

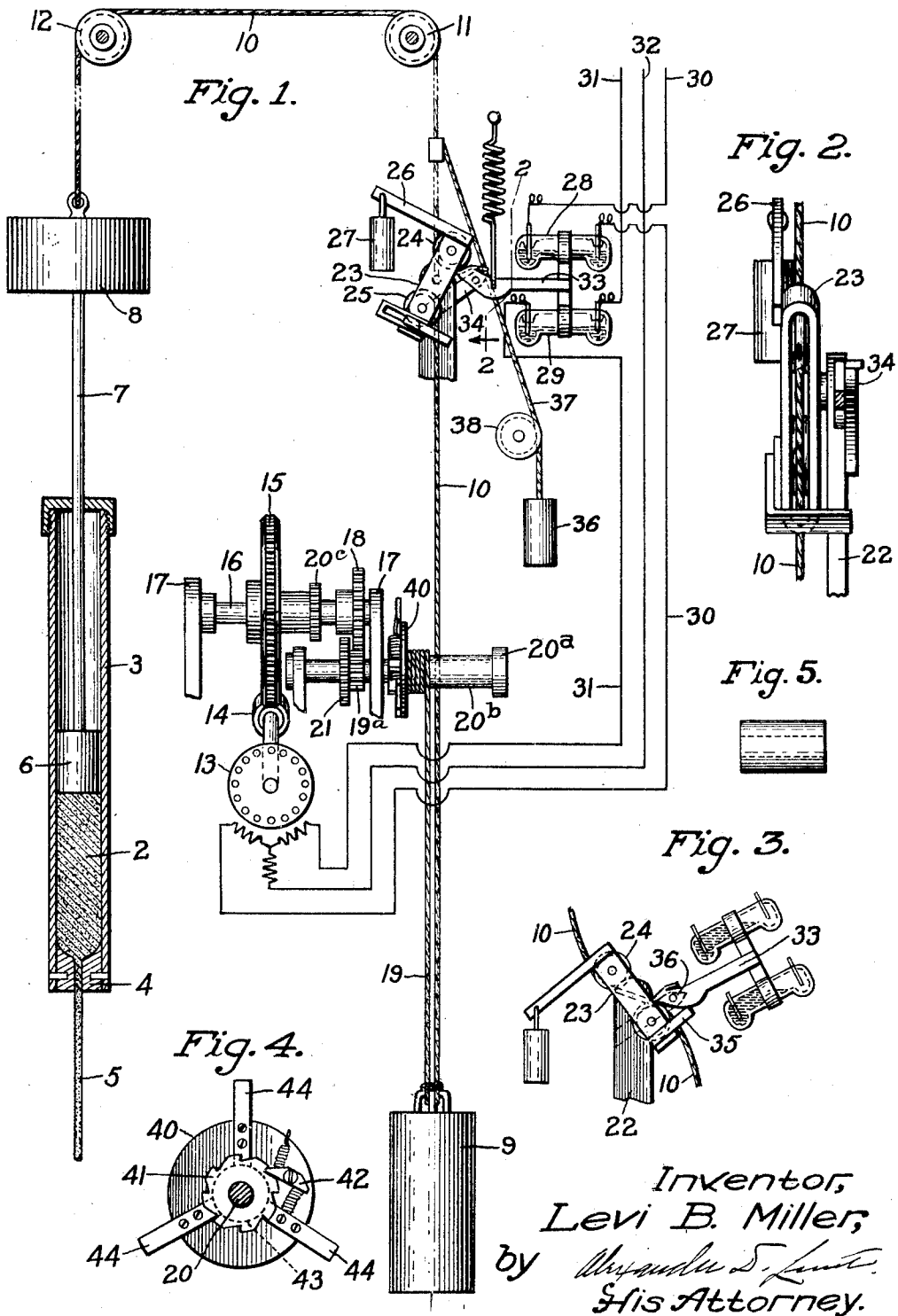
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L. B. MILLER

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MACHINE FOR FORMING PLASTIC MATERIAL

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LEVI B. MILLER, OF LYNN, MASSACHUSETTS, ASSIGNOR TO GENERAL ELECTRIC COMPANY, A CORPORATION OF NEW YORK.

MACHINE FOR FORMING PLASTIC MATERIAL.

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My invention relates to machines for forming plastic or semi-fluid or viscous material such, for example, as fused quartz, into lengths. The quartz is heated in a suitable furnace such as, for example, an electric furnace. One form of such machine is shown and described in either of the following United States Letters Patent Nos. 1,562,115, issued Nov. 17, 1925; 1,549,597, issued Aug. 11, 1925, and 1,579,019, issued March 30, 1926. The quartz, while in its heated condition, is forced through a suitable die. The rate of flow of the quartz or plastic material through the nozzle may under certain conditions vary with the temperature of the material and with the pressure maintained upon the quartz. This pressure is easily applied, for example, through the medium of a piston.

