

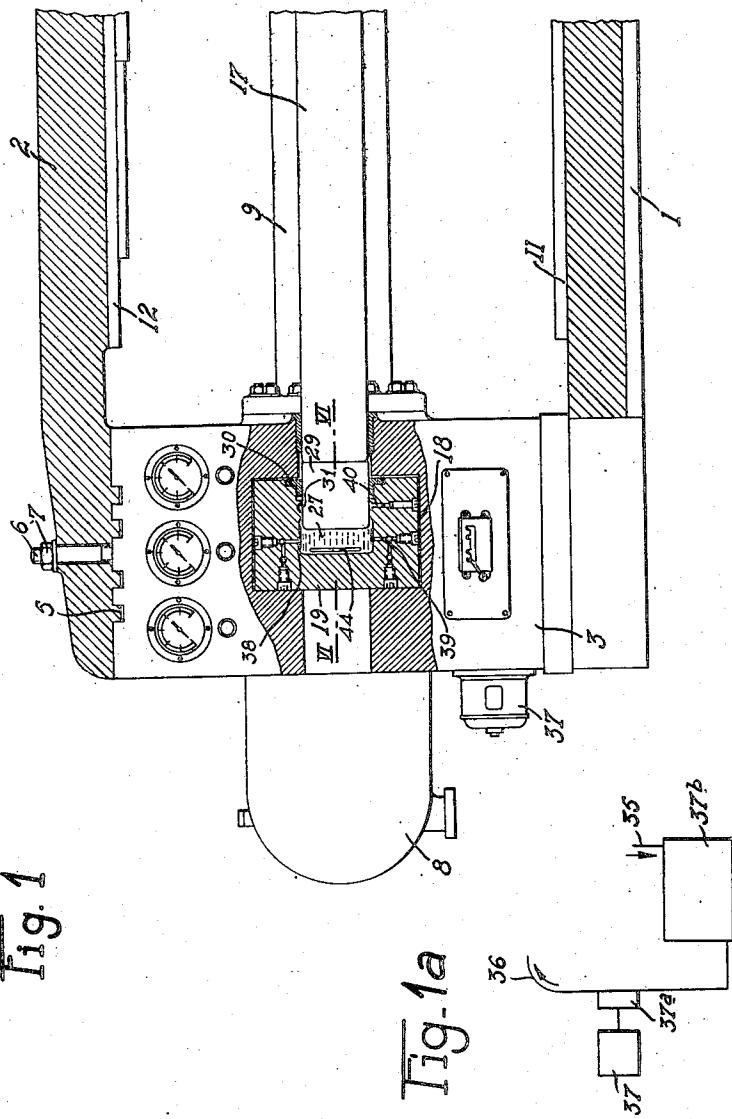
Nov. 13, 1951

J. DE STERNBERG
MOLten METAL SUPPLYING DEVICE FOR
PRESSURE DIE CASTING MACHINES

2,575,162

Filed July 19, 1949

10 Sheets-Sheet 1



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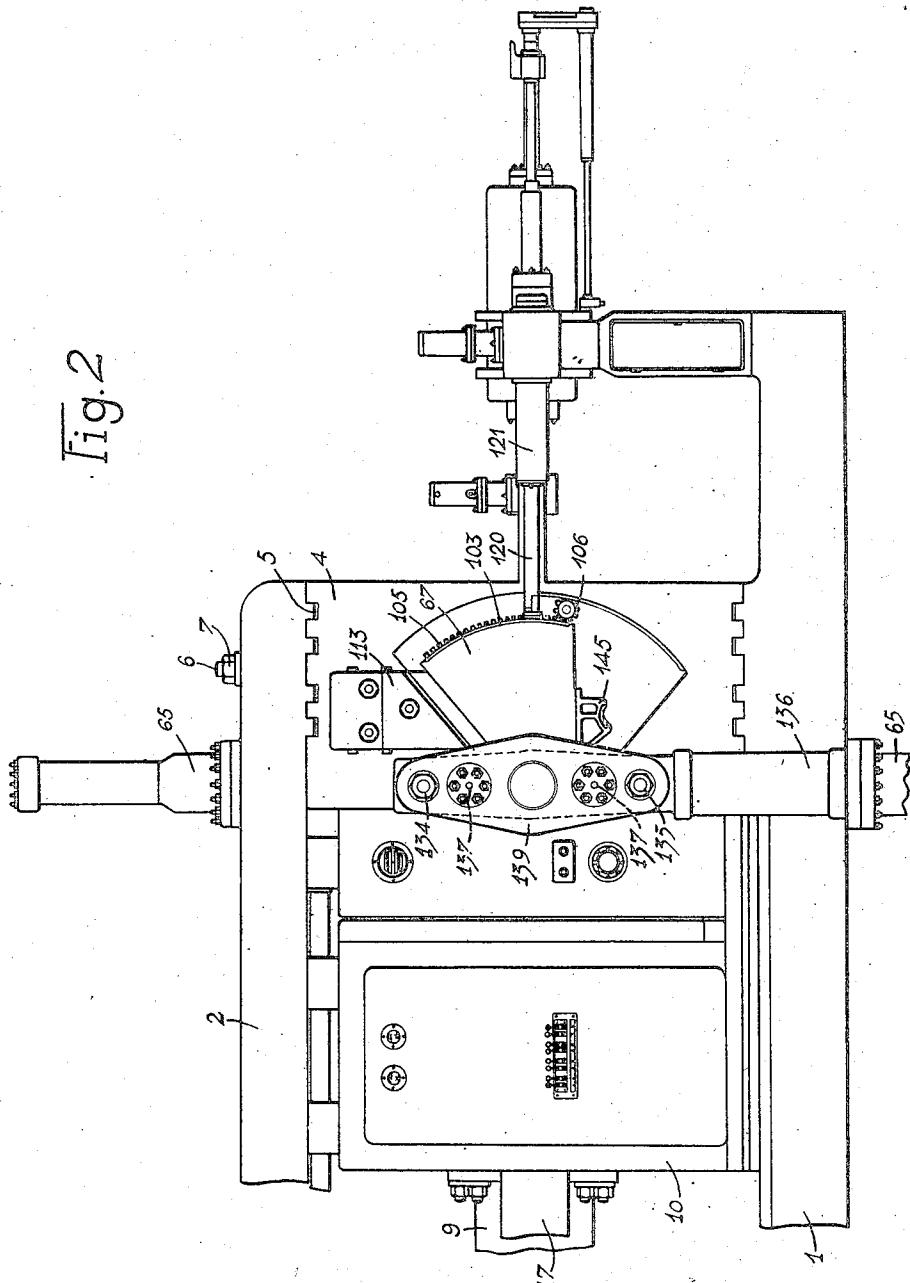
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Filed July 19, 1949

