

Aug. 21, 1951

J. DE STERNBERG
MOLD SECTION LOCKING DEVICE FOR PRESSURE
DIE-CASTING MACHINES

2,564,884

Filed July 19, 1949

2 Sheets-Sheet 1

Fig. 1

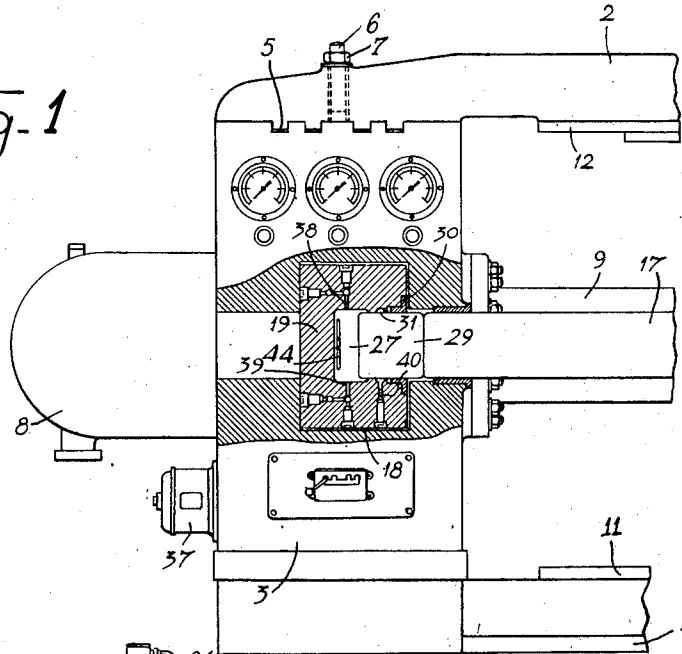


Fig. 4

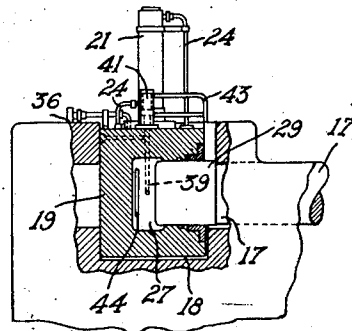
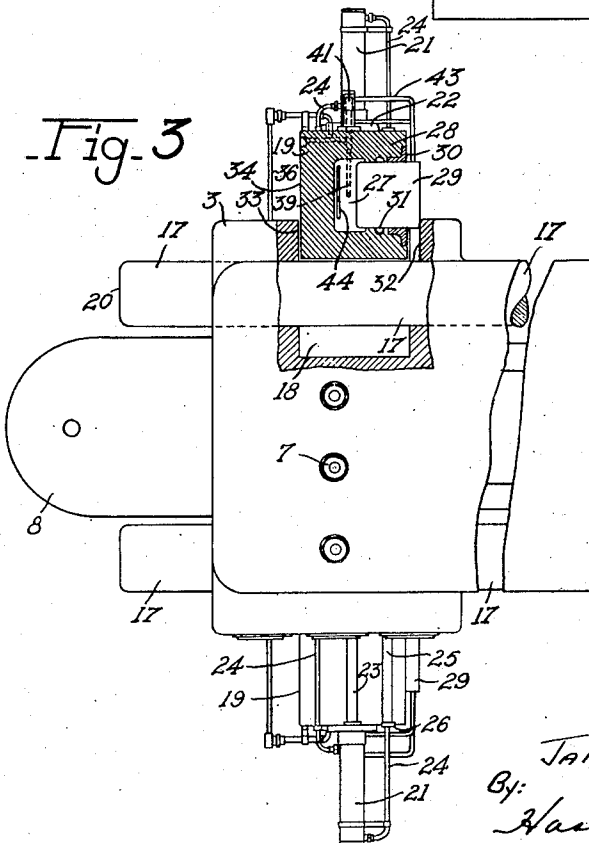


