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APPARATUS FOR THE MANUFACTURE OF ARTICLES IN SILICA GLASS

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Fig. 1.

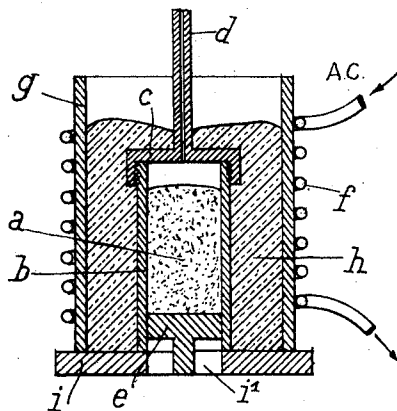
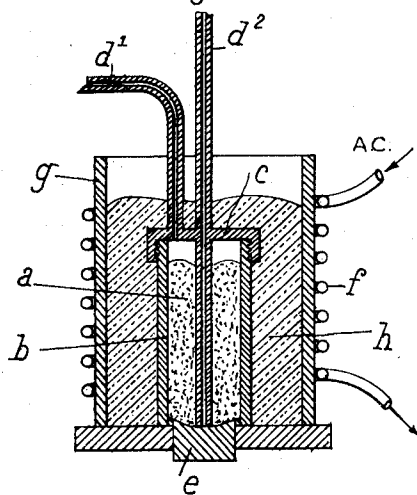


Fig. 2.



Fig. 3.



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APPARATUS FOR THE MANUFACTURE OF ARTICLES IN SILICA GLASS.

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The present invention has for its object an apparatus for the manufacture of articles in silica glass. Said apparatus allows of melting the charge in a crucible made of refractory and conducting material, preferably of graphite or amorphous carbon, by high frequency induction, until the mass is obtained in a pasty state allowing its expulsion from the crucible, either by drawing or in a block with a view to a further fashioning in the press or by any other suitable mechanical treatment.

This method of heating by high frequency induction allows the use of crucibles of large capacity which it is impossible economically to carry in their whole mass to the necessary temperature by the means of heating at present employed.

The type of furnace used in the present invention has some very marked advantages.

In the old process of heating by resistance, the conductor (carbon in the silica) is traversed by the current. This implies, first, a constant section throughout the resistance; second, the connection of the terminals themselves with the poles of the current generator.

In heating by induction at high frequency the graphite crucible is isolated from direct contact with the primary current and is given a high temperature by the heat developed in its own mass by the field of high frequency. It may therefore have any desired form. Furthermore, in heating by resistance it is necessary to use a very large current to raise large crucibles to a high temperature. By the use of my process a graphite crucible of 100 mm. internal and 120 mm. external diameter, and 600 mm. long can be raised to a uniform temperature of 2000° C. throughout its entire length in about thirty minutes with 15 kilowatts.

Heating this same crucible by resistance would require about 8000 amperes. It would be necessary to have at least double the length in order to compensate for the cool-

ing of the extremities at the connections. The connections themselves would be very difficult to effect and would entail great complication.

In heating by induction at high frequency the calorific conduction is excellent because there is no waste by connecting terminals and because one can heat the entire crucible.

The discharge of the mass rendered pasty is preferably carried out by means of a gas under pressure introduced into the crucible.

The crucible containing the charge, carried to the desired temperature by the passage of a high frequency current through a helical winding surrounding the furnace, is closed at the top by a cover provided with a tubule allowing the blowing in of gas under pressure for the expulsion of the pasty mass, and is closed at its lower part by a detachable plug or stopper which is removed for this expulsion.

This plug or detachable stopper can be replaced by a draw plate of which the aperture comprises likewise a detachable stopper in the case in which it is desired to effect the drawing of solid rods.

For the drawing of tubes, the cover of the crucible comprises, in addition to the tubule for the blowing in of gas under pressure, an axial tubule passing through the crucible from one end to the other and bearing upon the detachable plug closing the aperture in the crucible, in such a manner as to produce the boring of the tube, this second tubule likewise allowing the blowing in of gas for maintaining the interior diameter of the drawn tube or for ensuring the moulding of this tube at its exit from the crucible in a mould placed immediately beneath the furnace.

The annexed sheet of drawings represents by way of example different forms of construction of the melting furnace.

Figure 1 is a view in axial section of the furnace with detachable plug.

Figure 2 is a detail view of the draw plate replacing this plug for the drawing of solid rods.

Figure 3 is a view in section of a melting furnace for the drawing of tubes.