10 Sheets-Sheet 2



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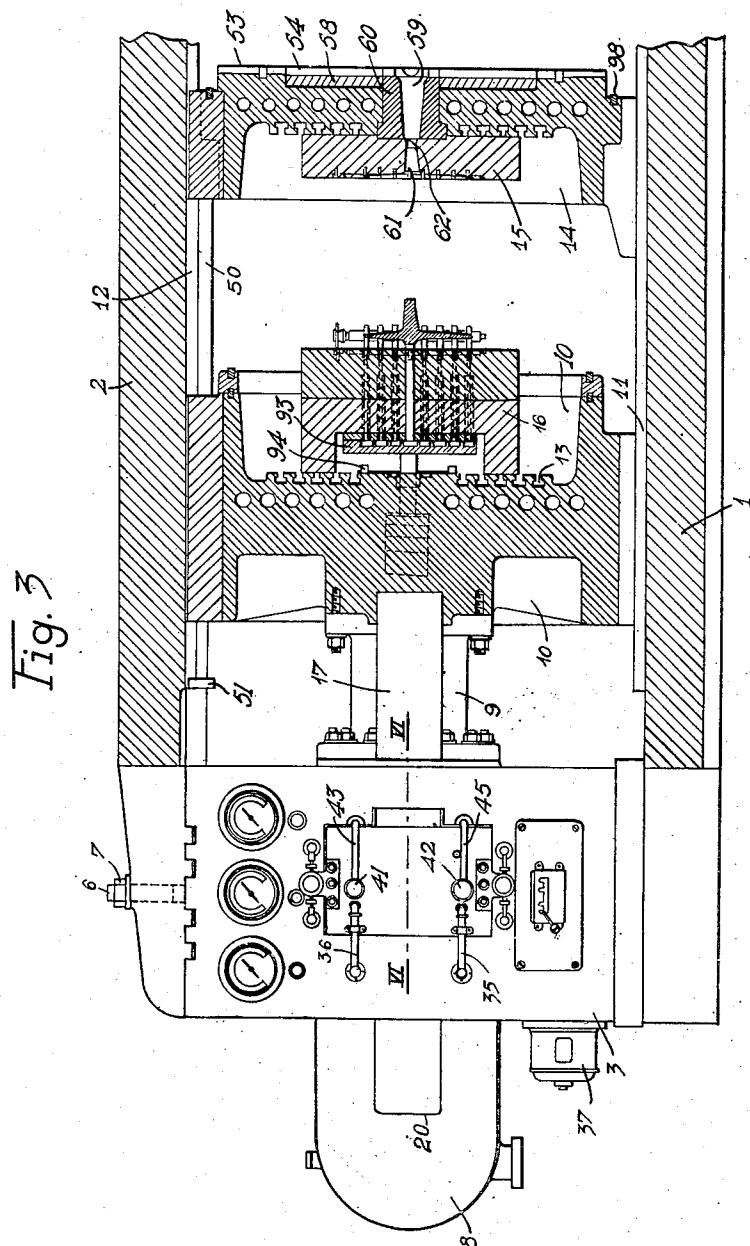
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Filed July 19, 1949

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2,575,162

Filed July 19, 1949

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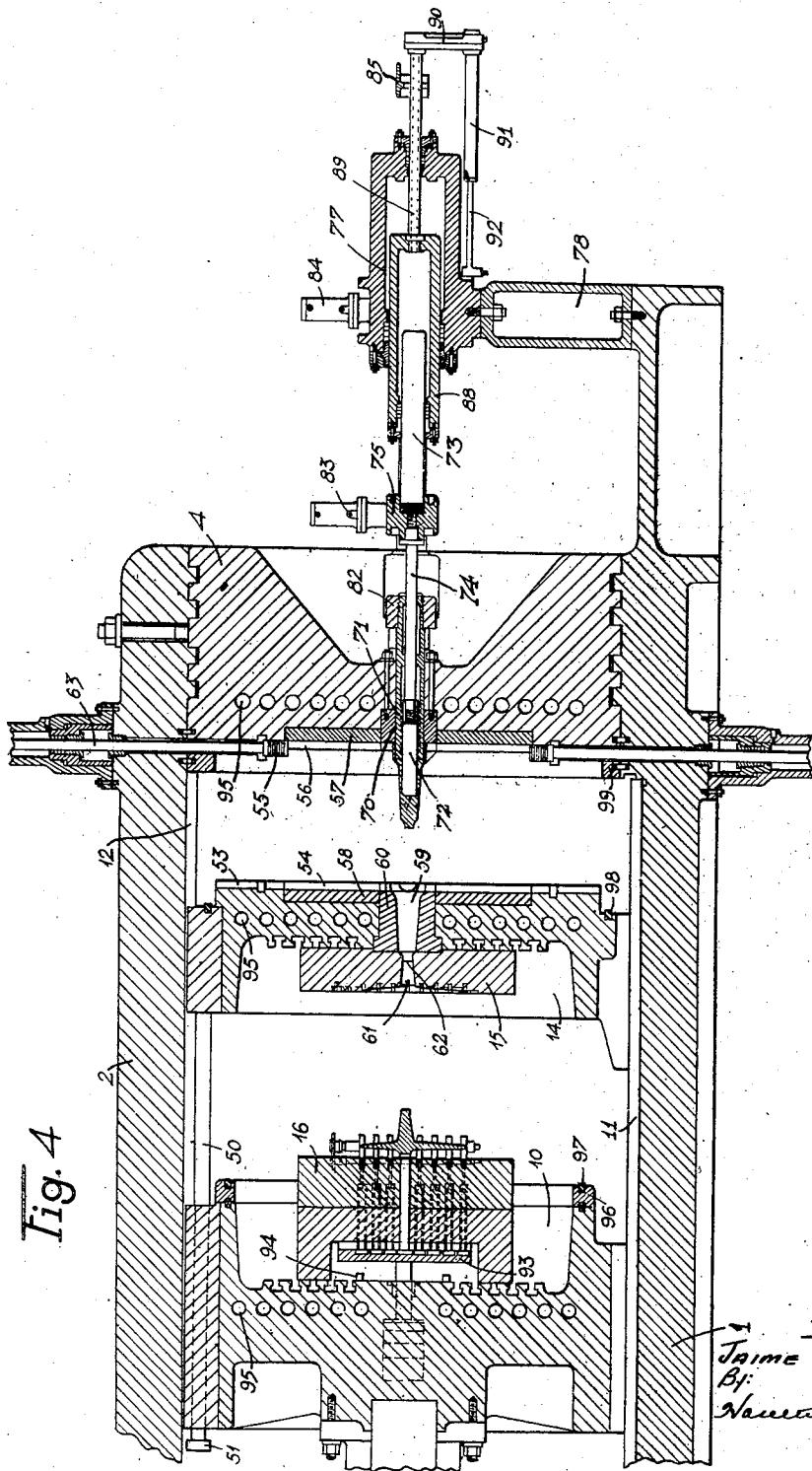


Fig. 4

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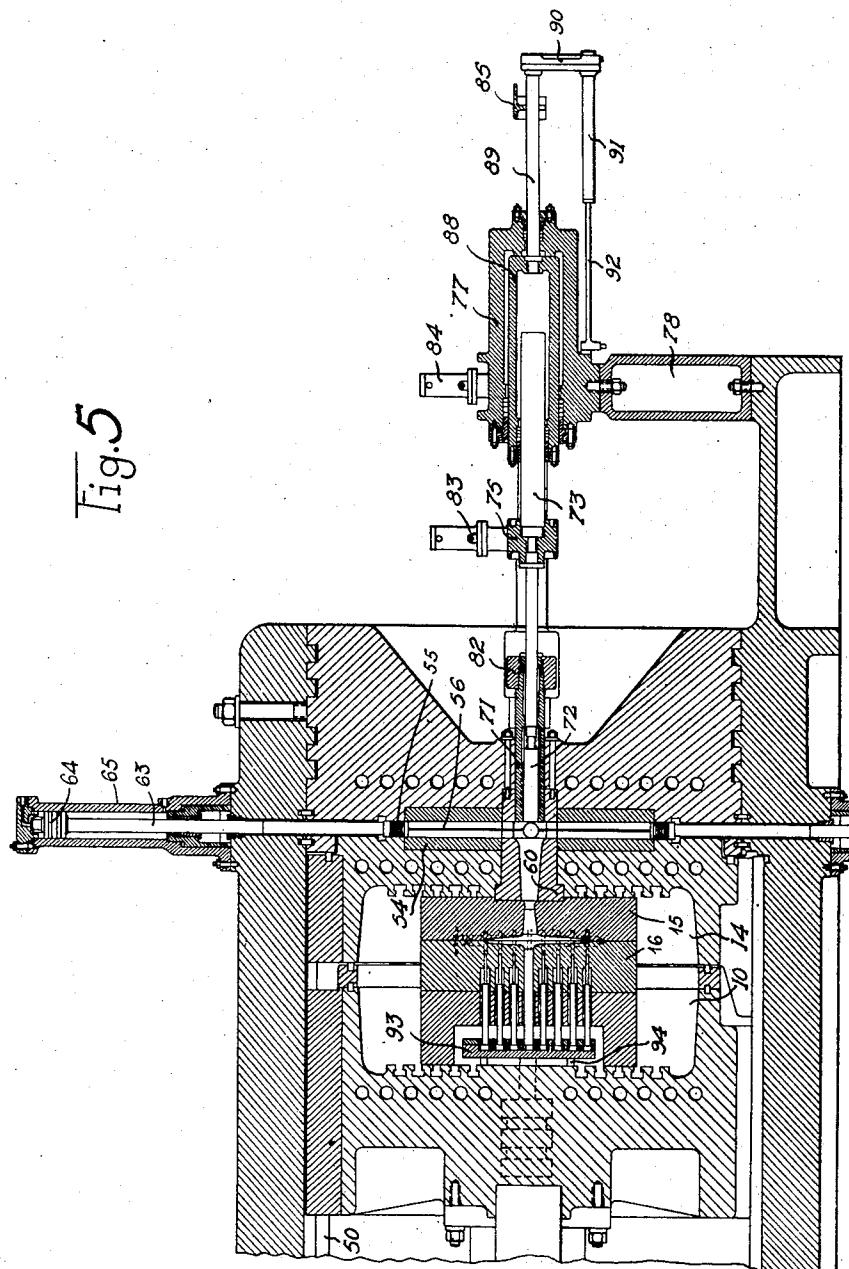
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2,575,162

