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MACHINE FOR DIE CASTING THERMOPLASTICS

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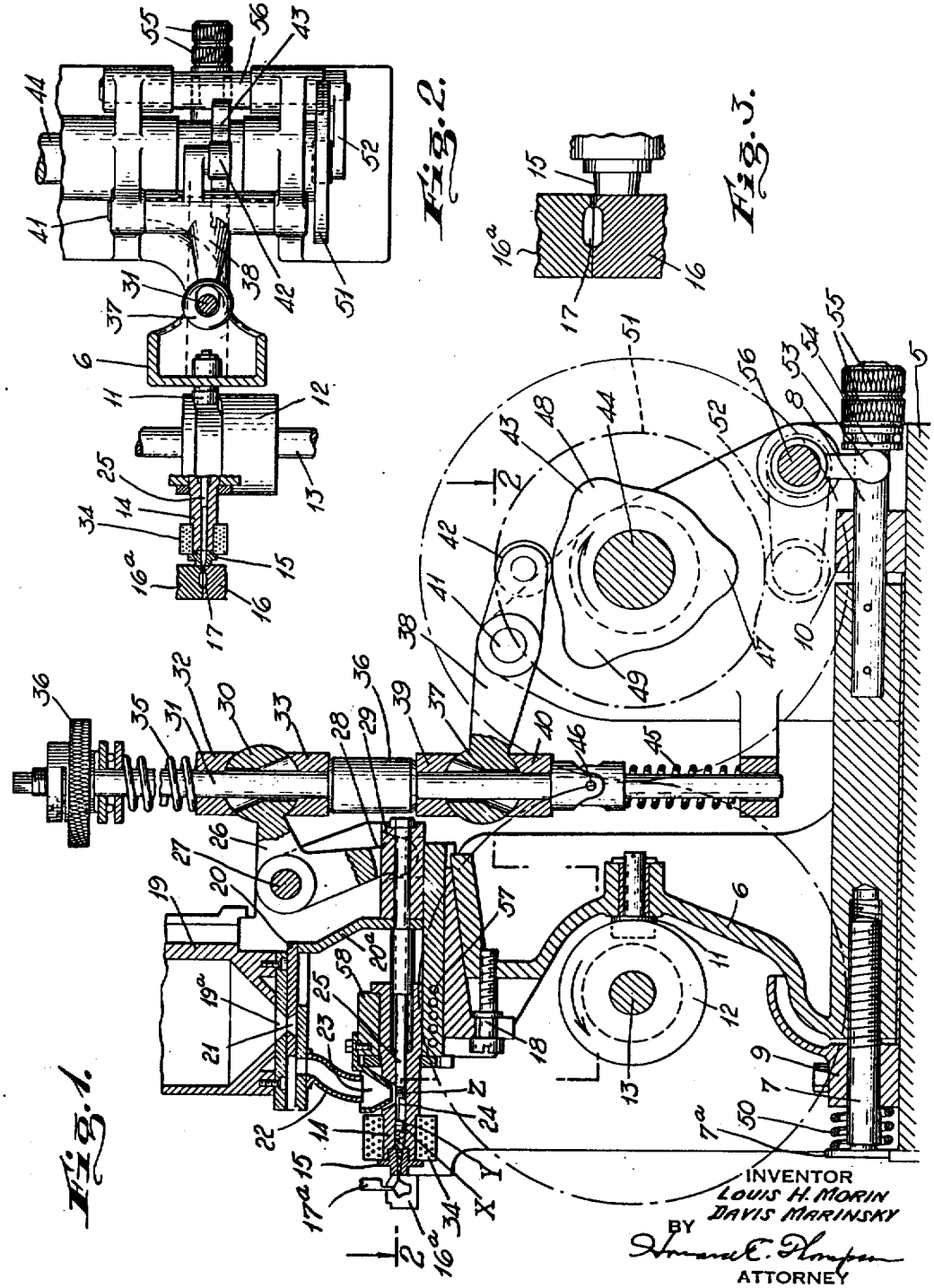


Fig. 1.

Fig. 2.

Fig. 3.

