

Dec. 22, 1942.

H. C. HARRISON

2,306,164

EXTRUSION DEVICE

Filed March 8, 1940

2 Sheets--Sheet 1

FIG. 1

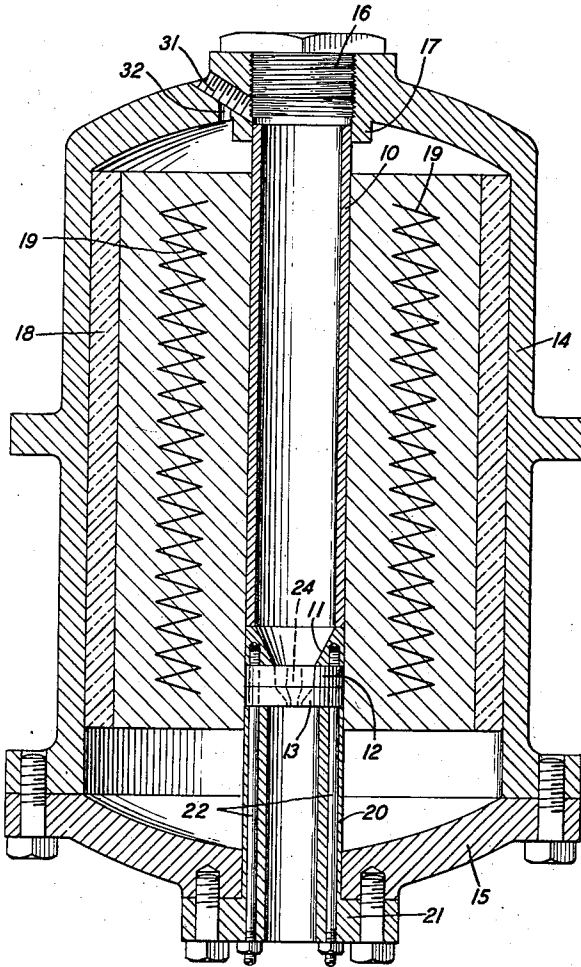


FIG. 2

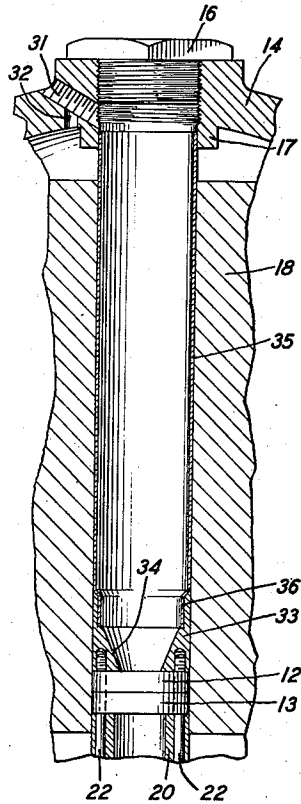


FIG. 3

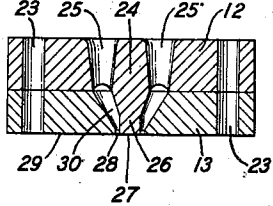
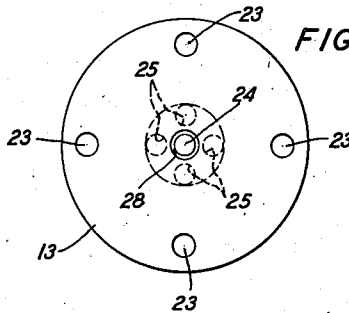