Filed July 19, 1949

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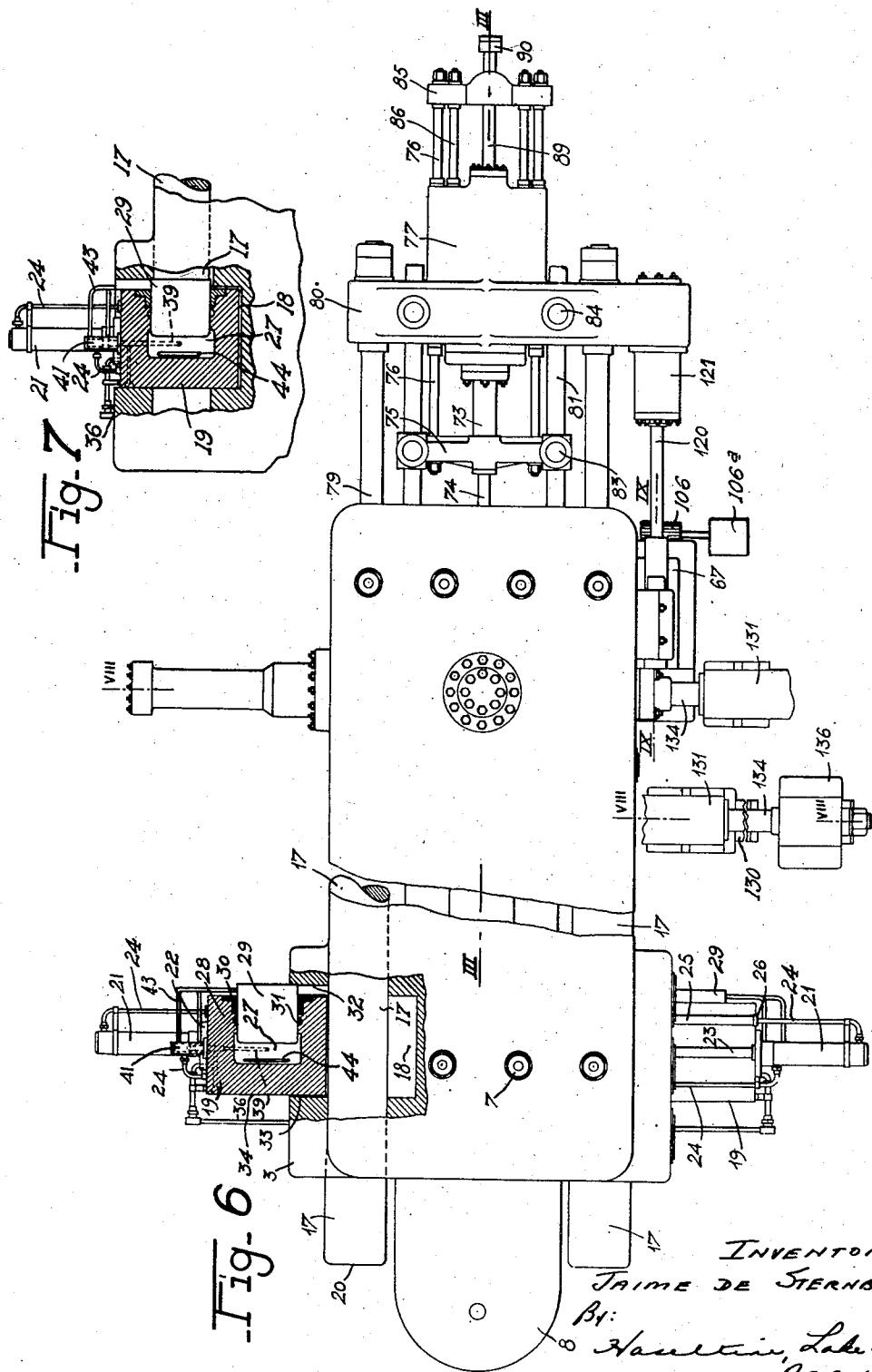
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2,575,162

Filed July 19, 1949

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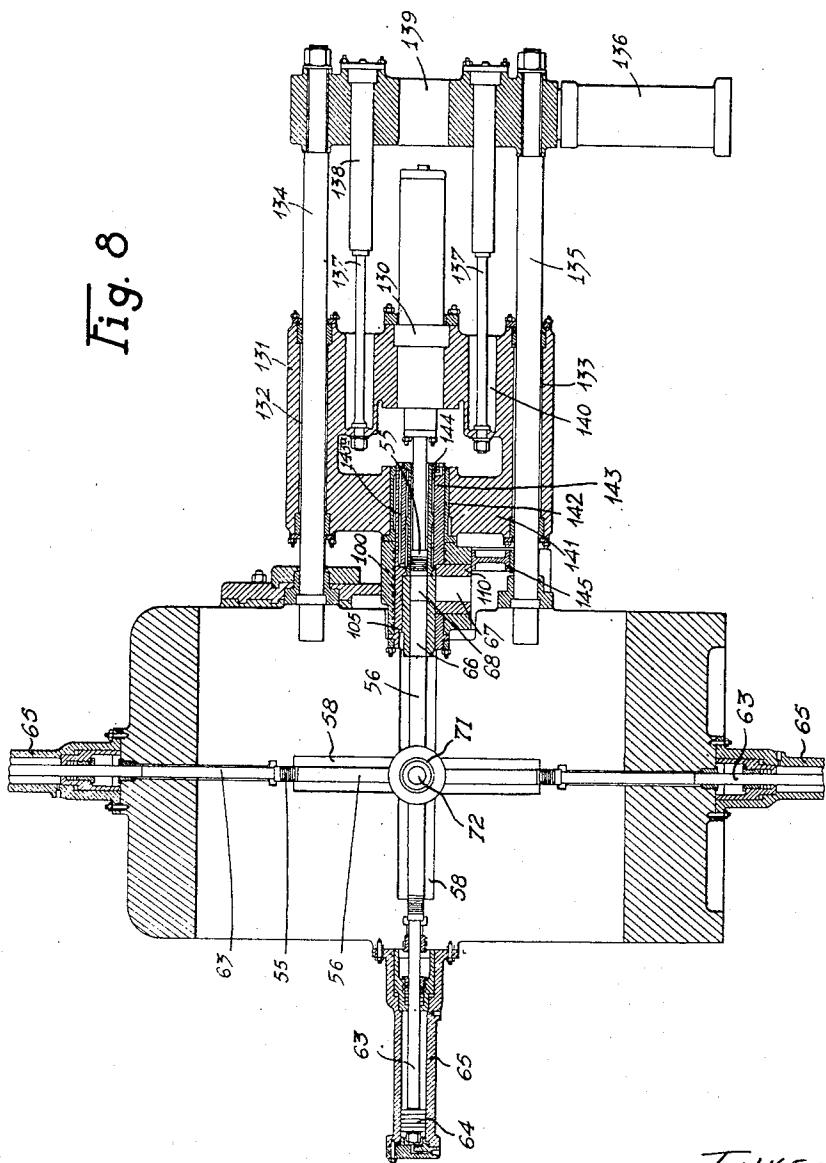
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Fig. 8