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MACHINE FOR DIE CASTING THERMOPLASTICS

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7 Claims. (Cl. 18—30)

This invention relates to die casting machines for use in die casting thermoplastic materials. More particularly, the invention relates to machines of this class having means for introducing a plurality of charges of thermoplastic material into a heated cylinder prior to the pressure discharge of heated material arranged in the cylinder into the impression of relatively movable dies, while at the same time maintaining a charge of the cylinder substantially consistent with and in proportion to the pressure discharge of the material from the cylinder into the impression of the dies so as to facilitate the formation of a successive series of castings in the automatic operation of the machine without any appreciable variation between the input and output of material with respect to said heated cylinder. The novel features of the invention will be best understood from the following description and annexed drawing in which one embodiment of the invention is disclosed, the separate parts being designated by suitable reference characters in each of the views, and in which:

Fig. 1 is a sectional view through a casting machine made according to our invention, omitting parts of the construction for clearness in illustration.

Fig. 2 is a partial section on the broken line 2—2 of Fig. 1; and,

Fig. 3 is a sectional view similar to Fig. 2 showing only a part of the construction on an enlarged scale with parts in a different position.

The machine forming the subject matter of this application constitutes a division of our prior application Ser. No. 152,942, filed July 10, 1937, as well as a continuation in part of our prior application Ser. No. 131,606, filed March 18, 1937; that is to say, the present machine is basically the same as the machine disclosed in the first application above named, it being modified solely to illustrate the adaptation of this machine in carrying out the method disclosed in Fig. 7 of the latter application above identified.

It will be understood that in the production of small castings such as were illustrated, for example, in application Ser. No. 152,942, it was only essential to actuate the plunger of the machine a single stroke in both feeding and ejecting the casting material into the die in that a very small amount of casting material was used, and this small amount could be quickly heated, especially in maintaining a reserve at all times in the cylinder. In other words, with the small castings a charge was fed into the cylinder and a casting formed at each stroke of the piston; whereas in the present machine and by simply using a modified form of cam and slightly altering the structure of some of the parts, a series of plunger or piston strokes is provided before the final discharge or injection stroke, thus building up in the cylinder and quickly heating the independent charges intermediate each of the injection strokes, and in this manner carrying out the method illustrated and described in application Ser. No. 131,606. At this time it is well to call attention to the fact that in different types of machines and in the formation of different castings, the number of charges introduced into the cylinder between each injection stroke may be varied simply by varying the cam employed.

By using the small bore cylinder and introducing the series of small charges thereinto in the manner later set forth, it will be apparent that the heat flow to the small charges not only through the cylinder but through the adjacent heated material, will result in a quick melting of the material, thus facilitating the high speed production of castings of this type and kind. It will, of course, be apparent that the speed of operation of the machine will depend to some degree on the size of the particular casting formed, and the number of charges essential to satisfy the requirements of the casting.

In the accompanying drawing, we have indicated such parts of the machine disclosed in application Ser. No. 152,942, as will enable anyone skilled in the art to fully understand the operation of the multiple charging means or mechanism which constitutes the subject matter of the present application.

In Fig. 1 of the drawing, 5 represents a part of the frame work of the machine in which is pivotally supported an oscillating frame 6 on the pivots 7 and 8, the latter being arranged in bearings 9 and 10. The frame 6 carries centrally thereof a roller 11 operating in connection with a cam 12 arranged on the driven shaft 13 so that in each cycle of operation of the machine, the cylinder 14 or the discharge nozzle 15 thereof will be moved from the position shown in Fig. 3, where it is arranged upon the surface of one die part 16, into position between said die part and the companion die part 16a to register with the impression 17 between the adjacent surfaces of the die parts in the injection of the heated casting material into the impression.

