

April 27, 1954

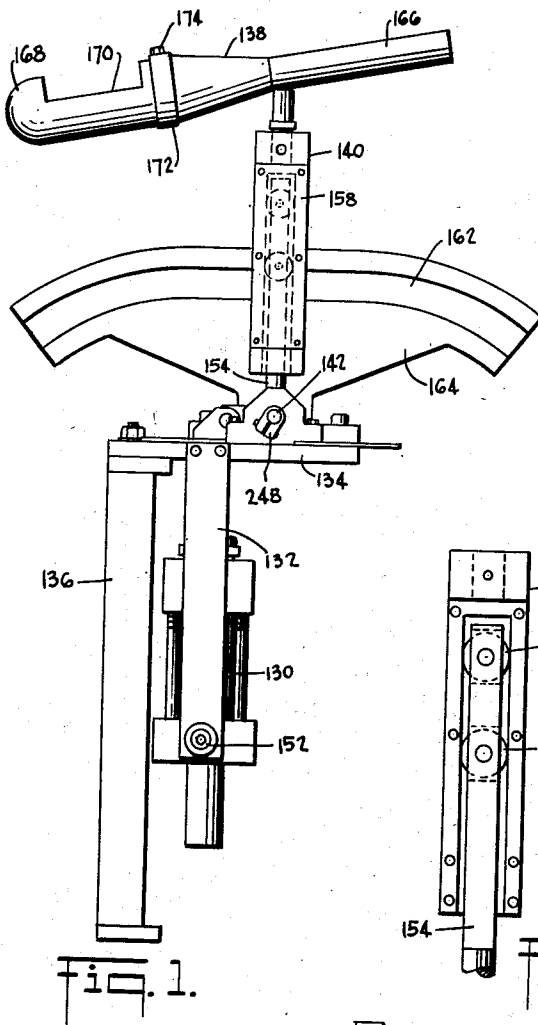
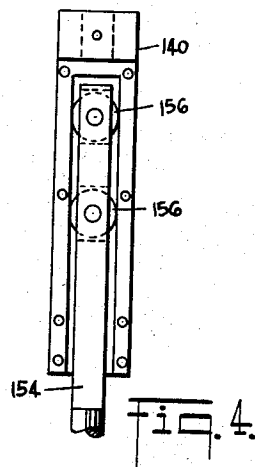
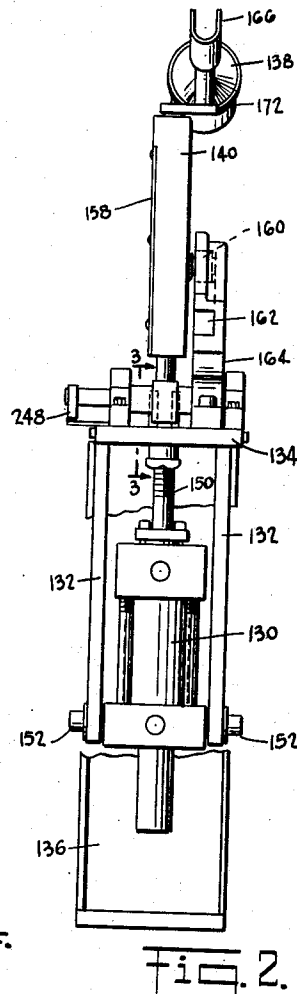
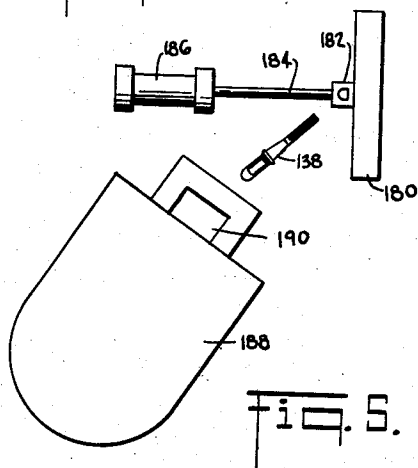
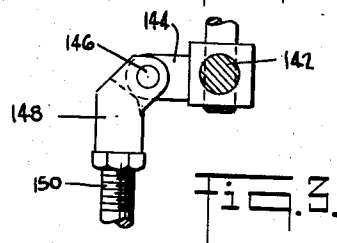
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2,676,370