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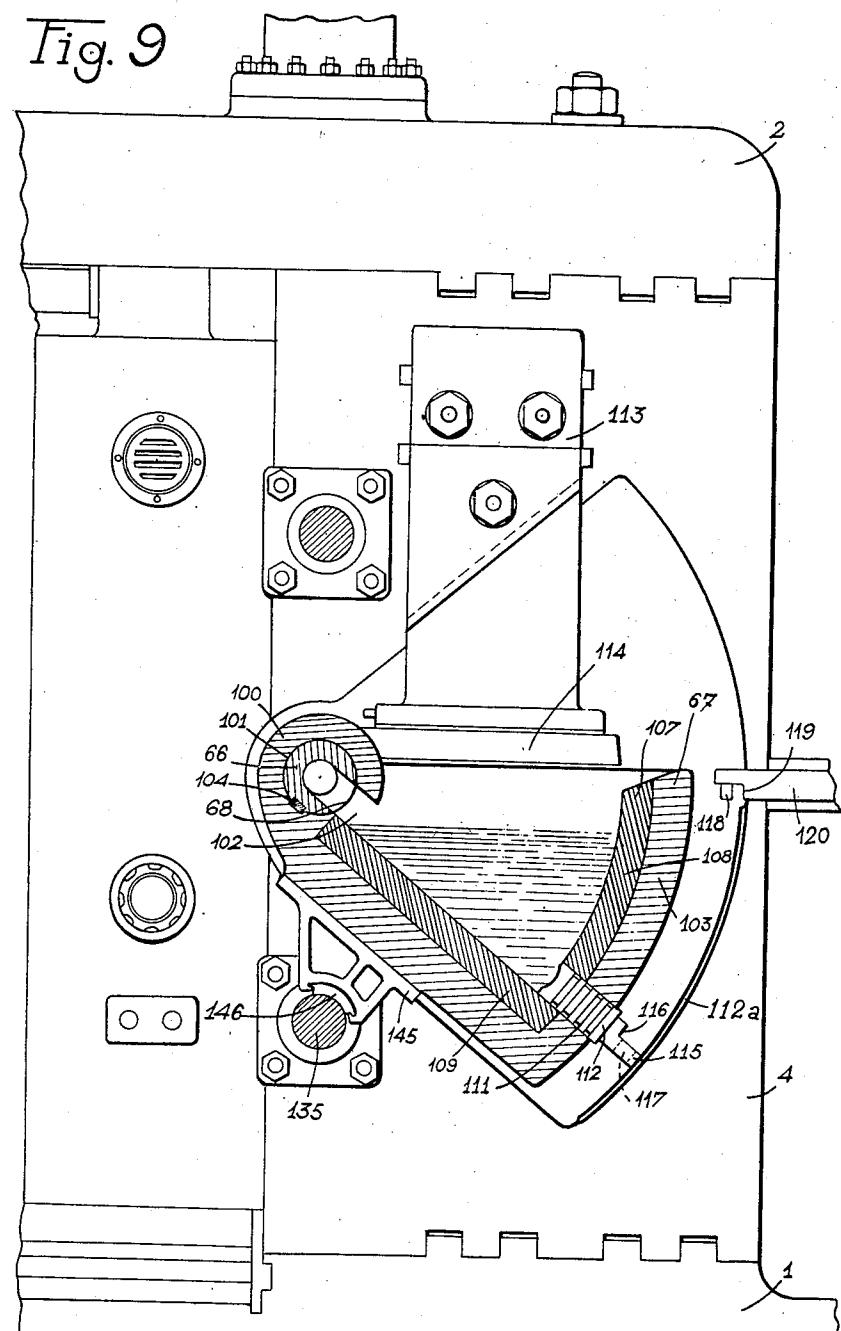
J. DE STERNBERG
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2,575,162

Filed July 19, 1949

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Fig. 9



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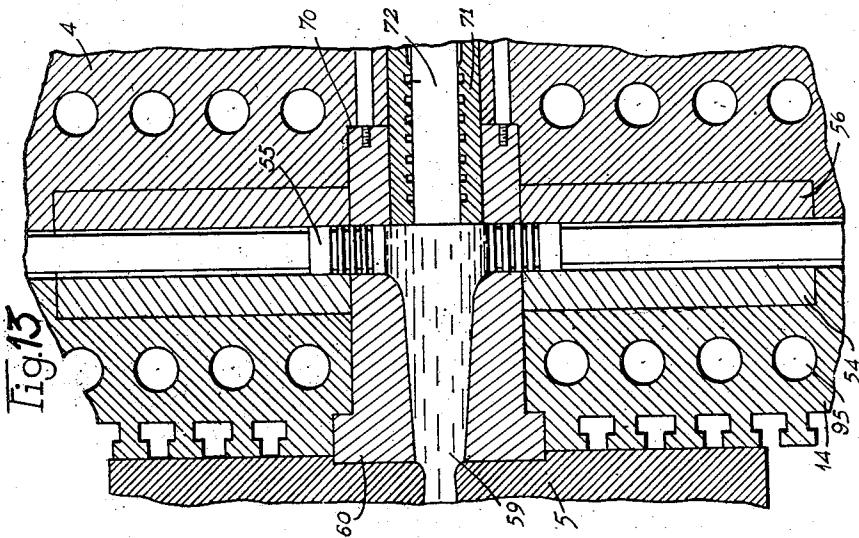