The cylinder 14 is adjustably supported in the upper end of the frame 6 through the means 18 illustrated in Fig. 1, and is movable with the frame as is also a hopper 19 in which the gran-

ular or powdered thermoplastic material is stored. Such material as cellulose acetate may be employed. Portions of this material are measured by a feed plate 20 slidable across the lower discharge end 19a of the hopper and having an aperture 21 of a size substantially controlling the size of the charge to be delivered to the cylinder. At 22 is shown a feed pipe associated with the slide 20 and into which the material disposed within the aperture 21, or a portion thereof, is delivered into the pipe 22 for delivery into the cylinder through a cone 23 arranged above an admission port 24 in the cylinder 14. The port 24 is arranged in the cylinder just forwardly of a piston or plunger 25 which reciprocates back and forth in the cylinder. The plunger 25 is actuated by a bell crank 26 pivoted as seen at 27 with one yoke-shaped end 28 thereof engaging a block 29 on the plunger 25, and the other ball end 30 thereof arranged upon a plunger operating rod 31 having a universal mounting between two shoes 32 and 33 on said rod.

The measuring and feed plate 20 is coupled with the plunger 25 through a bracket 20a so that the plate 20 moves with the plunger, and thus, if the forward movement of the plunger 25 should be limited by an excess amount of casting material in the cylinder, then the aperture 21 will not register with the feed tube 22, thus automatically preventing a build-up of material in the cylinder 14. Arranged around the cylinder 14 is an electric heating coil 34 for heating the thermoplastic material introduced into the cylinder. This coil is electrically controlled to provide the proper heating of the material consistent with the speed of operation of the machine and the number of charges thereinto.

Arranged upon the upper end of the rod 31 and cooperating with the shoe 32 is a spring 35, the tension of which may be adjusted through a suitable nut 36. The tension of this spring is sufficient to allow the plunger 25 to yield rearwardly when the forward movement of the plunger is restricted by the material arranged in the cylinder, so that the spring compensates for the varying forward movements of the plunger, notwithstanding the otherwise positive operation thereof through the rod 31 and bell crank 26. The rod 31 has centrally thereof an enlarged portion 36 below which is arranged the ball end 37 of a lever 38 which is arranged between two shoes 39 and 40 on said rod. The lever 38 is pivoted in the frame as seen at 41, and the free end of said lever supports a roller 42 which operates upon a cam 43 arranged on a cam shaft 44, which is driven from the shaft 13. A spring 45 is arranged upon the rod 31 to support the roller 42 in constant engagement with the cam 43 and a suitable universal coupling 46 is provided in the rod 31 to compensate for the swinging movement of the frame 6, which action is also compensated for by the universal ball ends 30, 37, as will be apparent.

In the construction shown, the cam 43 has two slightly enlarged cam surfaces 47, 48, and one greater protruding surface 49. In operation, the surface 47 will feed the first charge, for example at X, into the cylinder. The surface 48 will feed the second charge Y; whereas the surface 49 will feed the last charge Z, and also operate at this moment to pressure discharge heated casting material from the nozzle end 15 of the cylinder into the impression 17 of the die; and then the cycle of operation is repeated. That is, two more charges X and Y are independently advanced in the cylinder, and again in advancing the charge Z, the material is forced into the die impression. In each of the operations, X, Y, and Z, the measuring and feed plate 20 moves forwardly with the plunger and delivers a charge to the aperture 24 of the cylinder upon the top of the plunger 25 when in its forward position. This charge then drops into the cylinder, after the plunger has been retracted to the position shown in Fig. 1. The particular method of the successive operations herein briefly referred to are illustrated in detail in a companion application filed of equal date herewith in which the successive steps of the method are more clearly elaborated upon. The present application deals primarily with the mechanical structure for accomplishing the desired result as will be apparent.

As previously indicated, it will be understood that other forms of cams may be substituted for the cam 43 having a different arrangement of cam surfaces thereon for providing any desired number of charges of the material into the cylinder in advance of the final pressure discharge stroke of the plunger.

In Fig. 1 of the drawing I have indicated at 50 a spring which acts upon a head 7a on the pivot 7 to move the frame 6 or the nozzle 15 of the cylinder 14 supported in said frame, in tensional engagement with the dies during the casting operation. This tension is slightly reduced, for the purpose of avoiding excessive friction, through a cam 51 on the cam shaft actuating a bell crank 52, one arm 53 of which operates upon a collar 54 on the pivot 8. The collar 54 is adjustable through adjustment and lock nuts 55 employed for increasing or decreasing the tension of the spring 50. The bell crank 52 is pivoted as seen at 56.

