 (Fig. 218), and thence between guide-rollers, 51, similar to the guide-rolls, 3. It next passes under the cutter disc and over a spring-supported table, 52, and, after being acted upon by the cutter, travels past a guide-member, 55, into one of the pockets of the breaking-off and delivery wheel, 53. The cutter, 76, is rotated by a motor, 64 (Figs. 217 and 219), through belt gearing, 65, 66, 75, 71. It is mounted in a bearing-fork, 71, which is adjustably connected to

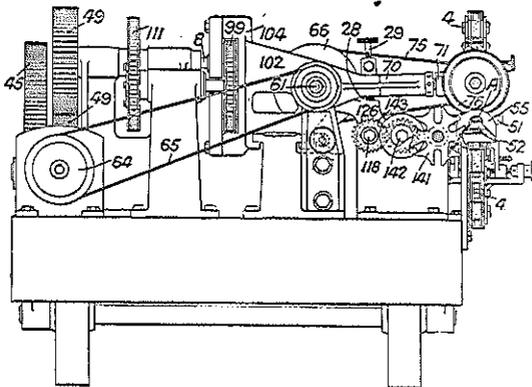


FIG. 219.

a slide head, 70 (Fig. 217), so as to permit tensioning of the belt, 75. The slide head, 70, is traversed along a shaft, 61, at the same speed as the work by means of an endless chain, 99, driven through gearing, 110, 111, 112, from the main motor, 43. A transverse stub shaft is mounted on the chain and carries at each end rollers, which engage in a groove formed in the vertically elongated boss, 104 (Fig. 217), of a yoke or slide frame, 102, which is mounted to slide on the shaft, 61, and carries the slide head, 70. The downward movement of the cutter to effect the actual cut is obtained by means of a cam, 123 (Fig. 216), having a peripheral cam surface, 125, and splined on to a shaft, 118 (Fig. 217), which is driven through gearing, 120, 122, from the drive shaft, 6, of the feed chains. An arm, 126, mounted on the shaft, 61, engages with a peripheral groove, 124, on the cam, 123. A roller on the arm, 126, contacts with the cam surface, 125, and as the latter is rotated the arm 126, is rocked about the shaft, 61, and imparts

a similar rocking movement to the slide head, 70, through a stud, 28 (Fig. 219), and thence to the cutter. Fixed at each end of the cam-wheel, 123, are cleaning gaskets, 131 (Fig. 216), which project into the spline grooves in the shaft, 118, and free them from accumulated dirt during each traverse. The cutter may be adjusted vertically with respect to the work by means of a screw, 129 (Fig. 217). A pair of work-guiding fingers are mounted by the side of the cutter disc and hold the work against any transverse movement during the cutting action. The breaking-off and delivery-wheel, 53, is rotated intermittently by Geneva gearing, 141 (Fig. 219), driven through spur gearing, 142, 143, from the shaft, 118.

H. G. C.

357. Device for Marking Glass Preparatory to Cutting.

H. D. FITZPATRICK and FOURS ET PROCÉDÉS MATHY SOC. ANON., Liège, Belgium (Brit. Pat., May 10th, 1919, No. 140257).—An appliance for marking various lines, curves, etc., on glass and the

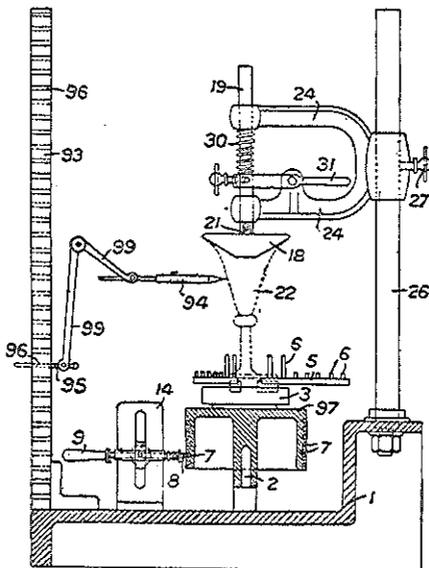


FIG. 220.

like preparatory to cutting, comprises a central table, and, arranged round it, a series of marking devices having pencils for marking the lines and curves in coloured liquid. The table is rotatable, but may be fixed at will in the desired positions. As shown, the table, 3, for supporting the object, 22, to be marked is rotatably mounted on a vertical pin, 2, in the centre of the frame, 1, which carries the marking devices, 67, 89, 94, etc. On the table, 3, are three radial slides, 5, having rubber-covered pins, 6, for clamping the object, and operable simultaneously to centre it, after the

manner of a chuck. A drum, 97, secured to the table, 3, has a series of horizontal rows of holes, 7, at different distances apart, any of which may be engaged by a pin, 8, for locking the table. The pin, 8, is adjustable in height to engage any one of the rows of holes, 7, on a bracket, 14, and is spring-pressed into engagement, after withdrawal by its operating handle, 9. A centring and steadying clamp for the upper end of the object comprises a conical buffer, 18, rotatably mounted at 21 on a rod, 19, slidably mounted in a bracket, 24, adjustably fixed by a screw, 27, on a post, 26. A lever, 31, is provided for lifting the rod, 19, and buffer, 18, which are pressed downwards by a spring, 30. The various marking devices are arranged round the table, 3, on supports, 36, 59, 49, 68, etc., and each is provided with one or more pencils or pens for applying a coloured liquid. These pencils, as

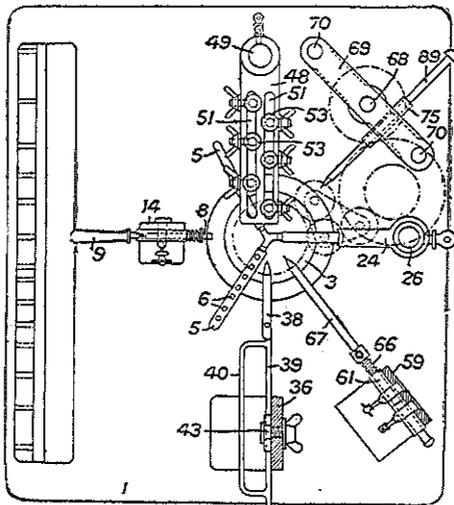


FIG. 221.

shown at 67 (Fig. 222), each comprise a pointed tube, 67, having a ball valve closed by a spring, 46, and opened when the pencil is pressed against the object, 22, by a needle point, 47, on the ball projecting through the nozzle or opening. For marking lines in vertical planes, a pencil, 38, is carried by a handle portion, 39, 40, pivotally mounted, and also slidable in a radial direction on a bracket, 36, the pivotal support, 43, being adjustable in a vertical slot. Concentric circles may be traced on horizontal or approximately horizontal surfaces of the object, 22, by a series of depressable vertical pencils, 53, adjustable in slots, 51, in an horizontal arm, 48, adjustable vertically and angularly on a post, 49. Horizontal circles may be marked on inclined or vertical surfaces of the object by a series of pencils, 67, slidable in brackets, 61, adjustable vertically and angularly on a slotted bracket, 59. Springs, 66,

retract the pencils, any of which may be pressed inwardly to engage the object. Helical lines are marked by a pencil, 89, in a carrier, 75, movable vertically in a bracket, 69, 70, and engaging a helically-grooved shaft, 68, journaled in the bracket. The shaft, 68, is geared by variable and reversible gearing, shown in Fig. 222, to a wheel, 88, on the table, so as to rotate the table, 3, and object,