Fig. 3



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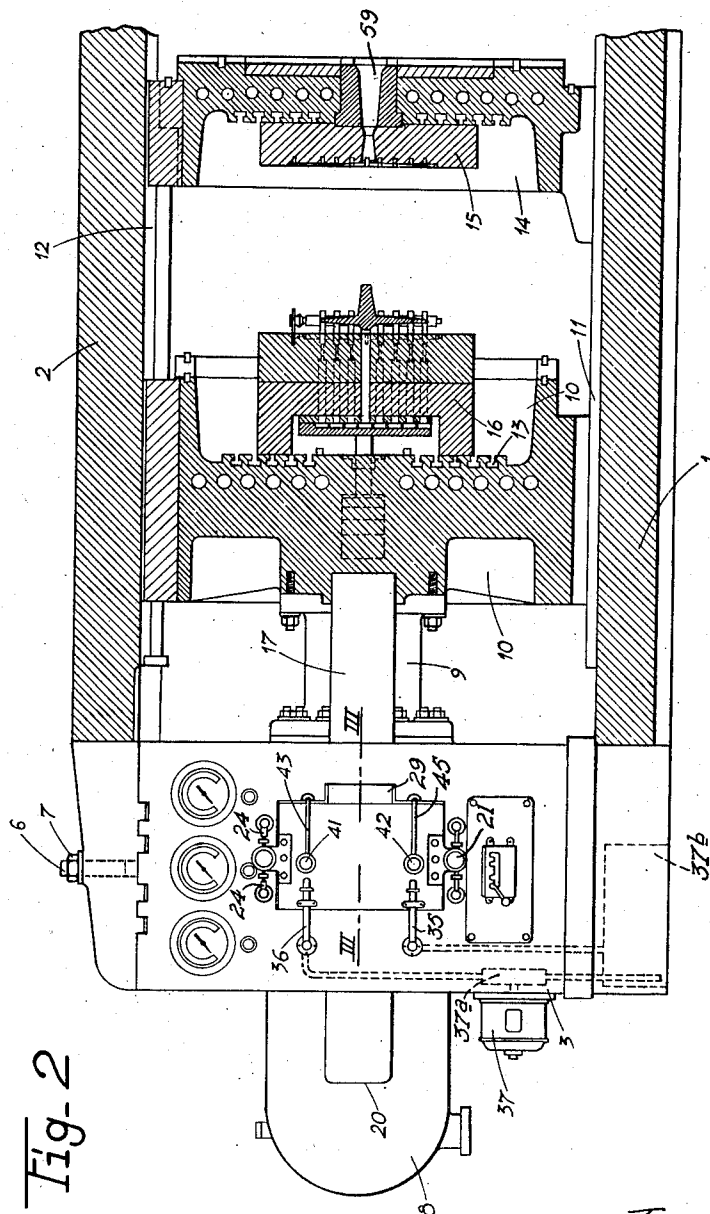


Fig. 2

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UNITED STATES PATENT OFFICE

2,564,884

MOLD SECTION LOCKING DEVICE FOR
PRESSURE DIE CASTING MACHINES

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Application July 19, 1949, Serial No. 105,626
In France June 23, 1949

5 Claims. (Cl. 22-156)

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

These requirements, consequently, result in the compulsory presence of elements for connecting the various sections of the mould which is necessarily of the open type and such elements must be capable of applying to the mould a very high closing pressure to avoid any leakage of the metal being moulded in the plane of the joint during casting.

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 main object of the present invention is to provide a pressure diecasting machine wherein the movable sections of the mould are locked against the fixed sections by means of elements which are placed in position when cold and which are heated during the locking operation. The expansion of the clamps during heating brings into play considerable pressure which make it possible to ensure the tightness of the various joints in spite of the enormous pressures which are developed inside the metal contained in the cavities of the mould.

The expansible clamps may consist, for example, of heated steel pillars, but the thermal inertia of such components must be kept down to a minimum to allow the rapid opening and closing of the moulds.