Fig. 15

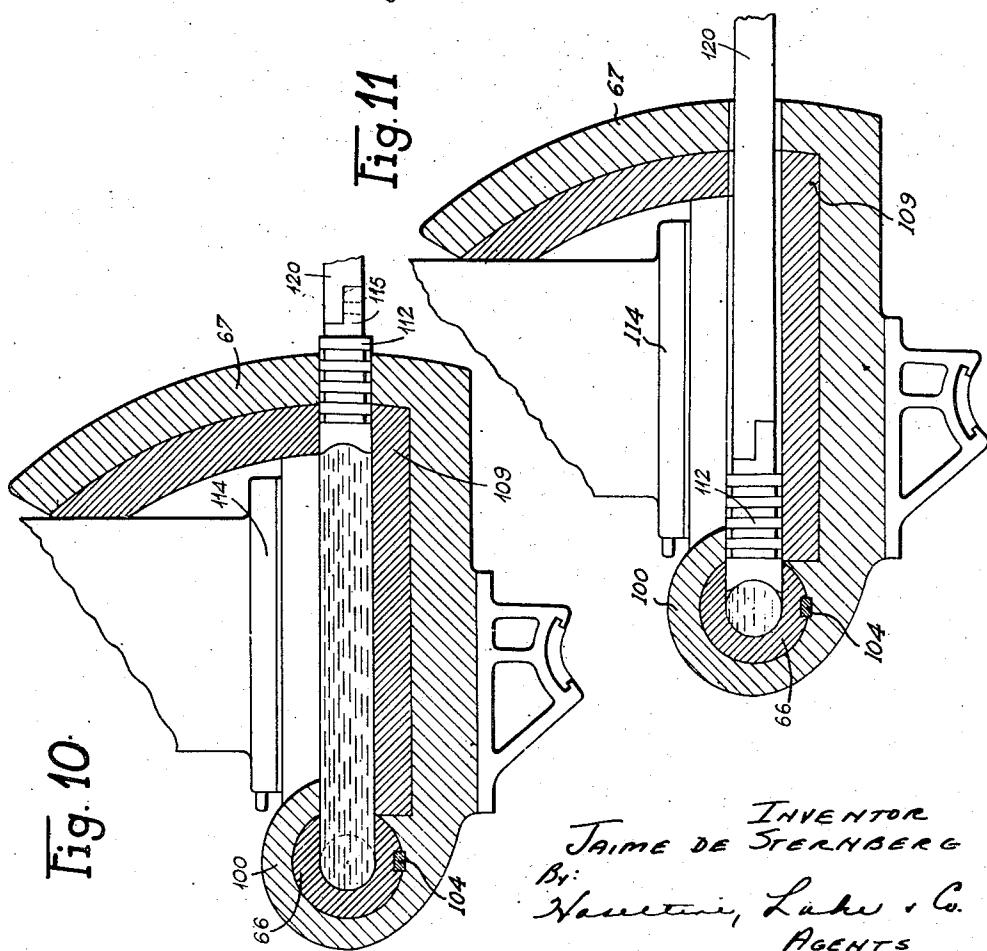


Fig. 10

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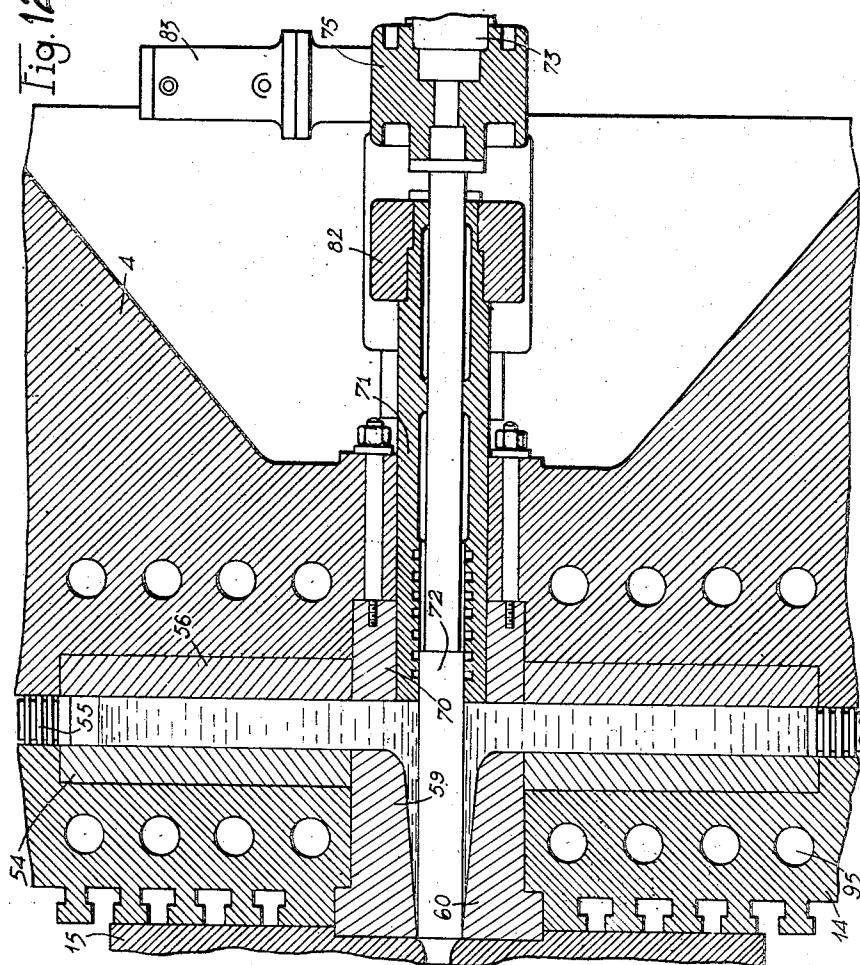
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Filed July 19, 1949

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Fig. 12



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UNITED STATES PATENT OFFICE

2,575,162

MOLTEN METAL SUPPLYING DEVICE FOR
PRESSURE DIE-CASTING MACHINES

Jaime de Sternberg, Courbevoie, France

Application July 19, 1949, Serial No. 105,627
In France June 28, 1949

5 Claims. (Cl. 22—79)

1

Machines are already known for the diecasting of metals and more particularly of steel. These machines involve, for the operation of their elements, considerable powers, since the quality of the products obtained depends essentially on the pressure under which they are casted. During casting, in the last stage of this operation, it is necessary to apply to the metal when stiff soft, a very high dieing pressure which, properly speaking, constitutes an actual forging operation.

Such machines, with a hydraulic drive, have been built and they operate perfectly when the amounts of steel to be handled in one operation do not exceed a few pounds.

The present invention relates to pressure diecasting machines capable of casting, in one operation, steel parts, for instance, weighing several hundred pounds.

The filling of the injection cylinder or cylinders requires the presence of a ladle into which the melted metal can easily be introduced and dosed. The main object of the present invention is to provide a pressure diecasting machine wherein the ladle assumes the shape of a cylindrical sector, rocking about a hollow trunnion; a fixed draining piston may enter, in a tight manner, the ladle. The bottom of said ladle is gone through by an additional draining piston which drives away the amounts of metal between said fixed piston and the bottom of said pocket when the latter is at its higher position. The hollow trunnion for rocking the pocket is preferably in line with one of the injection cylinders and within said trunnion is reciprocably mounted the corresponding injection piston which is capable of moving back beyond the inlet aperture communicating with the ladle. Thus one is assured that no part of the melted metal introduced is liable to stagnate at any point of the injection mechanism and to solidify, which would make the operation of the machine impossible.

Another object of the present invention is to provide, in a pressure diecasting machine, a molten metal supplying device of the character described wherein the assembly comprising the ladle, its hollow trunnion and the corresponding injection piston with its driving cylinder is mounted on a frame movable in the direction of the axis of the injection piston. Thus the ladle can easily be removed from under its fixed piston for cleaning it and, if necessary, for changing of its refractory lining.

The various elements of the machine are preferably driven, as defined above, hydraulically

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through sets of double action pistons and cylinders. It is obvious, however, that such hydraulic means could be replaced by mechanical, electrical or other means.

5 The thus built machine makes it possible to handle quantities of steel amounting to several hundred pounds at a production rate of approximately one closing of the moulds every two minutes. The various operations can, of course, be effected by manual control but they could be adjusted by an automatic control capable of causing the various operating elements to effect the functions necessary for the performance of the operating cycle in a strictly sequentially timed order.

According to the present invention, the supplying device in molten metal may be associated in the same pressure diecasting machine with a mould section locking device of the kind described in my co-pending application Serial No. 105,626 filed July 19, 1949, now matured into Patent No. 2,564,884, and/or an injection mechanism of the kind described in my co-pending application Serial No. 105,628 filed July 19, 1949, now matured into Patent No. 2,564,885.

The following description, taken in connection with the appended drawings given by way of example will show clearly how the invention may be put in application.

Figures 1 and 2, placed together, show a profile view of a diecasting machine according to the invention, with part of said machine torn off at the level of the lock.

Figure 1a shows, schematically, the supply circuit for the fluid locks.

Figure 3 shows, partly in section taken along line III—III of Fig. 6, the machine on the side of the piston operating the opening of the mould, said mould being open.

Figure 4, complementary to Figure 3, shows a section of the machine on the side of the injection cylinders.

Fig. 5, similar to Fig 4, shows a section of the machine, the various portions of the mould being adjacent.

Fig. 6 is a plan view of the machine with a partial cross-section through the line VI—VI of Fig. 3 which shows one of the locks in inoperative position

Fig. 7 is a partial view corresponding to Fig. 6, the lock being in operative position.

Figure 8 shows a partial section of the machine along line VIII—VIII of Figure 6.

Figure 9 shows, on a larger scale, a profile view

of the machine with a section effected along line IX—IX of Figure 6.

Figure 10 shows in partial section the ladle shown on Figure 9 in the raising position.

Figure 11 is a view similar to Figure 10, showing the positions of the elements at the end of the filling period.

Figure 12 shows, on a larger scale, the positions of the elements in the injection chambers at the end of the injection cylinder filling period.

Figure 13 shows, similarly to Figure 12, the positions of the elements at the end of the mould filling.

The machine comprises (Figures 1 to 4), a frame formed by a lower slide 1 and an upper slide 2, slides which are anchored on end cross pieces 3, 4 by castellated assemblies 5, tightened by threaded rods 6 which receive tightening nuts 7. The crosspiece 3 supports a hydraulic cylinder 8 associated with a control piston 9 secured to a frame 10, moving on sliding surfaces 11 and 12 formed on slides 1 and 2. Frame 10 carries protruding parts 13 for the fixation of the drag 16. This frame is to be brought in the neighbourhood of a frame 14, supporting the cope 15 complementary to drag 16 carried by the frame 13. Said drag and cope are brought together under the action of the hydraulic piston 9. This piston is double acting and ensures the uniting of the cope 15 and the drag 16 along their jointing plane, as well as their separation.