It will be noted that water circulating passages 57 are arranged in the support 58 for the cylinder to keep the plunger 25 cool when in its retracted position, and also to have a cooling effect upon the cone or supplemental hopper 23 which does not directly contact the cylinder 14 as will be seen. This prevents any appreciable pre-heating of the material prior to its discharge into the cylinder and prevents congestion or clogging of the delivery into the cylinder through said cone 23.

It will, of course be apparent that the illustration in the accompanying drawing is to some degree diagrammatic in that only such parts of the machine disclosed in the application hereinbefore referred to have been shown which will demonstrate the intermittent operation of the plunger for the multiple charging of the cylinder. All other parts or mechanisms of the machine dealing with the operation of the dies and to time the operation thereof consistent with the plunger operation, have been omitted to avoid unnecessary complications in the present illustration. It is quite apparent, however, that the cam 12 operates to normally support the frame 6 and the cylinder 14 so that the nozzle 15 will be in the position shown in Fig. 3 so that when the charges X and Y are introduced into and advanced in the cylinder 14, the casting material will be sealed at the nozzle 15 by engagement with the die 16. However, when the last charge Z is moved forwardly in the cylinder, the nozzle 15 will be moved into the position shown in Fig. 2, and the heated casting material will be pressure discharged into the cavity 17. If desired, a suitable core 17a may be provided so that the formed casting will be arranged on the core, and

this core may be used to eject the casting from the impression 17 of the dies when the dies are opened.

It will also be understood that the fundamental principles of a multiple charge machine of the type and kind under consideration are adaptable to cylinders of different sizes in the formation of different size castings. However, in all instances, it will be desirable to inject a series of small charges of the thermoplastic material into the cylinder to gain the benefit of the quick heating occasioned thereby. A further advantage of a construction of this type and kind resides in the fact that in advancing the last charge in the pressure discharge or injection stroke of the plunger, relatively cool granular material is disposed directly adjacent the end of the plunger. This maintains a clear and clean cylinder at all times, and prevents any possible gumming up of the cylinder or the plunger which would be the case if the plunger were operating directly upon a melted or partially heated mass of material. This granular or unheated material also acts as a skid which materially reduces the pressure required in ejecting the material from the cylinder and from this standpoint, it is always desirable that as small a cylinder as possible be employed, which would, of course, be consistent with the size of the casting to be formed.

It will, of course, be apparent that our invention is not necessarily limited to the particular mechanism or devices herein disclosed for actuating the plunger in producing the multiple charge strokes thereof, as other means may be employed for controlling the number of these charges, and the time period between successive charges and the final injection stroke of the plunger. It will also be apparent that a single machine may be operated to produce a wide range of castings within certain limit sizes by not only changing the cam 34, but by also changing the measuring and delivery plate 20 so as to increase or decrease the amount of independent charges delivered to the cylinder for admission thereinto.

Having fully described our invention, what we claim as new and desire to secure by Letters Patent is:

1. A die casting machine comprising an elongated movable cylinder, means heating the discharge end of the cylinder, means moving the cylinder into casting and non-casting positions, a plunger arranged in said cylinder and movable longitudinally thereof toward and from the discharge end of the cylinder for injecting heated casting material into the impression of relatively movable dies, means coupled and movable with the plunger for delivering a measured quantity of casting material to the cylinder for arrangement in the cylinder forwardly of said plunger, and means operating the plunger in a feed stroke a plurality of times to feed a series of measured charges of material to the cylinder and to deliver the same into the heated end portion thereof and in the last of said strokes to pressure discharge the material from the cylinder into the impression.

2. A die casting machine comprising an elongated movable cylinder, means heating the discharge end of the cylinder, means moving the cylinder into casting and non-casting positions, a plunger arranged in said cylinder and movable longitudinally thereof toward and from the discharge end of the cylinder for injecting heated casting material into the impression of relatively movable dies, means coupled and movable with the plunger for delivering a measured quantity of casting material to the cylinder for arrangement in the cylinder forwardly of said plunger in a feed stroke, means operating the plunger a plurality of times to feed a series of measured charges of material to the cylinder and to deliver the same into the heated end portion thereof, and in the last of said strokes to pressure discharge the material from the cylinder into the impression, and the means for intermittently actuating the plunger comprising a cam having cam surfaces controlling the series of charge operations of the plunger and discharge of material from the cylinder in each complete cycle of casting operation of the machine.