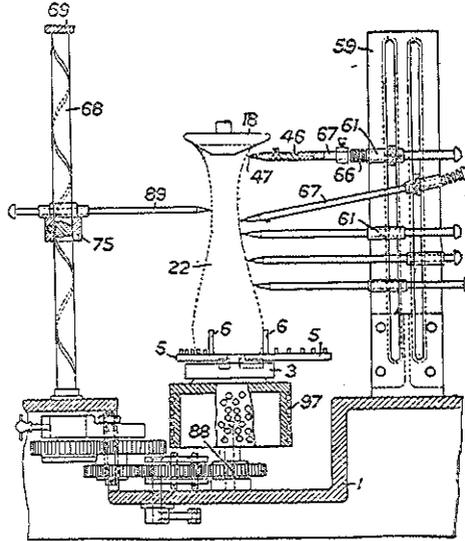


FIG. 222.

22, when the carrier, 75, is moved up or down. Arcs of circles and other curves may be marked by a pencil, 94 (Fig. 220), on a jointed compass or carrier, 99, pivoted to a pin, 95, which may be pivotally engaged in any one of a series of horizontal holes, 96, in a vertical plate or bracket, 93. The curves are made by pressing the pencil, 94, against the object, and at the same time rotating the compass about the pin, 95.

H. G. C.

358. Cutting Sheet Glass. J. WATERLOO, assignor to EMPIRE MACHINE Co., Pittsburgh, Pa., U.S.A. (Brit. Pat., February 17th, 1920, No. 139189).—In glass-cutting apparatus, in which a stationary sheet of glass is cut by a number of cutters mounted on a traversing carriage, means are provided for resiliently depressing the cutters when in action and for raising them when the cutter carriage is moved into position for a subsequent cut. An improved mounting for a cutter is also described. The apparatus may form an attachment for existing glass-cutting tables. A sheet of glass is passed over a table, 2, which may be provided with rollers, 3, into the cutting position, where it is engaged by gauges, 8. It is then cut transversely by a number of cutters mounted on a carriage, 9, adapted

to be moved across the glass on rods, 5, by a handle, 32. Each cutter, 23 (Fig. 223), is slidably adjustable in an angularly adjustable shaft, 22, carried by a member, 18, angularly adjustable around an intermediate member, 15, secured to a member, 14, clamped to a spindle, 13, mounted freely for oscillation in the carriage. An adjustable spring-pressed pin, 28 (Fig. 223), bears on an arm, 27, secured to the spindle, 13, to depress the cutter normally, but it is adapted to be raised when the carriage is moved

FIG. 223.

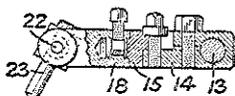
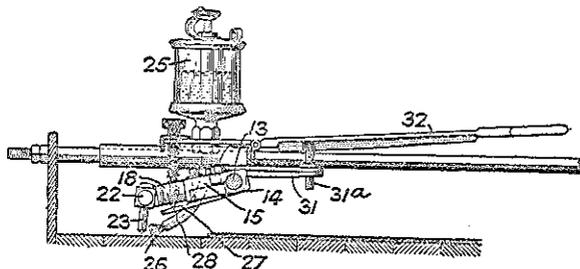


FIG. 224.

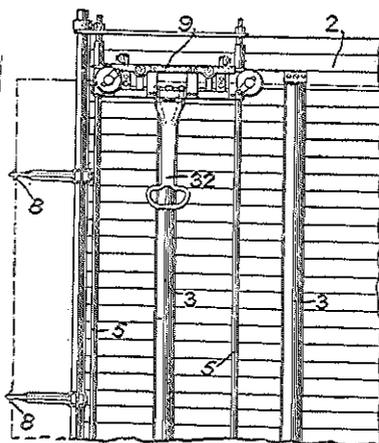


FIG. 225.

back into position for a subsequent cut by depression of the handle, 32, acting through a bolt, 31^a, carried by an arm, 31, secured to the spindle, 13. Lubricant is passed from oil cups, 25, to the glass immediately in advance of the cutters by means of wicks, 26.

A further device by the same inventor is as follows:—

(Brit. Pat., February 17th, 1920, No. 139190).—Relates to a machine for both cutting sheets of glass and for breaking them along the line of cut, and comprises a work support and feed of the endless conveyor type provided with transverse cleats of adjustable length, affording an edge over which the cut strips are severed by the bending action of a breaker device. The work is kept down

on the conveyor in its passage under a stationary cutter by presser rolls disposed on each side of the cutter, and delivery and stacking devices are provided for the cut sheets. The conveyor may consist of two belts, 4, driven from a motor, 14, and to which are secured a series of cleats, 5 (Fig. 226), having reduced ends, 6, and some of which are provided with adjustable pallets, 7, furnishing an adjustable edge, over which the cut strip is severed by a breaker roll, 46. This roll, preferably of wood, fibre, etc., is transversely adjustable on a rod, 49, carried by a rod, 51, trunnioned at 53 in the fixed support, 18, and carrying a weight, 56. The conveyor is provided at intervals with raised cleats, 13, which serve to raise momentarily the breaker roll, 46, its subsequent descent

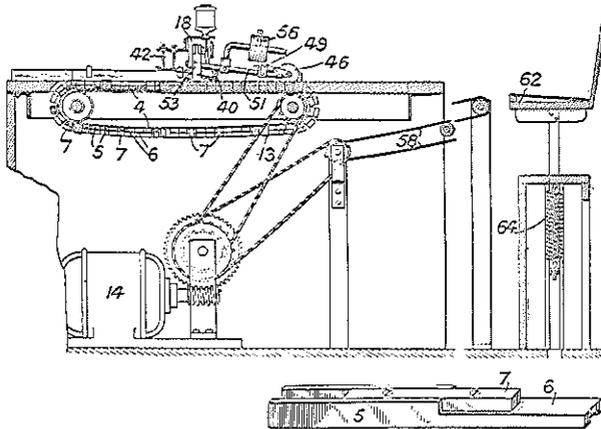


FIG. 226.

under the action of the weight, 56, serving to detach the cut strips. The cutting or scoring tool, 40, is pivotally mounted in the support, 18, and bears on the work resiliently under the action of a spring, 42. Pairs of presser rolls, carried by pivoted arms depressed under the action of springs or weights, are disposed on each side of the cutter to control the work in its passage through the machine. The cut strips are received by a belt, 58, and conveyed to a stacking chair, 62, supported by a spring, 64, adapted to be adjusted so that the chair is depressed the width of a glass sheet as each is collected thereon.