Another object of the invention is to provide in a pressure diecasting machine a mould section locking device of the character described where-
in the expansible material selected is a fluid which is taken from a refrigerated chamber to be introduced, cold, inside a cylinder and which is hermetically enclosed inside the cylinder to be

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heated therein. The hot fluid can be immediately evacuated to the refrigerated chamber and it is not necessary to wait for a cooling inside the cylinder to proceed with the unlocking of the mould. The fluid used is preferably mercury.

Another object of the invention is to provide in a pressure diecasting machine a mould section locking device of the character described where-
in the chamber inside which the mercury expands consists of a moving cylinder to which a piston element is associated; this assembly is capable of sliding transversely with respect to ram plungers associated with the movable elements of the mould and the lock thus formed is capable of being inserted behind each one of said plungers while bearing on the fixed portions of the machine. Thus, whatever be the run necessary for opening the mould, the amounts of mercury indispensable for the locking are reduced to a minimum, since a stroke of a few millimeters is sufficient for the above mentioned piston element to apply a high pressure behind the ram plungers which, for their own part may be as long as desired.

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

The machine thus built makes it possible to handle quantities of steel amounting to several hundred pounds at 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 mould section locking device may be associated in the same pressure diecasting machine with an injection mechanism of the kind described in my co-pending application Serial No. 105,628, filed July 19, 1949, and/or with a device supplying molten metal such as the one described in my co-pending application Serial No. 105,627, filed July 19, 1949.

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

In the drawings:

Fig. 1 is an elevational view of a diecasting machine equipped with a locking device according to the invention with part of said machine in section at the level of the lock.

Fig. 2 is an elevational view of a diecasting machine equipped with a locking device according to the invention, said machine being partly in section in the part thereof supporting the mould, said mould being open.

Fig. 3 is a partial plan view of the diecasting machine illustrated in Fig. 1 with a partial cross-section through the line III—III of Fig. 2 which shows one of the two locks in inoperative position.

Fig. 4 is a partial view corresponding to Fig. 3, the lock being in operative position.

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 such as the cross piece 3 by interlocking assemblies 5, tightened by threaded rods 6 which receive tightening nuts 7. The cross piece 3 supports a hydraulic cylinder 8 associated with a control piston 9 secured to a frame 10, Fig. 2, moving on sliding surfaces 11 and 12 formed on slides 1 and 2. Frame 10 carries protruding parts 13 for the support of the drag 16. This frame is to be brought in contact with 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 joining 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 cross piece 3 housings 18 are provided, for receiving sliding locks 19, Figs. 3 and 4, 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 cross piece 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 3) with interposition of seals such as 26. Under such conditions, the piston is fixed and the cylinder 21 moves with respect to the piston, moving 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 seal is ensured by a packing 30 acting as a gland, completed by a retaining groove 31 (Figs. 1 and 3).

The axis of each piston 29 is parallel with the axis of the ram plungers 17 and the housing

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18 of the lock comprises a cut-out portion 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 cross piece 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 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 respectively arranged on the locks 19 near the top and the bottom thereof. 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 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 energy.

Movements of the cope 15 and the drag 16 as well as the injection of the metal through the tuyère 59 when the mould is closed are performed by suitable conventional apparatus.

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

At the starting, by means of a distributing device not shown, the double acting piston 9 is charged for ensuring the uniting of the cope 15 and the drag 16 along their joining plane by the displacement of the drag 16 toward the cope 15. At the same time, the ram plungers 17 are moved so that they free the housing 18, their ends 20 being abreast of the closest wall of said housing to the mould. Simultaneously, double acting pistons of cylinders 21 are charged so that said cylinders move with respect to said pistons and drive the locks 19 into the recesses 18 while pistons of cylinders 41 and 42 are respectively discharged and charged for opening and closing the corresponding stop valves interposed in the inlet and return ducts 36 and 35 for mercury. The chambers 27 are filled with mercury supplied by pump 37a for applying the piston elements 29 against the ends 20 of the ram plungers 17. Then pistons of cylinders 41 are charged, whereby the spaces 27 filled with mercury are hermetically sealed. At that time, the resistors 44 are put in action and the mercury contained in the lock mechanisms 19 ensures by its expansion the closing of the mould with a very high energy.