In addition to the piston rod 9, the frame 10 carries two ram plungers 17 which traverse the end cross piece 3 through bores provided for that purpose.

On the two opposite sides of the crosspiece 3 housings 18 are provided, for receiving sliding locks 19 (Figs. 6 and 7) which become interposed behind the ends 20 of the ram plungers 17 when the component elements of the complete mould are united, i.e. when the frame 10 is pushed all the way against the frame 14.

The locks 19 are driven by double acting hydraulic cylinders 21, which are associated through plates 22 with the bodies of the locks. Each lock 19 is operated by an assembly of two cylinders 21 respectively arranged above and underneath the lock and each cylinder contains a piston the rod 23 of which is secured at one of its ends to the side face of the crosspiece 3. The driving fluid is brought into the cylinders 21 by rigid pipes 24 reaching each end of the cylinder and capable of sliding in a telescopic manner inside the distributing pipes 25 (Figure 6) with interposition of tightness seals such as 26. Under such conditions, the piston is fixed and the cylinder 21 moves with respect to the piston, driving the lock 19. The lock 19 is a hollow body capable of withstanding very high pressures and the chamber 27 provided therein opens on the side through a cylinder 28 which contains a piston element 29. The piston element 29 is guided inside the cylinder 28 and the tightness is ensured by a packing 30 acting as a gland, completed by a retaining groove 31 (Figures 1 and 6).

The displacement axis of each piston 29 is parallel with the displacement axis of the ram plungers 17 and the housing 18 of the lock comprises a relief 32 for the passage of the foot of the piston 29. This housing 18 comprises, further, a bearing face 33 for receiving the corresponding bearing face 34 of the lock, this bearing face 33 also containing the opening in which the ram plunger 17 moves.

The chamber 27 of the lock is placed in communication through telescopic pipings 35 and 36 with a mercury tank 37b located inside the crosspiece 3. This mercury tank is provided with a refrigerating device. A pump 37a, driven by a motor 37 is capable of drawing the mercury from the above tank to bring it, under a high pressure, into chamber 27 through the piping 36. This piping 36 opens into ducts formed in the mass of the lock 19 and opening through a perforation 38 into the chamber 27 at the upper portion of the latter. Similarly, at the lower portion of the chamber 27 open ducts 39 formed in the mass of the lock 19, and placed into communication with the telescopic pipe 35 to ensure, through gravity, the return of the mercury contained in the chamber 27 to the refrigerated tank. The retaining groove 31 communicates through a duct 40 with the return duct 35.

In the inlet and return ducts for mercury, machined in the mass of the lock 19, there are interposed stop valves operated by hydraulic cylinders 41 and 42. These double action cylinders 41 and 42 play the part of closure cylinders for the mercury valves and said cylinders are connected with the hydraulic circuit of cylinders 21 through telescopic pipes 43 and 45, the ends of which only have been shown and which are similar to the pipes 24. These hydraulic connections are effected in such a manner that when the cylinders 21 are operated to drive the locks 19 into the receiving cavities, the valves 42 are closed and the valves 41 are open; at the end of the driving in of the locks 19, the valves 41 also close, thus enclosing in hermetically sealed spaces the mercury contained inside chambers 27. When the cylinders 21 cause the locks 19 to come out of their housings 18 the valves 41 and the valves 42 open, allowing the return of the mercury contained in the cavities 27 to the refrigerating tank, the mercury pump 37a being stopped.

Further, inside the space 27 an incased heating element 44 is arranged, strongly armoured so as to be able to withstand very high pressures. This electric heating element, the external connections of which have not been shown, acts to heat the mercury contained in the chamber 27 when said chamber is hermetically sealed by the valves 41 and 42. Under these conditions, the mercury tends to expand with a considerable expansion power. Now when this expansion tends to occur, the lock 19 is completely pushed inside the cavity 18 and the piston element 29 is applied against the rear edge 20 of the corresponding ram plunger 17, said ram plunger 17 having been carried completely forward by the hydraulic piston 9. The expansion of the mercury thus brings into action considerable pressures which are transmitted along the jointing plane of the cope 15 and the drag 16, ensuring the closing of the mould with a very high pressure.

The operation of the above described device, consequently, is as follows:

The piston 9 ensures the closure of the mould and when the two half sections are in contact along their jointing plane, the locks 19, operated by the hydraulic cylinders 21, enter the housings 18 and insert themselves behind the ram plungers 17. The cavities 27 are filled with mercury by the mercury pump driven by the motor 37, said mercury being relatively cold. The pistons 29 are applied against the ram plungers 17 and at

that time the spaces 27 are hermetically sealed. The heating element is put in action during the whole time of the mould closure.

When the mould is to be opened, the action of the heating element 44 is discontinued or not. The valve 42 is opened thus allowing return of hot mercury to refrigerated tank. The pistons 29 move back. The cylinders 21, driven in the opposite direction, cause the locks 19 to come out and free the passage for the ram plungers 17. The mould is opened by the slip caused by the piston 9. The mercury is refrigerated inside its tank and is prepared for the next locking operation.

The volume of chambers 27 and the thermal energy developed by the heating elements 44 are determined so as to obtain the required pressure on the jointing plane of the half-moulds. The hydraulic energy to be brought into action is thus reduced to that which is necessary for obtaining the operations and the hydraulic pressures can thus be reduced in a very large proportion, which brings about a substantial saving in motive forces. Further, the forces necessary for the putting under pressure of the jointing plane of the sections of the mould are also obtained very economically, since there is no need to provide any pressure accumulator or any pump developing said pressure. The total cost of the installation will be favorably affected since the dimensions of the pressure producing mechanisms will be very much reduced.

The above described mechanism are for the purposes of opening and closing the moulds, wherein a molten metal is injected under pressure, this metal being generally steel. The device allows the construction of moulds having very large dimensions, wherein considerable pressures will be developed at the time of dieing. These large dimensions of the moulds thus make it possible to mould bulky parts, such as example parts weighing about 900 to 1350 pounds. The filling of the mould, under such conditions with such a large amount of steel, makes it impossible to use a single filling cylinder. Such a cylinder would have such diameter and length that seizing of the thrust piston would inevitably occur.

To obviate such drawbacks, the machine comprises a plurality of cylinders for filling the mould, wherein pistons move, said cylinders being capable of being opened after each injection operation.

Under such conditions, as clearly shown in Figure 4, the frame 14 carrying the cope 15 is also mounted so as to be movable along the slides 11 and 12 and it is tied to the frame 10 by assemblies of sliding rods 50 attached to frame 14 and going through the frame 10 in corresponding bores where the rods 50 can move freely. Stops 51 are provided on the rods 50 in such a manner that the backward motion of the frame 10 causes first the separating of the half sections 15 and 16 before causing the backward motion of the frame 14.

Opposite the face carrying the cope 15, the frame 14 is formed with a face 53 on which are mounted half-cylinders 54 for injection pistons 55. The conjugate half-cylinders 56 are formed in fittings 57, secured to the crosspiece 4. Similarly the half-cylinders 54 are formed in fittings 58 secured to the frame 14.

The pistons 55, four in number in the machine more precisely described, are opposite in pairs and at right angles to each other. Their axes are contained in a plane perpendicular to the

movement axis of the frames 10 and 14. The axes of said cylinders 54, 56 are concurrent and, perpendicularly directed to their plane a converging tuyère 59 for the injection of metal opens into the frame 14, said tuyère being formed in a socket 60 secured to the frame 14. This injection tuyère opens into a pouring hole 61 formed in cope 15 and which follows it, said pouring hole being used for the formation of the runner-stick of the metal introduced into the stamps of the mould and having a neck 62 which constitutes, in said runner-stick, the breaking throttle upon opening the mould.

The pistons 55 (Figure 5), are set in motion by rods 63 which are connected with pistons 64 moving inside double action hydraulic cylinders 65. Said cylinders 65 make it possible to obtain synchronous reciprocating motions of pistons 55, for example.