It is one of the objects of my invention to provide means for maintaining a pressure on the quartz such as to insure a practically constant rate of flow through the die thus insuring practically uniform diameter of the lengths and preventing the material from running out faster than it can conveniently be handled. In this connection it is necessary to vary the pressure on the material with varying conditions. For example, if the temperature of the material rises, the tendency is, of course, for the material to flow faster and the pressure should be reduced and vice versa.

It is also the object of the invention to provide other elements of improvement for increasing the efficiency and serviceability of such a device.

The means for accomplishing the foregoing ends are hereinafter more fully set forth and claimed, reference being had to the accompanying drawing in which Fig. 1 shows the device in a more or less diagrammatical form, the chamber for heating the material being shown in section; Figs. 2, 3, 4 and 5 show details of the device; Fig. 2 shows one of the elements enlarged.

Referring more in detail to the drawing in Fig. 1, the heated material 2, such as quartz, is shown within the chamber 3 of the furnace. The material, being viscous, is extruded through the die 4 into lengths 5. The pressure above the quartz is applied by the piston 6 which latter is shown connected to the lower end of the rod 7. If the pis-

ton does not have sufficient weight, the necessary pressure may be insured by the provision of an additional weight 8 which may be secured, as shown, to the upper part of the rod 7. In the particular construction illustrated, I have elected to provide the counter weight 9 which acts in opposition to the weight of the piston and of the body 8. It will be observed that the rod 7 is connected with the counter weight 9 through the medium of a cable 10 which passes over the pulleys 11 and 12. The device is also provided with a motor 13 of any suitable design for the purpose of varying or controlling the rate of travel of the counter weight 9.

The means which I have elected to illustrate for this last purpose comprises a worm 14 on the shaft of the motor 13 in engagement with which a worm gear 15 is mounted on a suitable shaft 16 which latter is supported on suitable bearings 17. On the shaft 16, there is a second gear 18 which latter in turn is shown in engagement with a third gear 19^a mounted on the shaft 20. It will be seen, therefore, that when the motor is operated the shaft 20 is rotated. It will be understood, of course, that the ratio of rotation between the motor shaft and the shaft 20 may be varied by varying the sizes of the various gears. If it is desired to insure a given rate of flow of the material through the die 4 when the quartz 2 has a particular constancy, the rate of rotation of the shaft 20 is fixed for that purpose. It will be seen that the counter weight 9 is connected at the end of a second cable 19 which is arranged to wind about the spool 20^b on the shaft 20 as the shaft rotates. On the end of the shaft 20 I provide a cap 20^a which may be secured in any suitable manner to the shaft for holding the spool 20^b in position. This cap may be in the form of a nut and the shaft may be provided with suitable threads for receiving the nut. The rate of flow of the quartz may also be varied by altering the diameter of the body about which the cable 19 is wound inasmuch as varying the diameter varies the rate of travel of the counter weight 9. If it is desired to increase the rate of travel, a spool of larger diameter such as shown in Fig. 5 is fitted on to shaft 20 and when a slower rate of speed is desired a spool of

smaller diameter, such as spool 20^b, Fig. 1, is substituted. As a result of this construction, a pull is exerted upon the cable 19 by the shaft 20 and therefore the counter weight 9 is raised with the result that the weight 8 forces the piston 6 down at a rate depending upon the rate of rotation of the shaft 20. Obviously, with this arrangement, a given rate of flow of the material 2 through the die may be obtained. If, for any reason, the temperature in the furnace should vary so that the viscosity of the material increases, the rate of flow through the die 4 will, of course, tend to diminish. As a result, the piston 6 will be retarded. Consequently the tension in the cable 19 will be increased as the result of this cable assuming a greater portion of the weight of the counter weight 9. The result, of course, is that the tension in the cable 10 will be diminished, thereby allowing the pressure upon the material 2 to be increased. Consequently, even though the viscosity of the material 2 may have momentarily become reduced, it is possible to insure that the rate of flow through the die 4 remain constant, or approximately constant, due to a constant motion of the weight 8, this being true up to a certain viscosity.

It will be seen that if instead of the material 2 becoming less viscous, the reverse should be the case, as for example if the temperature of the furnace were to be increased, the rate of flow through the die will tend to increase; consequently, the piston 6 will tend to travel faster than the counter weight 9 with the result that tension on the cable 10 will increase while the tension on the cable 19 will diminish and therefore the pressure exerted by the piston 6 will correspondingly diminish so that the tendency to increase the rate of flow through the nozzle will be checked.