FIG. 4



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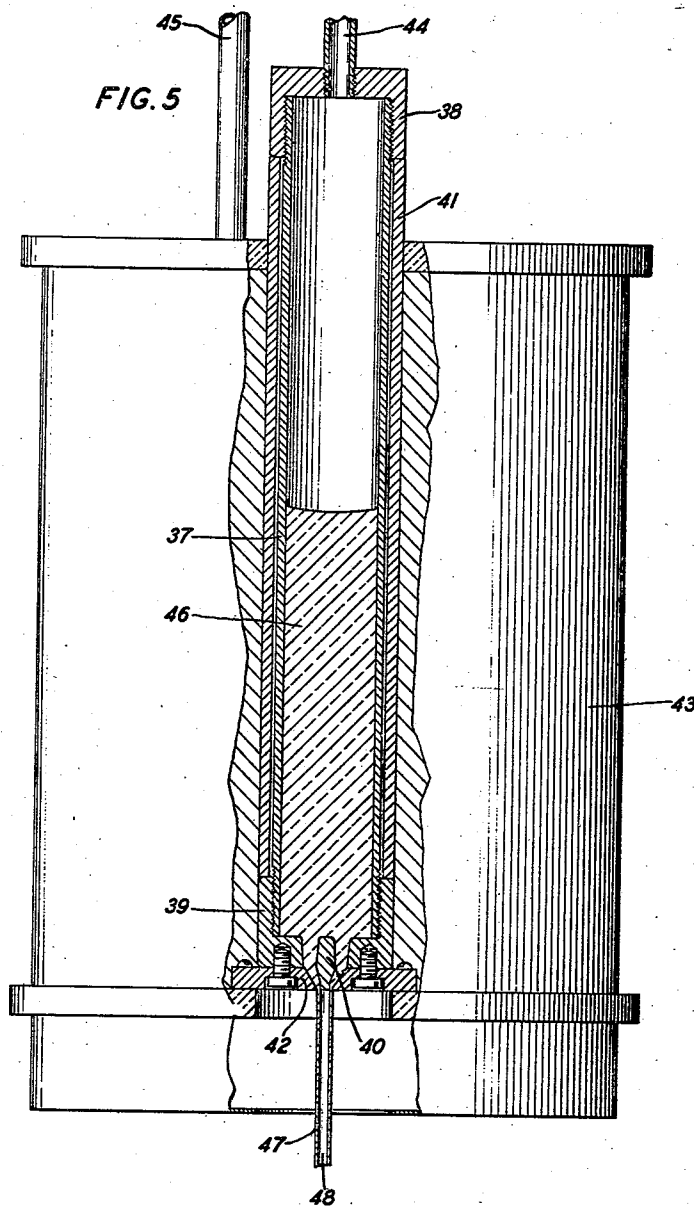
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EXTRUSION DEVICE

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5 Claims. (Cl. 49—17.1)

This invention relates to an extrusion device and more particularly to a device for producing vitreous tubing for various purposes.

An object of the invention is to fabricate accurate internal diameter tubing on a mass production basis.

Another object of the invention is to facilitate the manufacture of glass tubing of uniform quality adaptable for devices employing an oscillatory element.

A further object of the invention is to overcome difficulties of corrosion and oxidation in the device which affects the prescribed limits of the diameters of the tubing.

In accordance with this invention, a supply of material adapted to be formed into tubular lengths is contained in a hollow reservoir or receptacle and maintained in a plastic or semiviscous condition by a furnace which surrounds the receptacle. The outlet of the reservoir is provided with complementary core and die plates forming an extrusion head in which the emergence faces of the plates are ground and polished to a smooth surface which lies in a single plane and their edges are definitely sharp to avoid adherence of the plastic material to the extrusion head. A fluid medium, preferably an inert gas, under high pressure, is supplied to the inlet of the reservoir to force or extrude the plastic material through the head and produce tubing of the required inner and outer diameter accuracies to within .0015 inch. The high pressure gaseous propelling medium is also supplied to the furnace in order to equalize the pressure on the plastic material and facilitate uniform flow of material through the extrusion head.

A feature of this invention relates to the location of the extrusion head within the furnace enclosure and an extension sleeve or cap projects to the exterior of the furnace to facilitate the removal and cleaning of the die plates of the head.

Another feature of the invention relates to an assembly in which the extension cap permits the removal of the head and reservoir as a unit to facilitate changes in tube diameter or material.

A further feature of the invention is concerned with a removable refill or magazine to replenish the supply of material extruded in the device. In this arrangement the furnace cap supports the extrusion head and a superimposed cup member which is adapted to receive a thin metallic shell or casing containing a mass of material in solid form. The telescopic joint provided between the cup member and the refill casing provides an

effective seal to prevent the entrance of gas adjacent the extrusion head which might cause imperfections, such as gas cavities, in the extruded tubing.