H. G. C.

359. Cutting-machines for Glass. EMPIRE MACHINE Co., Pittsburgh, Pa., U.S.A. (Brit. Pat., February 17th, 1920, No. 139188).—Relates to a machine for cutting rectilinearly sheet glass fed beneath stationary cutters by an endless conveyor. The conveyor may consist of two belts, 5, to which are secured slats, 6, forming a continuous supporting surface for the glass, which is adjusted thereon against abutments, 16, on the conveyor and side gauges, 17, on the table, 2. The conveyor may be driven, as shown, by a treadle-controlled motor, 12, and its edges are sup-

ported by angle irons, etc., secured to the table. Each cutter, 26, is mounted on a carrier, 22, transversely adjustable on a vertically adjustable bar, 19, and bears with adjustable resiliency on the work. Pivotal adjustment is provided for the cutter in its holder. The glass is supplied, immediately in advance of the cutter, with lubricant from a cup, 32. A resiliently-mounted roller may be provided to press the work down on to the carrier. In a modifi-

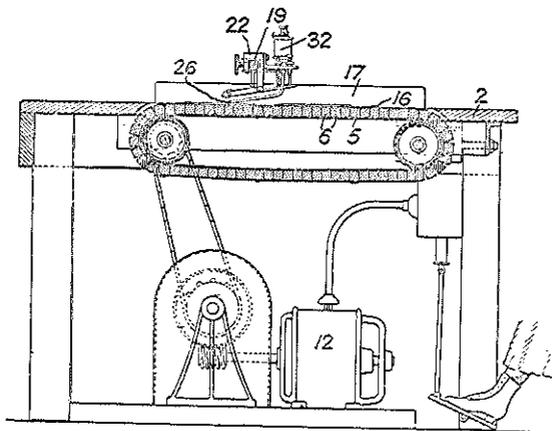


FIG. 227.

cation the carrier is moved by hand, and may work over adjustable drums provided with ball bearings. The machine may be provided with an additional conveyor for the removal and inspection of the cut sheets.

H. G. C.

360. Glass Gathering Machine and Process. J. O. JENSEN and J. HENLE, assignors to J. O. JENSEN Co. (U.S.A. Pat., May 27th, 1919, No. 1304568. Filed November 21st, 1917, No. 203142).—This machine is designed to operate a gathering punty in a way very closely approximating the motion of a punty during hand gathering. The nose of the punty is advanced into the furnace, and partly submerged in the molten glass. While partly submerged, it is rotated and pushed forward so as to localise the bulk of the gathering at the forward end of the punty. On being lifted from the surface of the glass, the punty is drawn slightly to the rear in order to form a tail to help the gather to enter the mould easily, and then carried slightly to one side, so that when the gather breaks away from the main bulk of glass, the strand which has been drawn out falls to one side of the gathering point, thus minimising the tendency to form blisters and streaks. The punty is withdrawn rapidly from the furnace and swung laterally over the delivery point, and then lowered over the mould. The gathering is severed and the punty rotated through one-half a revolution, so that the cut-off end comes to the top of the glass remaining on the end of the punty.

Fig. 228 shows a side view of the machine. The punty, 21, with a clay nose, is clamped at 22 to the punty operating rod, 23. The cam groove, 33, times and controls the longitudinal motions of the punty. The cam groove, 34, causes and controls the vertical tilt-

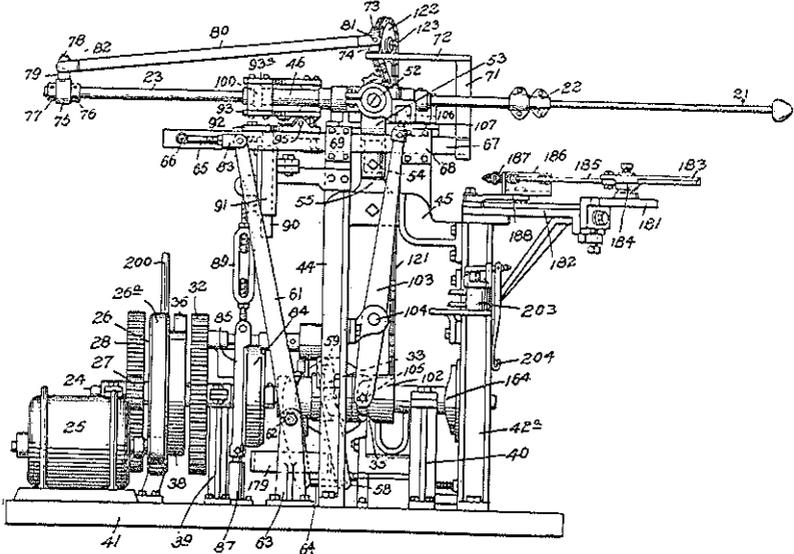


FIG. 228.

ing motions, while the groove, 35, controls the lateral swinging movements. The punty is rotated by means of the manipulator rod, 23, which is feathered within a tubular sleeve, 46, mounted for rotation in a supporting bracket, 47. The sleeve, 46, serves as

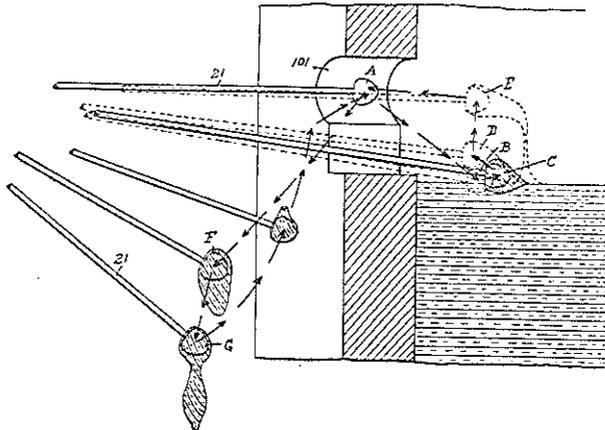


FIG. 229.

a universal support arranged to swing about two axes at right angles to each other. The point at which these axes intersect lies in the axis of the punty rod, and about this, as centre, the punty has universal movement.

Fig. 229 shows diagrammatically the movements of the punty in gathering and delivering a gob of glass. S. E.

361. Making Wire Glass. R. S. PEASE (Assignor to Pittsburgh Plate Glass Co.) (U.S.A. Pat., March 18th, 1918, No. 1259772. Filed June 21st, 1912, No. 705032).—Wire glass is made by drawing the glass in a cylinder surrounding the wire and then flattening the cylinder to embed the wire in the walls of the cylinder. Fig. 230 shows in cross-section a doghouse, 1, containing the metal from which the cylinder is drawn, and having beneath

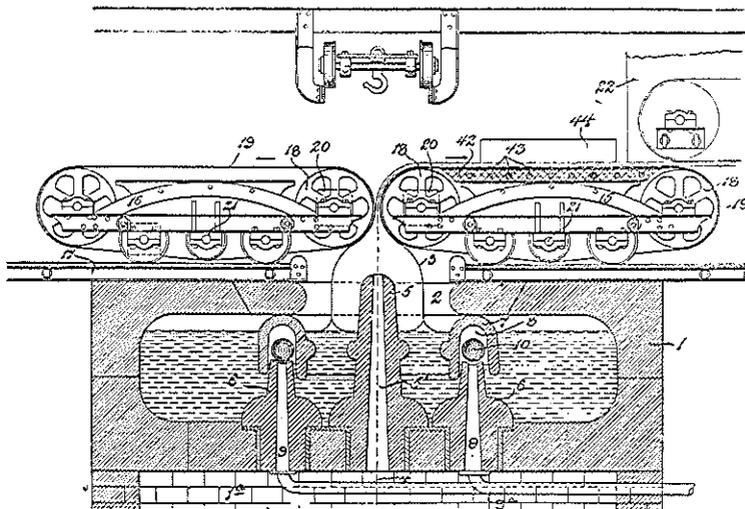


FIG. 230.

it an airtight chamber, 1^a, supplied with air under pressure for the drawing. The wire strip, 4, which is stored in a roll in the chamber, 1^a, passes upwards through a slot, 5', in a standard, 5, built up from the bottom of the doghouse. The wire and glass are drawn upwards by conveyor belts, 19, mounted on carriages, 15, 16. The belts are driven by motors, 20, and the carriages are mounted on rails, 17, so that they may be moved away from the drawing opening, 2.