It will be understood that with variations in the character of the material 2 and with variations in the size of the die 4, it may be necessary to vary the rate of rotation of the shaft 20, for example, in order to reduce the rate of rotation of the shaft 20, the gears 19^a and 21 form a unit and may be shifted to the left of the gear 19^a beyond engagement with the gear 18 and the gear 21 into engagement with the gear 20^c.

In the event that the tension in the cable 19 increased while the tension in the cable 10 decreased, if the retarding action of the piston 6 should continue until the whole weight of the counter weight 9 is relieved by the cable 19, it is desirable, in order to avoid excessive sagging of cable 10, that the motor 13 be stopped. For this purpose I provide a device in connection with cable 10, the character and operation of which is as follows, reference being had to Figs. 1, 2 and 3. Pivotaly mounted to a section 22

of the frame of the machine, I provide a small frame 23 on which there are mounted a pair of pulleys 24 and 25. This frame is so located that the cable 10 passes through the frame 23 and between the pulleys 23 and 24 with the result that when the cable 10 is taut the frame 23 is held in the position illustrated in Figs. 1 and 2. It will be observed that the frame 23 is provided with an arm 26 to the end of which there is mounted a weight 27 which weight serves to give the frame 23 a tendency to rotate in counter clockwise direction, Fig. 1. In proximity to the frame 23, there is also provided a switch for controlling the motor circuit, which switch comprises a pair of mercury circuit closing and breaking elements 28 and 29. It will be seen that one of these mercury elements is in series with a conductor 30 while the other one is in series with a conductor 31. It will be understood that the conductors 30, 31 and 32 are connected to any suitable three phase circuit for operating the motor 13 in case the motor used is a three phase motor as represented in the drawing, Fig. 1. When the mercury elements 28 and 29 are in a horizontal position, as shown in Fig. 1, the circuit of the motor 13 is closed and, under these conditions, the motor, of course, operates to rotate the shaft 20. The mercury elements are secured to an arm 33 which is suitably pivoted about the pin 36 to the support 34 which latter is also fastened to the frame of the machine. If, however, the tension is relieved from the cable 10 so that the cable sags, as indicated in Fig. 3, the weight 27 operates to tilt the frame 23, as indicated in Fig. 3, with the result that the mercury elements 28 and 29 are tilted, as indicated in Fig. 3, with the result that the circuit through the motor is broken and therefore the motor stops, stopping in turn the shaft 20. The frame 23 is provided on its lower side with an adjustable finger 35 which latter, when the frame 23 is tilted, engages the heel of the arm 33, rotating the latter about the pivot 36, as shown in Fig. 3. Under the conditions just described, in order to prevent the cable 10 from leaving the pulleys 11 or 12 when the cable 10 sags, I provide a small auxiliary weight 36, Fig. 1, which is connected with the cable 10 at a point below the pulley 11 by means of a cable 37 which latter passes over the pulley 38 and which is secured to the cable 10 at any suitable point between the frame 23 and the pulley 11.

It will be understood that in case of very high viscosity the pressure on the piston required to give the desired speed would be dangerous for the machine. For this reason, the weight 8 is made the maximum which is considered safe for the apparatus. When the viscosity reaches a given point the ap-

paratus must be operated at a reduced rate of speed.

It will be understood that the lengths of the cables may be varied and that the distance between certain of the elements such, as for example, between the frame 23 and the pulley 11, may be also varied so as to allow the piston to make a full stroke without having the point on the cable 10, to which the cable 37 is attached, strike either the pulley 11 or the pulleys in the frame 23. The drawings, as have already been pointed out, are more or less diagrammatic.

Referring to Figs. 1 and 4, the upper end of the cable 19 is fastened to the wheel 40. The wheel 40 is so mounted that it may be rotated upon the shaft 20. Upon the same shaft and next to the wheel 40, there is provided a ratchet wheel 41 which is normally engaged by a dog 42 which latter is pivotally secured to the side of the wheel 40. This ratchet wheel 41 has a deep groove, as indicated by the dotted line 43, Fig. 4. Secured to the wheel 40, there are also three arms 44, the inner ends of which are cut away on the side nearest to the wheel 40, forming a shoulder; the thinner portion of the inner extremity of these arms 44 project into the groove 43. This construction enables the wheel 40 to rotate upon the shaft 20 but prevents the wheel 40 from sliding along the shaft 20 so that the wheel 40 is held in place and prevented from sliding sidewise along the shaft. It will be understood that the ratchet wheel 41 is locked to rotate with the shaft 20. In order to avoid the necessity of reversing the motor 13 in case it is desired to unwind the cable 19 from the shaft 20, the dog 42 is lifted from engagement with the ratchet wheel 41 so that the wheel 40 may be rotated and the cable 19 unwound.