5 These and other features and advantages of this invention will be apparent from the following detailed description taken in connection with the accompanying drawings:

10 Fig. 1 is a view in cross-section of one form of the tube extrusion device of this invention showing the details of assembly of an extrusion head and associated elements contained within an outer housing for producing accurate diameter tubing;

15 Fig. 2 is a partial view in cross-section of the device including a modification of the invention in which a removable refill shell is associated with the extrusion head;

20 Fig. 3 is an enlarged view in cross-section of the plates of the extrusion head showing the planary emergence faces of the core and die portions of the plates;

25 Fig. 4 is a plan view showing the appearance of the cooperating plates of the extrusion head in a direction toward the lower plate of Fig. 3;

30 Fig. 5 shows another form of the invention with parts in cross-section to illustrate the extrusion of plastic material into tubular lengths; and

35 Fig. 6 illustrates a length of glass tubing of accurate internal and external diameters produced in accordance with the teachings of this invention.

Referring to the drawings and Fig. 1 particularly, the tubulating apparatus of this invention involves a cylindrical metallic reservoir or receptacle 10 adapted to be filled with a material which can be rendered plastic or semiviscous, such as various glasses, clear resins and similar materials, so that it may be extruded to the desired shape and solidified by cooling in air. The reservoir is provided with a conical throat or outlet 11 at the lower end which leads into a pair of cooperating core and die plates 12 and 13, respectively, which form an extrusion head 45 whereby the glass, or other material, is shaped in any desired form, such as a tube, having accurate inner and outer diameters.

50 The reservoir and extrusion head are enclosed in a furnace housing 14 provided with a removable cover plate 15 at the lower end and a large cap screw 16 at the upper end. The orifice closed by the cap screw enters a cylindrical extension 17 of the housing which forms an internal guide for the upper end of the reservoir 10. A heat resistant lining 18, is placed within the

furnace housing and surrounds a heater, such as a resistance wire heater, shown schematically at 19, which is located around the reservoir to heat the same by conduction and thereby reduce the material in the reservoir to a plastic state.

The cover plate 15 is provided with a central aperture through which extends a removable sleeve member 20 having a circular flange 21 which is secured to the cover plate by bolts. The sleeve member is drilled longitudinally at equidistant points to receive guide rods 22 which are anchored in the outlet portion of the reservoir 16. These rods extend through registering apertures, such as 23, in the core and die plates of the extrusion head and insure accurate alignment and true concentricity of the plates. The rods are provided with threaded ends extending beyond the flange 21 to receive nuts which exert clamping pressure upon the sleeve member and the plates 12 and 13, to insure rigidity and constant position of the plates in cooperative relation. This arrangement forms a unitary assembly of the reservoir and extrusion head and facilitates the removal, cleaning and replacing of the extrusion head plates. Furthermore, this construction escapes difficulties of corrosion and welding of threaded connections in the high temperature zone of the furnace.

Since the extrusion head is affected by high temperature due to its location within the furnace, it is essential that the plates 12 and 13 should be formed of a high temperature resistant metal or alloy, such as platinum-iridium or other suitable alloy. Such an alloy also resists oxidation and wear and therefore insures a long operating life.

In order to maintain accurate and uniform diameters, and particularly the internal diameter in the tubing, produced in accordance with this invention, it is essential that the plates 12 and 13 have sufficient hardness to overcome wear especially at the exit surfaces of the plates. Furthermore, the plates should be fabricated in pairs to insure accurate concentricity of the respective cooperating parts of the plates. This is accomplished by forming the plates with accurate parallel surfaces and forming a central core piece 24 on the core plate 12 which extends beyond the surface of the plate. A plurality of tapered holes 25 are drilled through the plate 12 around the central core to form passageways in the core plate for the extrusion of the plastic material in the reservoir. The core 24 is also tapered for a short distance beyond the lower surface of the plate but the termination of the core is a solid cylinder 26 with the flat surface 27 at right angles with respect to the surface of the cylinder 26. The die plate or ring 13 is provided with a central cylindrical aperture 28 adjacent to the surface 29 and coaxial with the periphery of the plate. This aperture connects with a tapering aperture 30, the larger diameter thereof coaxial with the apertures 25 in the core plate 12. When a suitable gauge is interposed in the cylindrical gap between the core 26 and the surface 28 of the die plate 13 the guide holes 23 may be drilled to insure concentric relation of the plates when placed in position in the extrusion device. The final processing of the plates 12 and 13 is the finishing and polishing of the contact surfaces of the core 24 and the inner walls of the apertures and the lapping of the surfaces 27 and 28 to insure a positive geometrical plane surface relation at the emergence faces of the plates. These operations produce sharp clearance edges