In commencing operations, an oval bait is lowered into the metal so as to surround the standard, 5, and at the same time the wire is attached to hooks carried by the bait. The bait is now raised, thus drawing a flat-sided "cylinder" of glass surrounding the strip of wire mesh. When the bait is drawn upwards a sufficient height, the carriages are run into the position shown, thus flattening the

cylinder. The bait is laid on a belt and is carried away to the right. The drawing then proceeds continuously, a cylinder, 3, being formed, then flattened on to the wire, 4, and the complete sheet being conveyed through a lehr, 22. A floating ring, 7, surrounds the standard, 5, and protects the cylinder, 3, from the heat and flames in the doghouse. The truck, 15, is provided with steam pipes, 43, to prevent cooling of the sheet before it reaches the lehr.

G. D.

362. Making Glass Letters for Signs. EUGENE C. GMELIN (U.S.A. Pat., December 23rd, 1919, No. 1325785. Filed June 19th, 1916, No. 104488). — The

specification describes a method of making letters for display signs in which the letters appear in relief on the surface of a sheet of glass. The sheet of glass is placed on a die plate, 21, which is provided with grooves or depressions in the form of a letter, and the die is then placed in a furnace

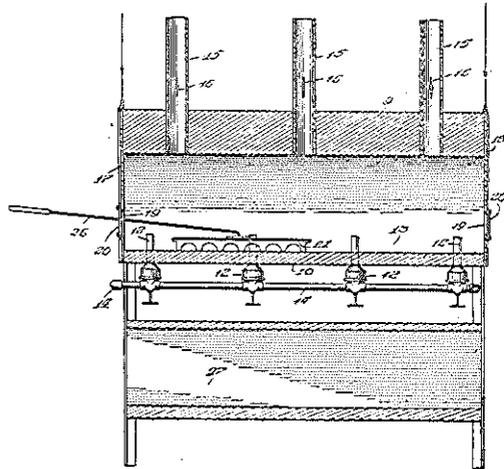


FIG. 231.

The furnace consists of a flat bottom, 10, and a semi-circular arch, 9, and is heated by a row of burners, 12, on each side. When the glass is soft and commences to sag into the grooves of the die plate, the workman presses it completely into the grooves with a small male die fixed to a handle, 26. The die with the finished letter plate thereon is removed to a chamber, 27, beneath the furnace and allowed to cool slowly.

G. D.

363. Apparatus for Feeding Molten Glass. B. D. CHAMBERLAIN, assignor to the EMPIRE MACHINE Co. (U.S.A. Pat., February 19th, 1918, No. 1256979. Originally filed June 2nd, 1911, No. 630944).—This invention consists of apparatus for feeding metal in definite charges, shaping each charge into a parison, and affixing the parison to the end of a blowpipe, thus dispensing with gathering and marvering. The invention is particularly intended for use with a blowing machine, which appears to be the type described in Brit. Pat. 16794/1910. In this machine the blowpipes are automatically inserted in the tank to gather the metal, and the gather is marvered and blown automatically. As

shown in Fig. 232, the device consists of a tank extension, *A*, in the bottom of which a hole, *B*, is formed. The metal runs through *B* in a continuous stream, and is received in a parison mould, *E*, supported by a frame, *C*, *D*, which is free to oscillate on a vertical pin, *A*³. The stream of metal is cut off at suitable intervals by a rotary knife, *H*, having cutting edges, which co-operate with a cutting edge, *G*, fixed to the standard, *D*. Both the knife, *H*, and the cutter, *G*, are hollow, and may be heated or cooled by circulating suitable fluid through them. The parison mould, *E*, has trunnions, which are journalled on the ends of a lever, *F*, pivoted on the arm, *C*, and by moving this lever, the mould, *E*, can be

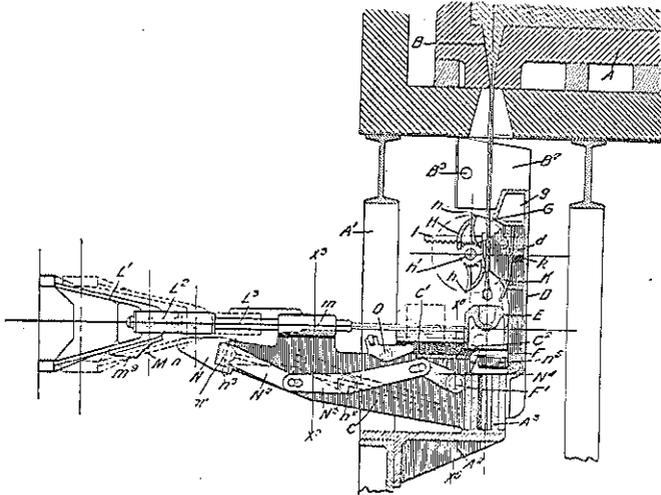


FIG. 232.

turned on its side, as shown in dotted lines, with the mould space facing outwards. A forked guide, *m*, on the top of the arm, *C*, serves to support a blowpipe.

The blowing machine comprises a rotary head to which arms, *L*¹, are pivoted, and supports, *L*², pivoted to these arms carry blowpipes, *L*³. As the machine rotates, it inserts a blowpipe, *L*³, into the guide, *m*, and moves the pipe inwards towards the mould, *E*. The support, *L*², then engages a sliding rod mounted alongside the guide, *m*, and, by moving it inwards, causes rotation of the knife, *H*, and thus severs a charge of metal from the stream. Almost at the same time, the support, *L*², engages an arm, *N*, connected with the lever, *F*, and thus turns the mould, *E*, on to its side. The end of the pipe enters the moulding space and presses against the charge of metal therein, so that the parison is formed and stuck on to the end of the pipe. Further movement of the machine withdraws the pipe and its attached parison, and a spring, *m*³, restores the mould to its upright position ready to receive more metal. To control the temperature of the stream of metal, it may

be surrounded by a shield, B^2 , having a pipe, B^3 , through which a gas flame or an air blast may be introduced as desired.