It will be seen, therefore, that with a device of the type shown and described the rate of travel of the piston 6 and therefore the rate of extrusion of the quartz is constant. The pressure, however, upon the quartz obviously varies with the condition of the quartz. In case the viscosity of the quartz should increase beyond a certain point, the maximum pressure that may be applied is, of course, limited to the weight of the piston 6, rod 7 and weight 8, this pressure being a maximum when the total weight of the counter weight 9 is being supported by the cable 19. Obviously, therefore, if the viscosity becomes too great, the rate of extrusion will diminish; therefore, the arrangement is such that the amount of pressure which may be applied is limited to a particular maximum in order to protect the die within the nozzle 4 otherwise the die might be broken, in which case it would, of course, drop out of the nozzle.

In the event of such a breakage, the ini-

tial tendency would be for the quartz to rush out of the nozzle. In order to prevent excessive extrusion under those conditions, the arrangement, as described, is such that the counter weight 9 soon comes into play; i. e. as soon as the slack in the cable 10 disappears, with the result that the piston 6 can advance only a short distance before the pressure is relieved and, consequently, the danger of forcing all of the quartz out of the chamber is done away with. Obviously, therefore, one of the results of the construction is that constant speed of the piston is insured within the limits of safety. It should be pointed out that within the limits of safety the pressure in the cylinder may be varied to a considerable extent without materially affecting the uniformity in the size of the quartz extruded.

In view of the disclosure, the principles of my invention may obviously be applied in various forms and I do not wish to be limited to the application of the principles to the specific means shown and described inasmuch as variations will readily occur to those skilled in the art without departing from the spirit of the invention or from the scope of the claims herein contained.

What I claim as new and desired to secure by Letters Patent of the United States, is:—

1. An extruding device having a chamber for holding material therein, said chamber provided with an opening, a piston in said chamber for extruding said material through said opening, means for applying pressure to the piston to overcome the resistance offered by said material, said means automatically responsive to variations in said resistance for varying the pressure applied to the piston, said means comprising a counter weight to the piston and a movable element for decreasing the opposing force of the counter weight upon the piston.

2. An extruding device having a chamber for holding material therein, said chamber provided with an opening, a piston in said chamber for extruding said material through said opening, means for applying pressure to the piston to overcome the resistance offered by said material, said means responsive to variations in said resistance for varying the pressure applied to the piston, said means comprising a counter weight to the piston and a movable element for decreasing the opposing force of the counter weight upon the piston, a motor for moving said element and means for stopping the motor when the whole opposing force of the counter weight is removed from the piston.

3. An extruding device having a chamber for holding material therein, said chamber provided with an opening, a piston in said chamber for extruding said material through said opening, means for applying pressure

to the piston to overcome the resistance offered by said material, said means responsive to variation in said resistance for varying the pressure applied to the piston, said means comprising a counter weight to the piston and a movable element for decreasing the opposing force of the counter weight upon the piston, and means for varying the magnitude of said opposing forces.

4. An extruding device having a chamber for holding material therein, said chamber provided with an opening, a piston in said chamber for extruding said material through said opening, means for applying pressure to the piston to overcome the resistance offered by said material, said means responsive to variation in said resistance for varying the pressure applied to the piston, said means comprising a counter weight to the piston and a movable element for decreasing the opposing force of the counter weight upon the piston, and means for varying the magnitude of said opposing forces, said means comprising a set of gears, said gears comprising in turn means for changing the gear ratio.

5. An extruding device having a chamber for holding material therein, said chamber provided with an opening, a piston in said chamber for extruding said material through said opening, means for applying pressure to the piston to overcome the resistance of-

fered by said material, said means responsive to variation in said resistance for varying the pressure applied to the piston, said means comprising a counter weight to the piston and a movable element for decreasing the opposing force of the counter weight upon the piston, and means for varying the magnitude of said opposing forces, said means comprising a cable attached to the counter weight and comprising also a winding drum about which said cable is wound together with means whereby the drums of various sizes may be substituted.

6. An extruding device having a chamber for holding a material therein, and an opening in said chamber, a plunger in said chamber for causing the material to be forced through said opening, a weight for moving said plunger, said weight comprising a main and a counter weight the latter serving normally to reduce the force of the main weight applied to the plunger, and means for moving the counter weight at a constant predetermined rate determined by the rate at which the plunger and the main weight should move, whereby if the plunger changes the rate of motion the weight applied to the plunger is varied.

In witness whereof, I have hereunto set my hand this 15th day of January, 1925.

LEVI B. MILLER.