for the exit of the extrusion head whereby adherence of the semi-solid tubing is prevented and constant uniform diameters maintained in the resultant tubing.

The pressure medium employed for forcing the plastic material through the extrusion head may be any suitable fluid but an inert gaseous medium, such as nitrogen, is preferred since it is more adaptable to the proposed construction and easily controlled. The nitrogen is supplied to the reservoir 16 through the threaded inlet port 31 under high pressure of the order of 500 to 1000 pounds per square inch, depending on the material and the speed of production. Since the high pressure may be detrimental with respect to the wall of the reservoir, it is proposed to inject the same pressure of gas into the furnace through a bypass opening 32 so that the pressure on the reservoir and vitreous material is equalized and the construction rendered safe and efficient.

In a modification of the invention, as shown in Fig. 2, the sleeve member 20 and the extrusion head comprising the plates 12 and 13 are supported in the same relation as in Fig. 1, but the reservoir is transformed to increase the efficiency and versatility of the extrusion device. In this arrangement, an annular base 33 receives the threaded ends of the guide rods 22 and is provided with a conic inner surface 34 to direct the plastic material through the extrusion head. The upper portion of the base is cylindrical and slightly larger in diameter than the wider end of the conical cavity formed by the wall 34 and the rim of the base is beveled. A thin walled metallic tube or sleeve 35, when filled with a solid mass of material which is to be extruded, forms a refill container or magazine which may be inserted through the opening of the furnace closed by the cap screw 16 and is readily removable when empty. The tube 35 is provided with a reduced end portion 36 formed to coincide with the beveled and cylindrical surfaces of the base 33 to produce a tight telescopic joint to prevent the entrance of gas and the leakage of plastic material from the reservoir.

This arrangement enhances the replenishing of the extrusion device with more material to be extruded, or, if desired, to substitute a different material. Since the refill contains the material in solid form, it is apparent that the furnace may be stocked expediently by providing a supply of refills with the desired material to be extruded. Furthermore, the equalized pressure of nitrogen in the furnace permits the use of such thin walled refills without damage to the operation of the device and with complete safety to the operator.

In Fig. 5 another form of the invention is shown to illustrate the operation of the extruding or tubulating device for producing accurate diameter tubing. In this figure, a tubular reservoir 37 threaded at both ends is provided with an apertured cap 38 at the upper end and a cap 39 at the lower end having a plurality of orifices surrounding a central core piece 40 of the same configuration as shown in Fig. 3. A metallic sleeve 41 surrounds the reservoir to space the end caps and facilitate the removal of the reservoir. A die plate 42 is secured to the core cap 39 and also to a cover plate of the furnace housing 43 to support the extruding device in rigid relation to the furnace. The cap 38 receives a pipe connection 44 which communicates with the nitrogen supply for producing a high pressure in the reservoir 37. A similar pipe 45

connected to the gas supply is joined to the furnace to induce the same pressure therein and equalize the pressure on the parts of the extrusion device.