A modified form of feeding device is shown in Fig. 233. In this form, the mould block, E^1 , has four mould cavities instead of the single cavity shown in the previous construction, and the mould is turned through a right angle to present a parison to the blowpipe. The descending stream of metal is received on an inclined trough, which is carried by a standard, D^1 , mounted on the pin, A^3 . The trough is mounted at its front end on a horizontal pivot, r , and may be tilted about this pivot by a set screw, r^1 , so that the inclination of the face of the trough may be altered. The metal flows down the trough, and by adjusting the screw, r^1 , the cross-sectional area of the flowing stream can be varied at will according to the size of parison to be worked. The charge is cut off

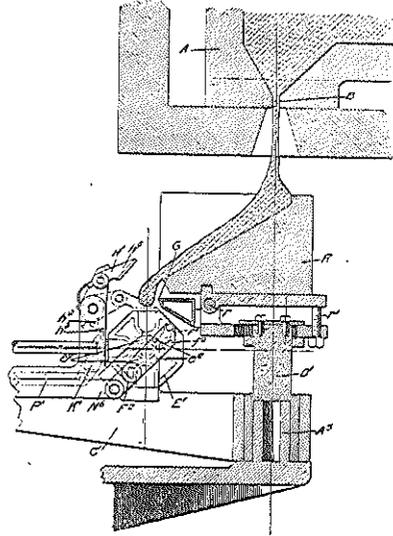


FIG. 233.

from the stream by a combined cutter and presser, H^1 , which oscillates about its pivot, as shown in dotted lines, and co-operates with a fixed cutter, G , situated below the lip of the trough. The member, H^1 , not only cuts off a charge of metal, but presses it into the mould. The trough, R , can be rotated about the pin, A^3 , and can thus supply metal to a number of machines arranged in a circle about the pin. This modified form of feeding device

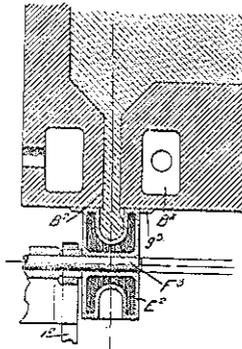


FIG. 234.

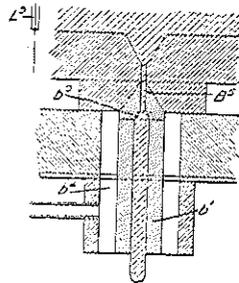


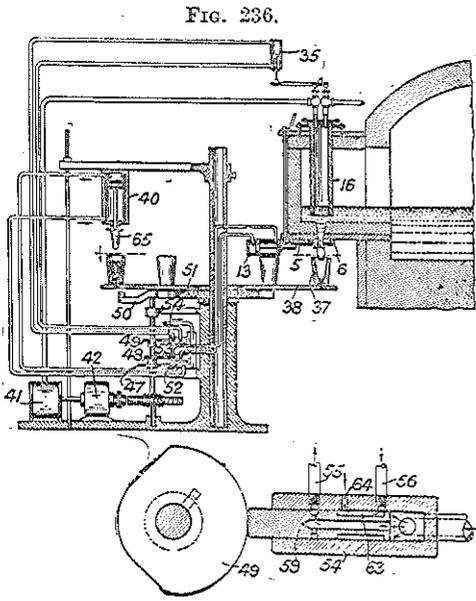
FIG. 235.

is the subject of a separate patent, No. 1256980, and another modification is the subject of a third patent, No. 1323450.*

A further modification of the invention, shown in Fig. 234, consists in forming an exit orifice in the side or bottom of the tank and having a rotating mould block, E^2 , having one or more mould cavities fitting closely against a curved face plate, g^2 , attached to the tank face around the outlet. Heating passages, B^2 , surround the outlet.

As pointed out above in connection with the device shown in Fig. 233, it is advantageous to have the falling stream of metal of nearly the same cross-section as that of the mould cavity. This may be secured, as shown in Fig. 235, by connecting the exit orifice, B^5 , of restricted size, with a discharge tube, b^1 , of greater area, and in surrounding the discharge tube with a space, b^4 , into which a cooling fluid may be introduced. The stream thus increases in area as it leaves the tube, B^5 , to the desired cross-section, and, being chilled, descends in a solid stream of approximately the same cross-section as the parison. G. D.

364. Automatic Glass Feeding Device. R. E. McCauley, Stockton, California, U.S.A. (Brit. Pat. No. 135454. January 6th, 1919, No. 360).—



Relates to apparatus for delivering molten metal of the kind described in Specification 113665, combined with a machine for moulding glass articles under pressure. The table, 38, carrying the moulds, 37, is rotated intermittently by a Geneva-stop mechanism, 50, 51, from a motor, 52, which also operates a blower, 41. The cut-off knife, 5, pneumatic delivery device, 16, and the pressing plunger, 65, are controlled by the pneumatic cylinders, 13, 35, 40, the air supply to which is controlled by valves,

53, 54, 52, operated by cams, 48, 49, 47. Fig. 237 shows one of the valves 52, 53, 54. In the position shown, the compressed air flows

* This JOURNAL, Abs. 1919, 3, p. 275.

as shown by the arrows. When the valve plunger, 59, moves to the left, the air passes directly into the pipe, 56, and the exhaust from the pipe, 55, passes through the port, 63, into the air by way of the hole, 64. The frame, 6, in which the shearing knife, 5, works is water-cooled.

H. G. C.

365. Feeding Device for Glass-making Machinery. HARTFORD-FAIRMONT Co., New York, U.S.A. (Brit. Pat., November 12th, 1919, No. 141320).—Relates to apparatus for feeding to moulding, etc., machines the charges delivered regularly from a tank, 2. The charges fall upon a curved distributor, 14, pivoted at 17 to a ring, 10, which is mounted in a bearing, 11, so that it can be turned automatically by cam mechanism to deliver the charges down a short trough, 15, successively to a

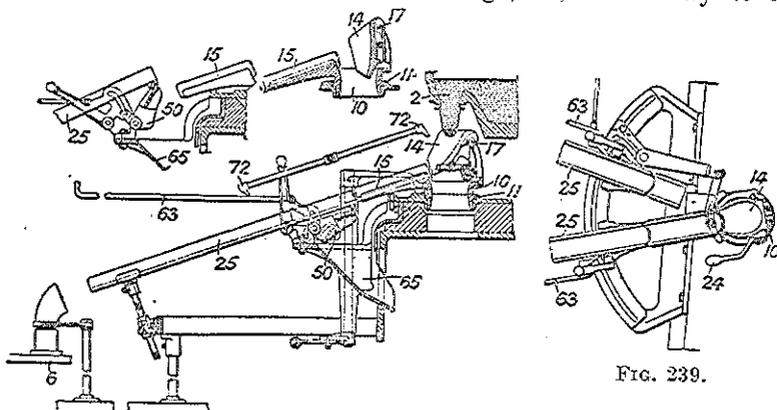


FIG. 238.

number of troughs, 25 (Fig. 238), each leading to a glass-working machine. When it is desired to stop feeding all the machines without stopping the delivery from the tank, 2, the distributor, 14, is tilted downwards, as shown in Fig. 239, by a handle, 24, at the distributor, or an extension, 63, at the machine. This allows the charges to fall through the ring, 10, into the cullet pit. If a particular machine is to be put out of action, its trough, 25, is raised, as shown in Fig. 238, so that the charges leave the short trough, 15, and are deflected by a plate, 50, down a shoot, 65, into the cullet pit. The trough, 15, may be arranged to discharge directly to the machines, and in this case the machine tables, 6, may rotate continuously. The troughs, 25, etc., are sprayed with liquid from nozzles, 72.