As represented in Figure 1, the charge *a* to be melted (sand, rock crystal, or any other silicious material possessing more than 99.5 per cent of silica) is placed in a crucible *b*, constituted by a tube of graphite or amorphous carbon or by an assembly of plates of the same material. This crucible is provided at its upper end with a tight-fitting cover *c*, provided with a tubule *d*. The bottom of the crucible is closed by the plug *e* of graphite.

The furnace comprises a helicoidal inductor winding *f*, traversed by currents of high frequency, above, for example, 5000 cycles. This helix is constituted by a tube of copper or aluminium, able to be traversed by a water circulation. This tube is wound upon the mandrel *g* of insulating material, which constitutes the housing of the furnace, in such a way as to produce the maximum field compatible with the tension between coils and the intensity which passes through it. As the electrical tension increases there is an increasing tendency for the current to short circuit by arcing between coils. The closeness of the coils will therefore be limited by the intensity of current which they are carrying. Also, obviously, the danger of excessive heating limits the current which may be passed through a given section of conductor. The high frequency current is produced by known means (high frequency alternator, arc or spark generator, three electrode lamps). The furnace is completed by a base plate *i* of refractory material pierced with a hole *z* for the release of the plug *e*. The space comprised between the crucible *b* and the housing *g* of the furnace is filled with an insulating and heat resisting powder *h*, of lamp black for example.

The operation is the following:—the high frequency current circulating in the helicoidal winding *f* induces in the mass of the crucible currents of a very great intensity which rapidly raise its temperature. When the melting temperature of the charge is attained, the plug *e* is removed and the melted charge, which remains very pasty, is driven out by means of a gas under pressure (several kilos) introduced by the tubule *d*. The melted charge is received upon a press where it is at once shaped or laminated.

If, instead of shaped articles or plates, it is desired to obtain solid rods, the lower closing plug of the crucible is replaced by a graphite draw-plate *j* (Figure 2), of which the aperture is normally closed by a plug. At the end of the melting, the aperture in

the draw-plate is unstopped and gas under pressure is admitted to the crucible. When the diameter of the draw-plate is less than 15 mm. approximately, the introduction of the gas into the crucible does not suffice for ensuring in a continuous manner the passage of the material through the hole in the draw-plate. It is necessary in this case to draw the rod from the exterior.

Figure 3 represents the arrangement of the melting apparatus for the drawing of tubes.

The cover *c* comprises two tubules; one *d*¹ serves as previously for introducing a gas under pressure into the crucible; the other *d*² passes through the crucible and comes to bear upon the detachable plug *e*, which closes the orifice formed in the crucible at its lower end.

When the melting is completed, the plug *e* is removed and the gas is admitted through the tubule *d*¹. The mass then passes in the form of a tube either spontaneously or by drawing from the exterior according to its diameter. A gas may be blown in through the tubule *d*² for obtaining the desired internal diameter or for molding the tube at its exit from the crucible in a mould placed immediately beneath the furnace.

The melting of the charge *a* can be carried out in vacuo or in any atmosphere. The tubule *d* can serve for this purpose.

The charge can, instead of being constituted by silica, be formed of a mixture very rich in silica; for obtaining for example special glasses with a content in silica exceeding 90 per cent, glasses of which the melting temperatures approach those utilized for pure silica and which are by their properties very close to this last product.

What I claim is:

1. An apparatus for the manufacture of articles of silica glass, comprising a crucible of refractory and electrically conducting material adapted to receive the charge to be melted, a housing of electrically insulating material spaced from the crucible and surrounding the same, an electrically insulating and heat resisting material filling the space between the crucible and housing, a detachable draw-plate of refractory and electrically conducting material closing the crucible at its lower end, electrical high frequency induction means for simultaneously heating the crucible and the said draw-plate, and means for expelling the charge, in a pasty state, from the crucible, through said draw-plate.

2. In an apparatus for drawing tubes according to claim 1, the provision, upon the cover of the crucible, of an axial tubular member extending within the crucible from one end to the other and bearing upon the detachable plug closing the lower end of

the crucible, said tubular member being adapted to produce a bore in the charge expelled from the crucible.

3. In an apparatus for drawing tubes according to claim 1, the provision, upon the cover of the crucible, of a tubular member, extending within the crucible from one end to the other and bearing upon the detachable plug closing the lower end of the cruci-

ble, said tubular member being adapted to produce a bore in the charge expelled from the bore and to allow the blowing in of gas for maintaining the internal diameter of the drawn tube.

In testimony whereof, I have signed my name to this specification at Paris, France, this 1st day of July 1924.

HENRI GEORGE.