DIE CASTING MACHINE WITH AUTOMATIC LADLE

Filed May 19, 1950

4 Sheets-Sheet 1



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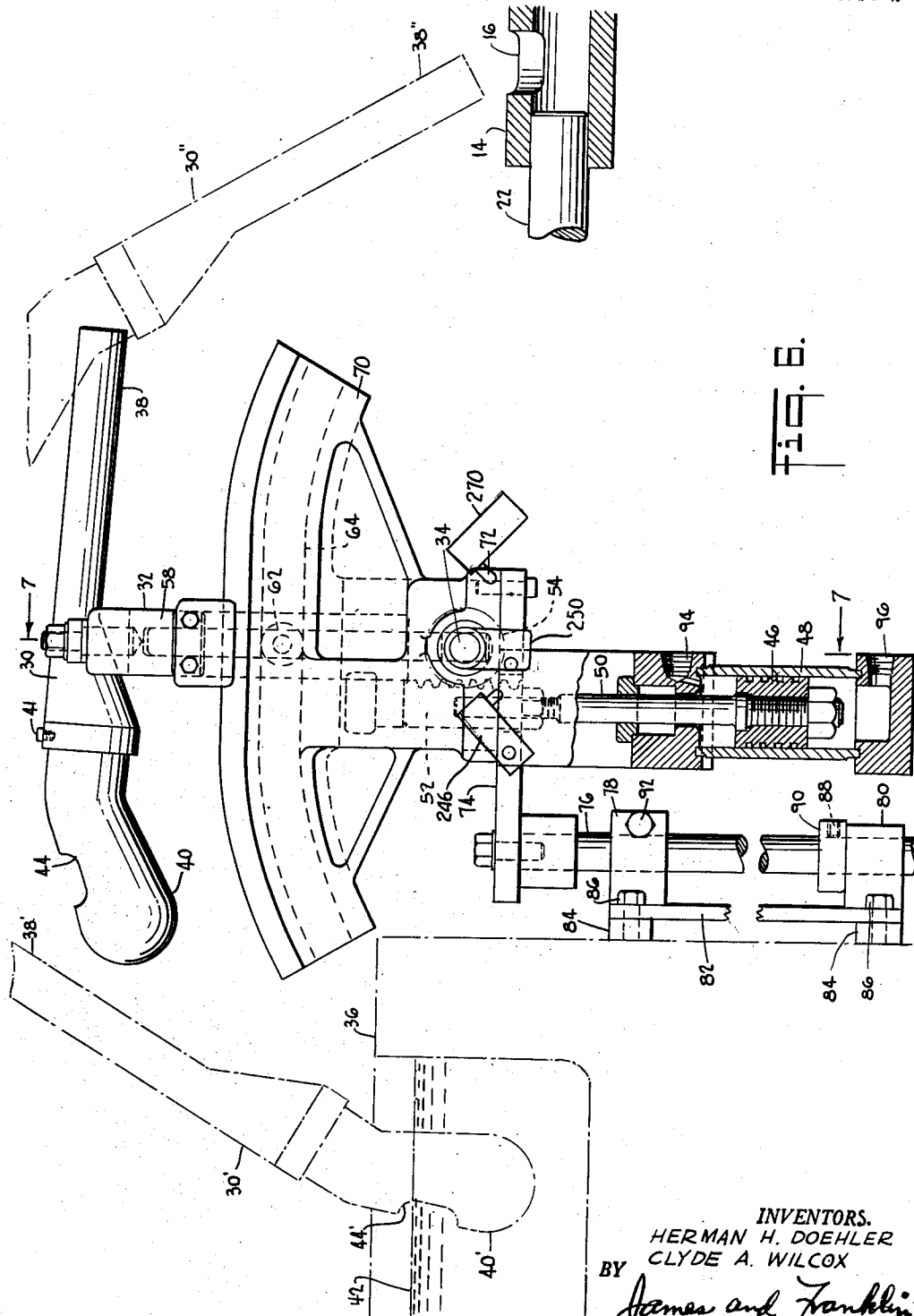
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4 Sheets-Sheet 2



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DIE CASTING MACHINE WITH AUTOMATIC LADLE