10 The introduction of the molten metal in the injection half-cylinders 54, 56 is effected through one of the cylinders 66 of this series of cylinders. To this effect the half cylinder 66 comprises a lateral aperture which communicates with a ladle 67. This aperture 68 is effected in the half cylinder 66 in front of the corresponding piston 55 when the latter is at the end of its back stroke.

15 The injection mechanism described below is completed by a mechanism for closing the tuyère 59 and for dieing the metal introduced into the stamps and which shall now be described:

20 The crosspiece 4 comprises, at its center, a cylindrical bore 70 formed in a socket and wherein moves a sleeve 71. The sleeve 71 itself is provided with a bore where a cylindrical mandrel 72 can move. The sleeve 71 has such a diameter that it can be applied in the tuyère 59 to obturate it in the vicinity of its wider portion and in a zone facing the crosspiece 4 while the diameter of the

25 mandrel 72 is such that it slides inside the tuyère 59 in its narrower portion and obturates the aperture thereof facing that of the pouring hole 61. The tuyère 59 can thus be closed in two different manners, either by the sleeve 71 or by

30 the mandrel 72. The mechanism operating the sleeve and mandrel comprises a hydraulic piston 73 tied to the mandrel through a rod 74, the piston and said rod being associated with a yoke 75; said yoke 75 is connected to return rods 76. The piston 73 is operated by a hydraulic cylinder 77 carried by a pillar 78, said cylinder being further tied to the crosspiece 4 through rods 79. Said rods 79 are also tied to a yoke 80 associated with the cylinder 77. The yoke 75 is capable of sliding on rods 81 which, through corresponding bores, go through the yoke 80 and which are associated with a movable yoke 82, itself associated with the sleeve 71.

35 30 In line with the rods 81, on the yoke 75 and on the yoke 80, stopping locks are provided, acting by the entrances of latches in apertures provided in said rods 81, these wedging latches being operated by auxiliary hydraulic cylinders, 83 and 84 and not being shown for greater clearness in the drawings.

40 35 The rods 76 go through the frame of the cylinder 77 and are tied to a movable yoke 85 acted upon by the rods 86 of auxiliary hydraulic return 45 pistons contained in the frame of the cylinder 77.

40 45 The cylinder 77 comprises an inner piston 73, tied to the yoke 75 and which enters a second piston 88 moving inside the cylinder 77. This hollow piston 88 is supplied by a pipe 89 going 50 through the yoke of the cylinder 77 in a tight slid-

ing manner, and is tied to the yoke 85. By an angle piece 90, the pipe 89 is put in communication with a cylinder 91 sliding in a tight and telescopic manner on a supply pipe 92.

The operation cycle of the apparatus thus described is as follows:

As will be seen clearly on Figure 5, the empty mould is closed. The cylinders 54, 56 are empty. The sleeve 71 and the mandrel 72 are at their rear positions. By means of the ladle 67 which will be described later, the cylinder 54, 66 is filled with molten metal and the latter enters the cylinders 56. Previous to the filling (Figure 12), the mandrel 72 is pushed forward completely until it closes the tuyère 59. The molten metal fills only said cylinders 54, 56. The mandrel 72 has been pushed all the way by means of the pistons 73, 88, the locks 83 having released the yoke 75 from the rods 81 and the locks 84 having been put in action for wedging said rods 81 and keeping the yoke 82 in its rear position. The sleeve 71 has been left behind.

The locks 83 and 84 remaining in the position indicated above, the return pistons acting on the rods 86 are put in action said rods 86 in turn acting on movable yoke 85, rods 76, yoke 75, rod 74 and mandrel 72. The mandrel 72 moves back completely (Figure 13) and the cylinders 65 are placed under load. The pistons 55 move closer to the point of convergence of their axes and the metal is driven into the stamps of the mould through the injection tuyère 59 and the pouring hole 61. At that time, the locks 84 are released and the locks 83 are wedged. The piston 88, acting as a cylinder is put under load by the pipes 89, 90, 91, 92, and the assembly of the mandrel 72 and of the sleeve 71 passes between the pistons 55 which are closer together and drives the liquid metal which was in this space, into the tuyère 59. When the sleeve 71 comes in contact with the wall of the tuyère 59, said tuyère is closed. At that time (Figure 5), the locks 84 are wedged and the locks 83 are released. The pipe 92 is then stopped and only the piston 77 is supplied, causing an important thrust on the mandrel 72, the only one which is free. The mandrel 72 enters the tuyère 59 (Fig. 12) and causes the dieing of the metal contained in the stamps of the closed mould. Under such conditions, the metal undergoes an actual forging operation which gives it a great strength.

When the metal is sufficiently cooled inside the closed mould, the hydraulic supplies of the injection mechanism are cut off and the pistons 64 are simultaneously moved upwards towards the dead points remotest from the axis of their assembly. The piston 9 is put in action for separating cope 15 and drag 16. The moulded parts are retained on the drag 16. When the stops 51 of the rods 50 (Figure 4) come in contact with the frame 10, the frame 14 is driven with the frame 10, causing the opening of the injection cylinders. The mass of metal contained in the pouring hole 61 breaks at the level of the neck 62 and there remains a runner stick associated with the moulded parts, on one hand, and a gate pit surrounding the mandrel 72, on the other hand. The backward motion of the mandrel 72 and of the sleeve 71 will cause said gate pit to fall. Ejectors 93 bear on stop rods 94, go through the frame 10 and, pushing against the crosspiece 3, will cause the extraction of the moulded parts out of the drag 16 and the moulded part will be capable of being seized by a suitable conveyor. The complete opening of the moulds and injection mech-

anisms will allow a complete cleaning of said mechanisms and their covering, for example by spraying of a suitable liquid.

It is to be noticed that the frames 10 and 14 and the crosspiece 4 comprise refrigeration ducts 95 for keeping them at a sufficiently low temperature whatever be the rhythm adopted for the casting operations. It is also to be noticed that the frames 10 and 14 are made in the shape of cups 10 containing the mould sections 15 and 16. The cup of the frame 10 is edged by a packing 96 which offers a plastic ring 97 for bearing on the edges of the cup formed in the frame 14 so that the moving closer together of these two frames 15 creates a sealed enclosure around the closed mould sections. The moulding can thus take place in a controlled atmosphere. Similarly, the rear face 53 of the frame 14 comprises a sealing ring 98 which, applied on a ring 99 of the front 20 face of the crosspiece 4 will make it possible to insulate the injection mechanisms and to also operate said injection in a controlled atmosphere.

When the mould sections and injection mechanism are suitably cleaned, the piston 9 causes the joinings and closures and the operation cycle can be repeated.

To operate at a fast rhythm, the moulding machine must be supplied with molten metal by means of a ladle 67 which makes it possible to accurately determinate the amounts of metal for the injection and said ladle must be capable of being easily cleaned and replaced. To this effect the ladle 67 is mounted on one of the sides 35 of the crosspiece 4 and, in profile, it assumes the shape of a circular sector (Figures 9 to 11). The metal wall of said ladle constitutes a pivot 100 whose bearing surface 101 encloses the cylinder 66. Said pivot 100 is pivotally mounted in a bearing member 100a. The aperture 68 provided radially inside the cylinder 66, inside the pivot 100 opens through an aperture 102 in said ladle. This ladle is keyed by a cotter-pin 104 on the cylinder 66 which pivots inside a socket and is connected tightly at the end of the corresponding cylinder 56. The circular wall 103 of the ladle is formed with a gear 105 coming into engagement with a pinion 106 the shaft of which is driven by a raising motor 106a (Fig. 6). This 45 raising makes it possible to cause the metal introduced into the ladle at the level of the receiving spout 107 to flow through the aperture 102 and the aperture 68 into the cylinder 66. The walls of the ladle are provided with a refractory lining 108, said wall offering a cylindrical portion, a plane bottom 109 and sides in the shapes of circular sectors 110 (Figure 8).