3. In a die casting machine of the class described, a pair of dies movable toward and from each other, an elongated cylinder disposed angularly to the dies, means heating the discharge end of the cylinder, means moving the cylinder bodily toward and from the dies, other means moving the cylinder bodily longitudinally of the direction of movement of the dies from a non-casting position to a casting position registering with the die cavity, a plunger in said cylinder movable longitudinally thereof toward and from the discharge end of the cylinder for pressure injecting heated casting material into the cavity of the dies when the cylinder is in casting position, means coupled and movable with the plunger for delivering a measured quantity of casting material to the cylinder forwardly of said plunger, means operating the plunger in a feed stroke a number of times to feed a series of measured charges of material into the heated end portion thereof and in the last of said strokes to pressure discharge heated material from the cylinder into the cavity of the dies, said last named means comprising a rod, means connecting said rod to said plunger including a universal joint, a cam, means connected to said rod and cooperating with said cam for driving said rod, and said last named means also including a universal joint.

4. In a die casting machine for die casting thermoplastic material, a pair of relatively movable dies with a cavity arranged between adjacent surfaces thereof, a cylinder heated at one end, a discharge nozzle at said end of the cylinder, means normally supporting said nozzle in engagement with one surface of one of the dies to normally seal the discharge of said nozzle, a plunger in said cylinder, means intermittently actuating said plunger a predetermined number of feed strokes in the cylinder, means operative with the plunger for charging the cylinder with measured supplies of material in each stroke of the plunger, and means for moving the cylinder to bring the nozzle in registering position with the cavity of the dies, whereby the last feed stroke of the plunger in the cylinder will pressure inject heated material from the cylinder into the die cavity.

5. In a die casting machine of the class described, means forming a mold cavity, a cylinder having a nozzle to discharge material into said cavity, a reciprocable plunger in said cylinder, means to move said nozzle out of position to discharge material into said cavity and to close the nozzle, a source of supply of material, means connected to said plunger to feed material from said source to said cylinder on each reciprocation of the plunger, means to reciprocate said plunger in a feed stroke a plurality of

times while said nozzle is closed, means then to move said nozzle into position to discharge material into said cavity, and means then to give said plunger a feeding stroke sufficient to discharge said material through said nozzle into the cavity.

6. In a die casting machine of the class described, means forming a mold cavity, a cylinder having a nozzle to discharge material into said cavity, a reciprocable plunger in said cylinder, means to move said nozzle out of position to discharge material into said cavity and to close the nozzle, a source of supply of material, means connected to said plunger to feed material from said source to said cylinder on each reciprocation of the plunger, means to reciprocate said plunger in a feed stroke a plurality of times while said nozzle is closed, means then to move said nozzle into position to discharge material into said cavity, means then to give said plunger a feeding stroke sufficient to discharge said material through said nozzle into the cavity, said plunger operating means comprising a cam having cam surfaces controlling the number of movements of the plunger in the cycle of each casting operation and a drive between the cam and plunger yieldable to compensate for movement of the nozzle of the cylinder into casting and non-casting positions.

7. In a die casting machine of the class described, means forming a mold cavity, a cylinder having a nozzle to discharge material into said cavity, a reciprocable plunger in said cylinder, means to move said nozzle out of position to discharge material into said cavity and to close the nozzle, a source of supply of material, means connected to said plunger to feed material from said source to said cylinder on each reciprocation of the plunger in a feed stroke, means to reciprocate said plunger a plurality of times while said nozzle is closed, means then to move said nozzle into position to discharge material into said cavity, means then to give said plunger a feeding stroke sufficient to discharge said material through said nozzle into the cavity, said plunger operating means comprising a cam having cam surfaces controlling the number of movements of the plunger in the cycle of each casting operation, a drive between the cam and plunger yieldable to compensate for movement of the nozzle of the cylinder into casting and non-casting positions, and an adjustable resilient means to compensate for varying stroke movements of the plunger during each cycle of operation of the machine.

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