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4 Sheets-Sheet 3

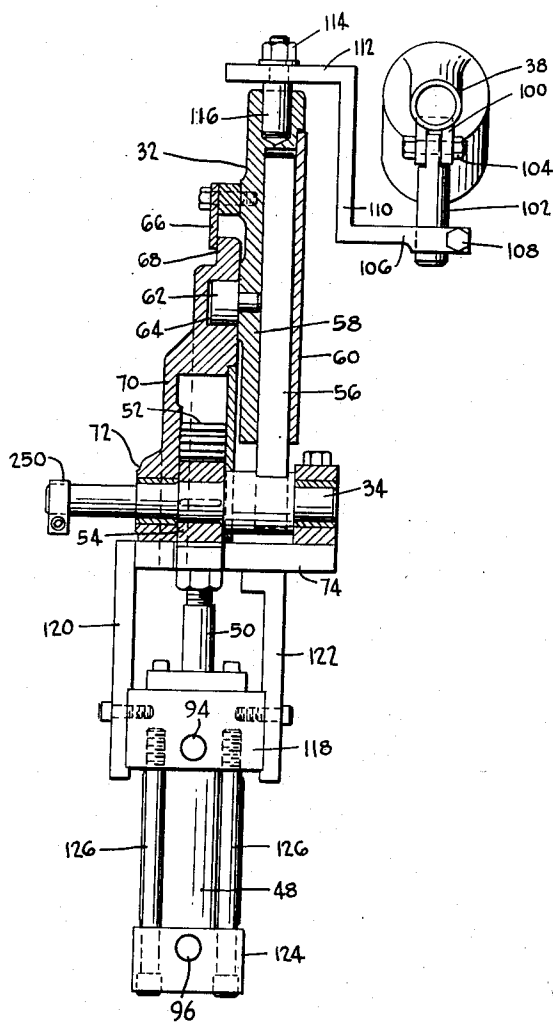


Fig. 7.

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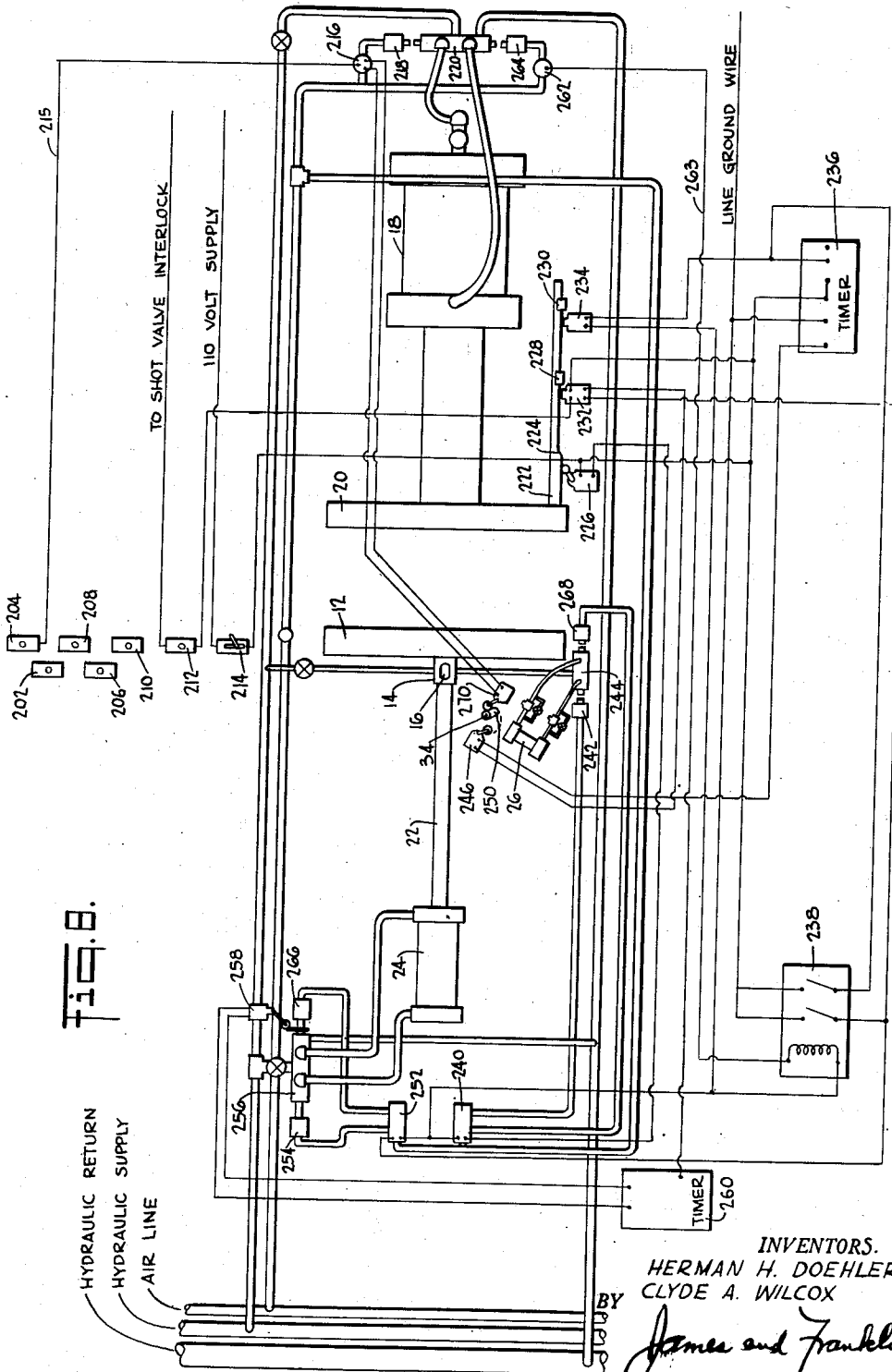
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DIE CASTING MACHINE WITH AUTOMATIC LADLE

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4 Sheets-Sheet 4



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2,676,370

DIE CASTING MACHINE WITH AUTOMATIC LADLE

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Application May 19, 1950, Serial No. 163,054

6 Claims. (Cl. 22—79)

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This invention relates to die casting machines, particularly of the cold chamber type, and more especially to automatic ladle mechanism therefor.