When the die-casting operation is ended, resistors 44 are cut off, pistons of the cylinders 42 and 41 are respectively discharged and charged so that the mercury contained in the chambers 27 returns to the refrigerated tank 37b, whereby the pistons 29 have no further action on the ram plungers 17. 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 piston 9 is discharged causing the separation of the drag 16 from the cope 15 and consequently the opening of the mold. The device is thus returned to its initial condition, the mercury being refrigerated inside its tank 37b and being 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 joining 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 joining 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 mechanisms 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 casting. These large dimensions of the moulds thus make it possible to mould bulky parts, such as for example parts weighing about 900 to 1350 pounds.

What I claim is:

1. The combination with a pressure die-casting machine having a frame and a mould

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formed with a cope slidably mounted on said frame and a drag movable to get closer or farther away from said cope, of at least one ram plunger rigidly connected with said drag, a cross-beam integral with the frame, and through which is reciprocally mounted said ram plunger, said cross-beam being formed in the path of each of said ram plungers with a recess the closest face of which to the mould is abreast of the free end of the corresponding ram plunger when said mould is closed, a lock mechanism movable into and out of each of said recesses, a cylinder in each of said lock mechanisms, a piston element in each of said cylinders, movable in the direction of travel of the corresponding ram plunger and adapted to bear on the same when said mould is closed and the corresponding lock mechanism is in the recess, a source of fluid under pressure, inlet and outlet connections from said fluid source to each of said cylinders, means for closing said inlet and outlet connections when each of said lock mechanisms is in the corresponding recess, means in each of said cylinders for heating the fluid in said cylinder when said mould is closed, whereby the expansion of the fluid under heat ensures the closing of the mould with a very high energy, and means for positioning and extracting each one of said lock mechanisms in the corresponding recess.

2. The combination with a pressure diecasting machine having a frame and a mould formed with a cope slidably mounted on said frame and a drag movable to get closer or farther away from said cope, of at least one ram plunger rigidly connected with said drag, a cross-beam integral with the frame and through which is reciprocally mounted said ram plunger, said cross-beam being formed in the path of each of said ram plungers with a recess the closest face of which to the mould is abreast of the free end of the corresponding ram plunger when said mould is closed, a lock mechanism movable into and out of each of said recesses, a cylinder in each of said lock mechanisms, a piston element in each of said cylinders, movable in the direction of travel of the corresponding ram plunger and adapted to bear on the same when said mould is closed and the corresponding lock mechanism is in the recess, a source of mercury under pressure, inlet and outlet connections from said mercury source to each of said cylinders, means for closing said inlet and outlet connections when each of said lock mechanisms is in the corresponding recess, means in each of said cylinders for heating the mercury in said cylinder when said mould is closed, whereby the expansion of the mercury under heat ensures the closing of the mould with a very high energy, and means for positioning and extracting each one of said lock mechanisms in the corresponding recess.

3. An arrangement according to claim 2, wherein the source of mercury under pressure and the inlet and outlet connections comprise a refrigerating tank containing mercury, a pump for simultaneously drawing mercury from said refrigerated tank and ensuring the filling of each one of the cylinders, at least one telescopic pipe for connecting said mercury pump with each one of the inlet connections, a closure valve on each one of said inlet connections, a gravity discharge pipe connecting each one of the outlet connections with said refrigerated tank, a valve for closing each of said discharge pipes, means for successively opening the closure valve of each inlet connection when the lock mechanism is in-

serted behind the corresponding ram-plunger, maintaining closed the two closure valve groups when each of the corresponding cylinders is filled with mercury and opening the closure valve of each discharge pipe when the moulding is finished.

4. An arrangement according to claim 3, wherein the means for positioning and extracting each one of the locks and the means for putting the closure valves in operation consist of double action hydraulic cylinders.

5. An arrangement according to claim 2, wherein the means for heating the mercury comprises, for each cylinder, an incased electric heat-

ing element housed inside said mercury cylinder, said element being maintained heated during the closure of the mould.

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The following references are of record in the file of this patent:

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