H. G. C.

366. Glass Feeding Device. EMPIRE MACHINE Co., New York, U.S.A. (Brit. Pat., February 9th, 1920, No. 138895).—Relates to the delivery of uniform charges of molten glass from tank furnaces. The object of the invention is to prevent or to

minimise the chilling or scarring of the charge by the shearing mechanism. Molten glass flows from the tank, 1, through a

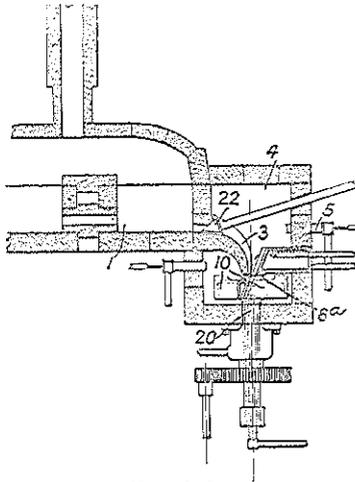


FIG. 240.

control valve, 22, and down a spout, 3, level with the end of which is a fixed water-cooled ledger blade, 6^a. The charges are severed by a water-cooled, four-armed rotating shearing device, 10, and drop through a hole, 20, on to a carrier, which conveys them to the forming mechanism. The shearing mechanism is enclosed in a chamber, 4, which is heated by burners, 5. By this means, the end of the glass stream flowing from the spout, 3, which has been chilled by the last shearing operation, is re-heated by the hot gases in the chamber. The fluidity of the glass stream, and hence its cross-section, can be regulated by the burners, 5.

H. G. C.

367. Machine for Fire-polishing Tumblers and other Glass Articles. H. H. PITT (U.S.A. Pat., June 24th, 1919, No. 1307453. Filed August 7th, 1917, No. 184954).—A machine for fire-polishing tumblers constructed according to this invention is characterised in that means are provided for passing water, steam, or air through the plugs which support the tumblers. The supporting plugs are arranged round the periphery of a horizontal

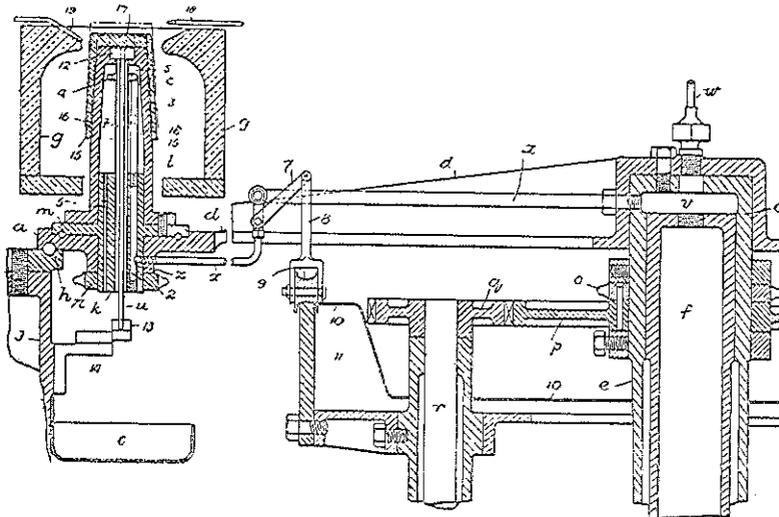


FIG. 241.

circular table, which, in rotating, carries the tumbler supports through a furnace or glory-hole, *g*. The plugs, *b*, are mounted on ball bearings, *m*, and are rotated by a chain passing round the outer side of the chain wheels, *n*, mounted on the plug shafts and round a central chain wheel, *O*. Each plug is hollow, and its cavity is filled with water supplied under pressure from the central chamber, *v*, in the hub of the machine. A port, *z*, in the shaft of the plug is adapted to register with the end of the pipe, *x*, once each revolution of the support, thus giving a regular supply of water to the interior of the plug. Excess water is led away through the hole, *5*, from which it drips into a circular tray, *6*. In order that water shall only be supplied to the plug as it is passing through the furnace, a cock is provided, and controlled by the lever, *7*, which in turn is operated by the rod, *8*, co-operating with the raised cam, *11*, on the track, *10*, opposite to the furnace. The central spindle, *u*, is raised and lowered alternately by a switch-back circular track, *13*, on which the lower end of the rod runs. This movement carries the tumbler upwards and allows the flame in the furnace to pass, to some extent, into the inside of the tumbler, thus smoothing the edge, *15*, and at the same time preventing the tumbler from contracting on to the plug. S. E.

368. Grinding, Polishing, and Bevelling Glass. P.

ERTINGER and W. FORBER, Liverpool (Brit. Pat. No. 136020. February 1st, 1919, Nos. 2531 and 3518).—In glass grinding, polishing, or bevelling machines, the mixture of abrading material and fluid is automatically supplied to the bevelling wheel or to the polishing table by means of an oscillating trough, *Q*, which is caused by the reciprocation of a rod, *N*, to rock about a pivot bolt, *R*, so that it alternately dips into a cistern, *C*, containing the abrading mixture, and then deposits this on the wheel or table. The rod, *N*, is reciprocated by means of a crank pin on a disk, *L*, which is rotated through worm gearing, *I*, by a shaft, *D*; the shaft, *D*, also carries a stirrer, *F*, which keeps the abrading material well mixed. The oscillation of the trough may be started or stopped by means of a foot-operated clutch, *X*. The abrading material may comprise pumice, emery, carborundum, colcothar, rouge, rotten-stone, etc.

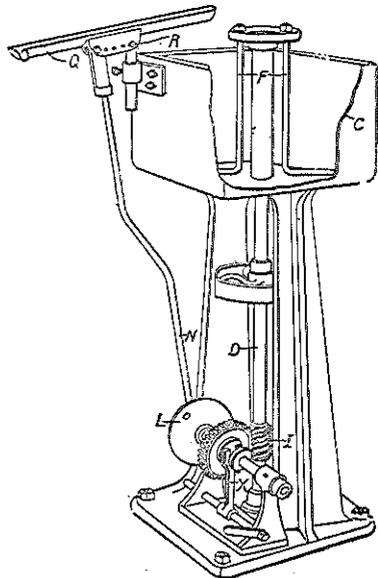


FIG. 242.

H. G. C.

369. **Bevelling Lenses, etc.** H. J. BIRCHALL, Erdington (Brit. Pat. No. 135354. January 2nd, 1919, No. 30).—In a grinding machine for double bevelling the edges of eyeglass lenses, etc., in which two grinding-wheels are employed, one for each bevel, movable to and from the lens under the control of a pattern

FIG. 243.