The cylindrical wall of the ladle is formed with an aperture 111 wherein a draining piston 112 is introduced. The cylinder 111 is tangent to the plane bottom 109 and the aperture 102 as well as the aperture 68 are located on the geometrical extension of the cylinder 111. Above the ladle 67 there is attached, on the crosspiece 4, a support 65 113 associated with a plate 114 forming a driving out piston. To this effect the contour of this driving out piston 114 is such that it enters exactly the space between the walls of the ladle during the raising of the latter. This piston 114 bears against the pivot 100. The piston 112 is provided with a tail piece 115 which comprises a half thickness assembling element 116 and a perforation 117. This half thickness assembling and this perforation are for the purpose of coming into engagement with a stud 118 and a cor-

responding assembly 119 provided on a thrust rod 120 (Figure 9) having an invariable direction with respect to the machine.

Upon the raising of the ladle, once it has been filled with metal brought by the spout 107, through the space which separates this spout from the contour of the piston 114, said piston 114 enters the ladle and drives out the metal contained therein into the cylinder 66. This operating phase is shown in Figure 10. At this moment, the tail piece 115 of the piston 112 guided by the wall 112a is associated with the rod 120 and the metal included between the bottom 109 and the piston 114 is ready for being completely driven out of the ladle by the thrust of the rod 120. The piston 112, the head of which is slightly hollowed is driven until it comes in line with the transverse bore of the cylinder 66. At this time the corresponding piston 55 (Figure 8) will drive out the metal remaining inside the pivot.

The operating of the rod 120 is caused by a hydraulic piston moving inside a double action cylinder 121 provided on the side of the cross-piece 80.

Construction and operation of this type make it possible to obtain an easy filling of the ladle and a total ejection of the metal it contains. The return of the piston 112 and the lowering in rotation of the empty ladle is effected by operations in the reverse direction to those described and when it reaches its lower position, the ladle is again ready to be filled. Suitable stops are provided for preventing the piston 112 from escaping from the bore 111.

The ladle 67 which receives the extremely hot metal is subjected to a rapid wear. Further, to effect the cleaning of said ladle, which must be fairly frequent, the latter must be easily accessible from the outside.

As can be seen from Figures 6 and 8, the corresponding piston 55 is driven by a hydraulic, double action cylinder 130, carried by a yoke 131; this yoke 131 comprises two bores 132, 133 which allow its motion on cylindrical guides 134, 135, one end of which is attached on the crosspiece 4 and the other end of which is carried by a stand 136 arranged laterally with respect to the machine. The front portion of the yoke is associated with two control rods 137 which, themselves, are double acting hydraulic piston rods moving inside cylinders 138 associated with the stand 136. The stand 136 is provided with a perforation 139 which allows a free passage to the cylinder 130 with a view to save space and, for the same purpose, the rods 137 are attached to the bottom of blind bores 140, which come and cover the cylinder 138 when the yoke 131 is at its withdrawn position.

The rear portion 141 of the yoke 131 is associated with a socket 142 within which is housed a socket 143 perforated with cooling ducts 143a; said duct 143 contains a cylinder 144 cooled by means of said cooling ducts and which serves as a guide for the piston 55 of the injection cylinder 66 when it is compelled to move back at the same time as the yoke 131. The pivot 100 of the ladle 67 rotates on the notched extension of the socket 143 and is stopped axially by a shoulder of the socket 142 and a second shoulder added on the end of the socket 143. The socket 143 itself is keyed on the end of the cylinder 66.

To relieve the pivot 100 and bearing member 100a from the weight of the ladle loaded with liquid metal, this ladle is provided with a stand 145 resting through an anti-friction bearing 146

on the lower rod 135, said stand being thus capable of sliding along the rod 135 when the ladle is moved sidewise.

The operation of the thus built apparatus is as follows:

The rods 137 pull on the yoke 131 which can drive the ladle 67 laterally with respect to the machine and release it from the piston 114. The ladle is easily accessible. It may be cleaned and its refractory lining can be changed. The reverse operation of the pistons contained within the cylinders 138 makes it possible to bring back the ladle in position and, at that time, the end of the cylinder 66 enters a housing for the corresponding end of the cylinder 56 facing it.

It is obvious that, within the scope of the invention, modifications may be made to the types of embodiment just described.

In particular, the operations may be controlled by hand and separately or they may be controlled by automatic relays which will effect the operating cycle for pressure diecasting.

What I claim is:

1. A molten metal supplying device for the injection cylinders of a pressure diecasting machine, one of said cylinders acting as molten metal supplying cylinder for the other cylinders, comprising, in combination, a ladle having longitudinally the shape of a hollow circular cylindrical sector, pivotally mounted about an axis coinciding with the axis of said supplying cylinder and formed with an upper rectangular filling opening contained in a horizontal plane when the ladle is at rest, said ladle comprising a wall formed of a part of a cylinder, two longitudinal parallel plane walls in the shape of circular sectors, and a rectangular plane bottom wall, the part of which directed towards the pivotal axis forms a hollow cylindrical pivot centered on said axis and having an aperture opening from said axis into the interior of said ladle along its total transverse inner thickness, dismountable refractory linings of uniform thickness mounted on said walls inside said ladle, the free surface of the lining corresponding to the plane bottom wall registering the lower edge of said radial aperture, a hollow pivoting trunnion housed in said hollow pivot one end of which is tightly and pivotally mounted on one end of said supplying cylinder, said hollow trunnion having an inner diameter equal to that of said supplying cylinder and being formed with a radial aperture registering with the radial aperture of said pivot whereby a tight communication between the ladle and the supplying cylinder is obtained, a driving out piston vertically secured on the machine above said filling opening for extending to substantially the horizontal plane containing said filling opening when the ladle is at rest, the cross-section of said driving out piston being equal to the radial inner cross-section of said ladle, means for pivoting upwardly said ladle when filled with molten metal up to an angle at which said emptying piston registers the upper edge of said radial apertures, whereby said molten metal is ejected from said ladle into said supplying cylinder, said pivoting means acting after emptying of the ladle for returning said ladle to rest position by a downwards pivoting movement, means for draining the part of said ladle located below said fixed piston when said ladle has reached its raised position, means for ejecting the molten metal thus contained in the hollow trunnion and the supplying cylinder to the other injection cylinders, and means for

releasing of said ladle from said fixed piston with a view to clean the same and replace said refractory linings when necessary.

2. A supplying device according to claim 1, wherein the means for ejecting the molten metal contained in the hollow trunnion and the supplying cylinder comprises a cylindrical extension in line with the supplying cylinder, secured on the ladle oppositely to said cylinder and having an inner diameter equal to that of said cylinder, 10 cooling means for said extension, an injection piston housed in said extension during the emptying of said ladle, means for reciprocating said injection piston through the hollow trunnion and the supplying cylinder when the draining operation of the ladle is ended, whereby all the molten metal contained in the ladle is ejected into the other injection cylinders.

3. A supplying device according to claim 1, wherein the cylindrical wall and the corresponding refractory lining are formed with a rectangular channel opening in the ladle perpendicular to the plane bottom wall of said ladle and having dimensions equal to those of the radial apertures and wherein the means for draining the part of the ladle located below the fixed piston when said ladle has reached its raised position comprises a draining piston housed in said channel and the operative face of which is flush at rest with the free face of said lining and means for reciprocating said draining piston between the plane bottom wall of said ladle and the operative face of the fixed piston when the ladle is in its raised position, whereby said draining piston ejects into the hollow trunnion the molten metal contained in said ladle after raising underneath said fixed piston.

4. A supplying device according to claim 3, wherein the draining piston has a rod extending out of the ladle and formed with a perforation and wherein the reciprocating means comprises

5 a thrust rod having at rest such a position that it registers with said piston rod when the ladle reaches its position of maximum raising, a stud fixed on said thrust rod for engaging the perforation of said piston rod, means for maintaining said draining piston flush with the cylindrical inner wall of said ladle during the raising of the latter, and means for reciprocating said thrust rod tied to said draining piston towards the radial aperture of the ladle when the ladle is at its position of maximum raising;

15 5. A supplying device according to claim 1, wherein the means for releasing of the ladle from the fixed piston comprises a movable support carrying the assembly formed by the ladle, the hollow trunnion, the injection piston and the operating means for the latter, said support being displaceable parallelly to pivoting axis of said ladle, means for guiding said support during such displacements, and means for moving said movable support farther away from the supplying cylinder when a cleaning of said ladle or replacement of the refractory linings is required and closer to said cylinder when such operations 20 have been performed.

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