In the operation of the extrusion device of this invention, let us assume, for example, that a small bore tubing is desired in which wire conductors are to be sealed and a section of the tube sealed to form a container for a switch or similar apparatus and that it is also desired that the internal diameter should not vary over a considerable length by more or less than .0015 inch. Such a tubing may be produced by filling the reservoir, such as 37 in Fig. 5, with a vitreous material, such as lead glass 46, either in a plastic or solid state, and energizing the heater 19 in the furnace to maintain a temperature between 600 to 700° C. When the glass mass 46 is in the proper condition for extrusion the nitrogen gas supply under a desired pressure, between 500 to 1000 pounds per square inch, is injected into the reservoir and the furnace, the pressure being high enough to attain a satisfactory rate of production, since the rate of flow is a function of temperature and pressure. Assuming the glass 46 is of the proper consistency for tubulating at 660° C. and the pressure of gas is 1000 pounds per square inch, the tubing 47 emerging from the extrusion head is formed at the rate of ten feet per hour and the internal diameter 47 does not vary from the limit of $\pm .0015$ inch. The rate of flow permits the tubing to solidify by cooling on contact with air and no elongation occurs if the length of tubing does not attain too great a weight. Tubing having lengths of two feet are readily produced without elongation. If high temperatures are employed or greater lengths desired, some counterbalancing method, such as a spring support for the tubing, may be used to offset attendant elongation of the glass tubing.

The accuracy obtained with any desired diameter of tubing is attributed primarily to the constantly sharp true edges of the high temperature resistant plates and the planary emergence surfaces of the core and die plates of the extrusion head. Any irregularity of internal diameter of the tubing would detract from the usefulness of the tubing for the switching device referred to but the tubing produced by the extrusion device of this invention has met all mechanical tests for this application and there are many equally pertinent mechanisms where the tubing produced may be employed with advantage from the standpoint of efficiency, long life and utility.

While the invention has been disclosed with respect to certain preferred forms, it is, of course, understood that modifications can be made in the components of the extrusion device without departing from the scope of the invention as defined in the appended claims.

What is claimed is:

1. A tubulating device including a housing, a reservoir within said housing, a sleeve member supported by and extending into said housing, guide members extending between said reservoir

and sleeve member, a pair of complementary extrusion plates slidably positioned on said guide members, and means external to said housing for rigidly clamping said plates in concentric relation.

2. A vitreous tube extruding device comprising a hollow chamber, a reservoir for a vitreous mass contained within said chamber, means for heating said mass mounted in said chamber, a core die plate adjacent the exit end of said reservoir and also mounted within said chamber, a ring die plate surrounding the core of said core die plate and mounted in juxtaposed relation therewith to constitute a tube forming head for the heated mass, and means for injecting a uniform high pressure gaseous medium into said reservoir and chamber to control the flow of said vitreous mass.

3. An extrusion device comprising a reservoir having an outlet port adapted to contain a vitreous mass which is to be formed into tubing when in a plastic state, a housing enclosing said reservoir, heating means between said housing and reservoir, said reservoir and housing adapted to contain a gaseous medium under uniform high pressure, and an extrusion head coaxially mounted at said outlet port including a pair of plates in complementary relation, one of said plates having a central projecting core with apertures surrounding the same, and the other plate having a central aperture coaxial with said core, the emergence surfaces of said core and other plate being in a single geometrical plane.

4. An extrusion device comprising a reservoir having an outlet port adapted to contain a glass mass which is to be formed into tubing when in a plastic state, a housing surrounding said reservoir, heating means between said housing and reservoir, said reservoir and housing being adapted to receive a supply of nitrogen under high pressure to be injected therein, an extrusion head mounted at said outlet port including a pair of platinum-iridium alloy plates in complementary relation, one of said plates having a central projecting core with apertures surrounding the same and the other plate having a central aperture coaxial with said core, the emergence surfaces of said core and other plates being in a single geometrical plane.

5. An extrusion device comprising a reservoir having an outlet port adapted to contain a glass mass which is to be formed into tubing when in a plastic state, a housing surrounding said reservoir, heating means between said housing and reservoir, said reservoir and housing adapted to be filled with a supply of nitrogen under high uniform pressure, a platinum-iridium alloy extrusion head comprising a core plate and a ring die in complementary relation to extrude glass tubing of an internal diameter unvarying from .0015 inch through its length, the emergent edges of said core and ring dies being acutely sharp and the emergence surfaces thereof being in a true plane, and clamping means securing said head to said reservoir and housing.

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