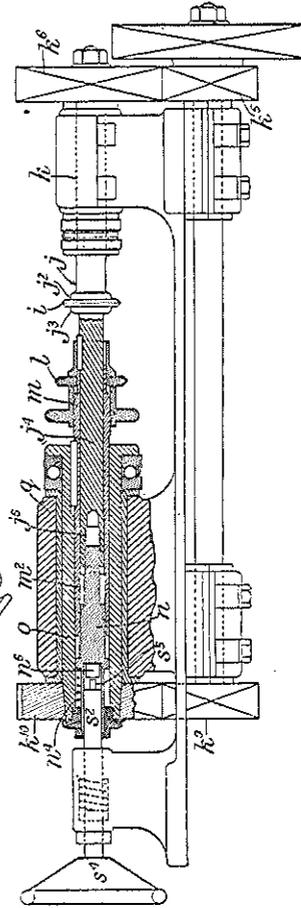
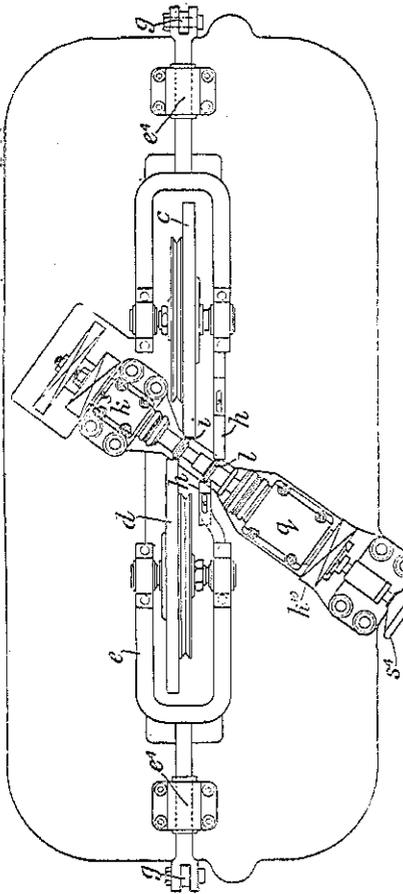


FIG. 244.

or former mounted on a rotating shaft which carries the lens, etc., the shaft is made in two parts, between the opposed ends of which the lens is mounted, and means are provided whereby the axial position of the former on the shaft can be adjusted relatively to the thickness of the lens, so that the apex of the V-bevelling is always in the centre of the thickness of the lens, etc. The divided shaft, *j*, has a part with an end, *j*², mounted for rotation only in a bearing, *k*, and driven by spur-gears, *k*⁵, *k*⁶, the other part, *j*⁴, of the shaft, having an end, *j*³, being driven at the same speed by exactly similar gearing, *k*⁸, *k*¹⁰.

The lens, *i*, mounted between the ends, *j*², *j*³, is ground by the

peripheries of the grinding-wheels, *c*, *d*, which are movable to and from the lens by the engagement of a former, *l*, with followers, *h*, carried by the grinding-wheel frames, *e*, and held up to the former by weights adjustably mounted on levers, *g*. When a lens of different thickness is to be ground, the former is moved axially along the shaft by a distance equal to half that moved by the end, *j*³, this movement being brought about by the following means. The sleeve, *m*, carrying the former is slidably keyed on the part *j*⁴ of the divided shaft, and is also slidably keyed in a sleeve, *o*, rotatably mounted in a bearing, *q*, and driven by the gear, *k*¹⁰. The ends of the sleeve, *m*, and the shaft, *j*¹, are internally screw-threaded at *m*² and *j*⁶, respectively, the pitch of the thread *m*² being half the pitch of the thread *j*⁶, and in engagement with these threads is a screwed plug, *n*, slidable in the sleeve, *o*, and pressed by a spring, *n*⁴. The plug is adapted to be rotated by means of a hand-wheel, *s*⁴, mounted on a spring-pressed shaft, *s*², which is moved axially to engage the part *s*⁵ with the part *n*⁵ of the plug; the holding pressure of the end *j*³ on the lens is due to the spring, *n*⁴. The grinding-wheel frames are guided by means of rollers running on guide-rails and by means of bearings, *e*⁴. According to the Provisional Specification, the grinding wheels may be laterally adjustable.

H. G. C.

370. Remelting the Sharp Edges of Glass Articles. M. MATHY, 14, Place des Franchises, Liège, Belgium (Brit. Pat. No. 137660. February 27th, 1919, No. 4956).—Relates to apparatus for remelting the sharp edges of glass articles left by cutting. The glass article, 6 (Fig. 245), is placed on a spindle, 5, carried by a slide, 3, which is pushed forward to bring the article into a furnace, 7. In this position, a pulley on the lower end of the spindle, 5, engages a belt, 12, which causes the spindle, 5, to rotate. The screw, 9, adjusts the height of the furnaces, 7. Fig. 246 shows a section of the furnace, 7. Air entering a pipe, 17, is heated during its passage up the annular space, 18, to the aperture, 20, where it mixes with gas from a pipe, 21. Combustion takes place in the pores of a refractory mass, 22. The hot gases pass down through holes, 23, and melt the edges of the article, 6. No flame comes into contact with the glassware.

H. G. C.

FIG. 245.

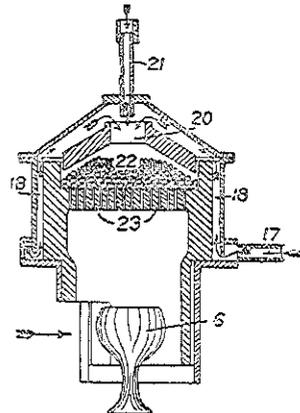
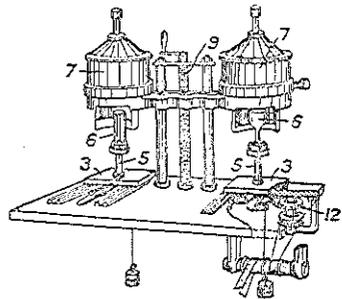


FIG. 246

371. Cracking-off and Remelting Machine. ALBERT B. KNIGHT (U.S.A. Pat., January 1st, 1918, No. 1251541. Filed

November 28th, 1918, No. 133939).

—The invention consists of a machine for cracking-off and glazing the ends or necks of electric lamp bulbs (or of other glass articles with necks) so that they leave the glass-works ready for making up into lamps. The machine consists of a rotary table, 26 (Fig. 247), which carries a number of bulb-

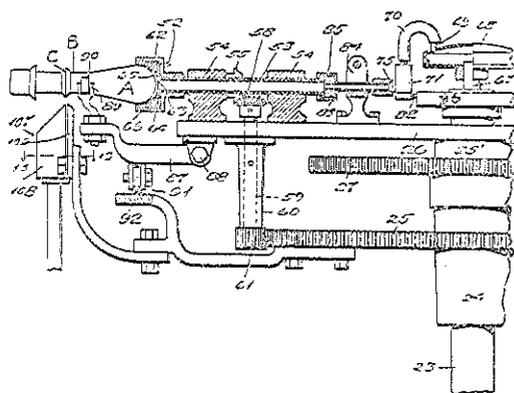


FIG. 247.

holding devices, 52. Each holder consists of a horizontal tubular spindle, 53, which has at one end a suction-cup, 62, and at the other end is connected through a valve, 71, and a distributing drum, 68', with a vacuum pump driven by the rotating gear of the table. The valve is opened or closed by a stationary cam, 86, and while it is open a bulb, A, placed in the suction-cup, is held in a horizontal position, as shown. The spindle, 53, and therefore the bulb, is rotated by bevel wheels, 58, and a stationary gear, 25. The bulb is also supported by a pivoted arm, 87, which is lifted by a cam track, 92, after a bulb is placed in the holder.

A bulb inserted in the machine is first carried beneath a scoring device consisting of a block of emery, 106 (Fig. 248), yieldingly held, which scores the edge of the bulge, C, in the neck of the bulb. The bulb then passes over burners, 107, the flames of which heat the scored neck until it cracks. The further movement of the table carries the bulb over other burners which heat the cracked-off end of the neck until the edge is glazed.

G. D.

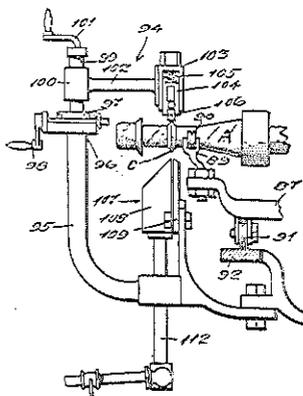


FIG. 248.

372. Grinding Lenses. H. E. RITTMAYER, London (Brit. Pat. No. 135401. March 5th, 1919, No. 5468).—In a machine for grinding the edges of lenses, of the kind in which the lenses and

a templet are mounted on a rocking support to rotate together about an axis parallel to the axis of the grinding-wheel, the templet bearing against an abutment, the abutment is carried upon a support mounted to rock about the axis of the grinding-wheel, and is so connected with

the lens support that it is rocked with and by the rocking movement of this. The lenses are carried by a spindle, *B*, mounted in a support, *C*, adapted to rock about an axis, *C'*, and the spindle is rotated through gearing, *B²*, by the grinding-wheel shaft, *A¹*. An arm, *D*, slotted at *D¹*, is mounted to swing about the shaft, *A¹*, and has formed thereon a head, *D²*, carrying an adjusting nut, *H*, and a clamp, *D³*; the slot, *D¹*, is engaged by a slidable block, *L*, embracing the spindle, *B*, and by a roller carried by a saddle, *E*, on

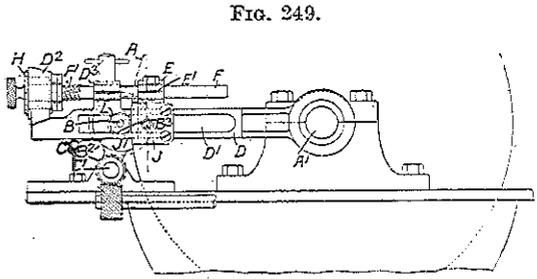


FIG. 249.

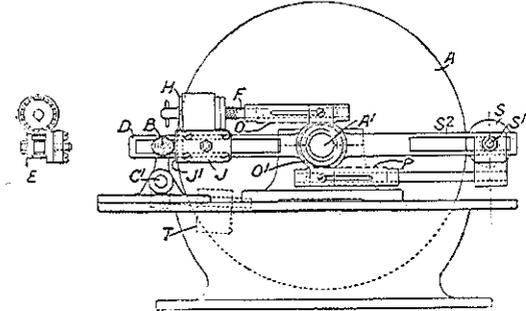
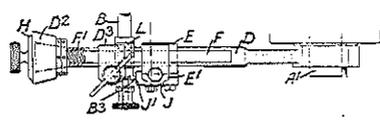


FIG. 250.

which is mounted the abutment, *J*, having a face, *J¹*, of the same radius as the grinding-wheel, *A*. The saddle, *E*, has formed thereon a clamp, *E¹*, adapted to slide on a spindle, *F*, which has at one end a screwed part, *F¹*, engaging the nut, *H*; the spindle, *F*, is also slidable in the clamp, *D³*. The machine is set by means of two disks, *B²*, mounted on the spindle, *B*, and by means of the clamps, *E¹*, *D³*, and the adjusting nut, *H*; the rocking movement of the arm, *D*, causes the points of contact of the lenses with the grinding-wheel and of the templet with the abutment always to lie in the plane of the axes of the grinding-wheel and of curvature of the templet at its point of contact with the abutment. In a modification, Fig. 250, compensation for the wear of the grinding-wheel, *A*, is provided for by mounting on the saddle, *E*, an extension with a rack, *O*, on its underside engaging a pinion, *O¹*, loosely mounted to rotate on the axis of the shaft, *A¹*, and engaging a second rack, *P*, connected with a roller, *S*, mounted on a spindle,

S^1 , slidable in a guide, S^2 , so that pressure of the templet on the abutment, due to a weight, T , holds the roller constantly against the surface of the grinding-wheel; as this wears, the abutment moves rapidly inward by an amount equal to the wear.

H. G. C.

373. The Construction of Mirror-polishing Machines in France. (*Diamant* 1918, 40, 99, 114).—Two machines were described which worked on the same general principle. The mirror to be polished was cemented to a horizontal table which could be rotated about a vertical axis, and was also capable of a horizontal sliding motion. The polisher, a plate of equal size, consisted of many small polishers, also capable of rotation about a vertical axis, but eccentrically to the table carrying the mirror. The weight of the polisher could be counterbalanced to any desired extent by a lever arrangement. The two machines described differed in the manner of mounting the small polishing discs which made up the large polisher.

J. R. C.

Review.

The Ceramic Industries Pocket Book. By ALFRED B. SEARLE. (Sir Isaac Pitman and Sons, Ltd., 1920. 8s. 6d. net.)—This small volume contains a considerable amount of valuable and useful data brought together in a concise and handy form. The contents are compiled from various sources, and include numerous tables, some of which, taken from Continental journals, are not readily available to the majority of manufacturers in this country.

Though only four pages deal specifically with glass, a great amount of the information compiled will be found of considerable interest to the glass manufacturer, particularly in the refractory materials section of the industry. Numerous data given relating to plant and machinery are of general interest, and should be useful to those concerned with power production and transmission. Orthographical errors are rather frequent in the text, and more careful proof reading would have been advantageous. Thus on p. 15 appears: "it is necessary to use . . . clays . . . low in air compounds to produce goods of light colour." The melting point of lead is given as 3220° (p. 63). On p. 75 the approximate percentage composition of Jena laboratory glass is given as CaO 20, SiO₂ 65, B₂O₃ 15. On p. 228: "to convert a volume of slip in cubic inches into pints, multiply by 28.5; quarts, multiply by 57; litres, multiply by 16.15."

The inclusion of the English Ceramic Society and the Society of Glass Technology under the heading of "Employers' Associations" (p. 247) is, to say the least, very misleading.

In spite of numerous small errors, the book should prove very useful, particularly to those concerned with the clay industries.

J. H. D.