The primary object of our invention is to generally improve cold chamber die casting. This is commonly employed for high temperature alloys such as aluminum, magnesium and brass, and is characterized by the fact that a charge of molten metal is manually ladled from a melting pot into the cold chamber or shot sleeve of the machine. It has heretofore been proposed to mechanize the ladling operation, but such prior proposals were not successful, and so far as we are aware, were not adopted and used successfully in a commercial way.

One specific object of the present invention is to facilitate the transport of metal over a substantial distance so that the melting pot may be spaced by the usual convenient distance from the machine. Still another object is to provide ladle mechanism which permits the bowl of the ladle to be immersed in the molten metal at a substantial angle approaching the perpendicular, and which permits the discharge spout of the ladle to discharge the molten metal into the pour hole of the shot sleeve at a convenient angle. With these objects in view, the ladle is carried at the upper end of a support arm which is pivotally mounted at its lower end, the said arm being of substantial length and therefore affording adequate space between the melting pot and the shot sleeve. The arm is preferably arranged to be swung over an angle substantially greater than 90°, and preferably greater than 135°, thereby attaining not only the desired transport distance, but also the desired dipping and pouring angles.

A further object of the present invention is to minimize the necessary lift of the charge of molten metal, and also to minimize the effect of centrifugal force, during movement of the ladle from dipping to pouring position. For this purpose the apparatus is preferably provided with means for substantially shortening the arm during the middle portion of its travel and for lengthening the arm at the end portions of its travel. In preferred form the arm is telescopically arranged, and the upper or ladle-carrying portion thereof is provided with a cam follower moving in a stationary cam track. This cam track is substantially horizontal in its middle portion, and is downwardly curved at its ends. Such an arrangement retains the advantage of large transport distance, combined with desired

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dipping and pouring angles, while minimizing the centrifugal force on and the elevation of the molten metal in the ladle.

Still another object of the present invention is to provide suitable inter-related control mechanism for putting all parts of the machine through their operating cycle automatically. The apparatus comprises a main clamp cylinder for opening and closing the die, a shot cylinder for moving the shot plunger in the shot sleeve, and a third cylinder for moving the ladle-carrying arm. The cylinders are preferably hydraulic and are controlled by air-operated hydraulic valves, which in turn are conveniently controlled by solenoid-operated air valves, which in turn are controlled by appropriate electrical circuits. No master cam shaft or timing shaft is needed, and instead two timers may be employed; one a delay timer to guard against premature operation of the shot plunger, and the other a main timer for timing the cooling interval after the shot is made and before the machine is opened for ejection. A number of machine operations are interlocked for safety, as is later described.

Still further objects of the present invention center about change or adjustment of the quantity of metal picked up by the ladle during each dipping operation. For this purpose the ladle is preferably provided with a bowl which is detachably secured to the ladle, and which is readily removable and interchangeable with other bowls of different size. Thus the charge of metal may be made commensurate with the size of the casting, without necessitating change of the entire ladle. In accordance with still another feature and object of the invention some adjustment of the charge of metal may be made without changing the bowl, and for this purpose the bowl is preferably made circular or cylindrical at its open upper end where it is connected to the ladle, and is made rotatably adjustable. Inasmuch as the outer side wall of the cup is cut away to provide the opening through which metal flows into the cup when the cup is dipped, the effective quantity of metal retained in the cup is varied somewhat when the bowl is turned to one side or the other from its normal position.

To accomplish the foregoing objects, and such other more specific objects as will hereinafter appear, our invention resides in the automatic ladle mechanism, and die casting apparatus, and their relation one to another, as are hereinafter more particularly described in the following

specification. The specification is accompanied by drawings in which:

Fig. 1 is an elevation showing one form of ladle mechanism embodying features of our invention;

Fig. 2 is an end elevation of the same;

Fig. 3 is a detail drawn to enlarged scale, and taken in the plane of the line 3—3 of Fig. 2;

Fig. 4 is a fragmentary view drawn to an enlarged scale and showing the telescopic arm with its cover plate removed;

Fig. 5 is a fragmentary plan view showing one typical relation between the furnace, the die casting machine, and the ladle;

Fig. 6 is a front elevation of a modified ladle mechanism;

Fig. 7 is a transverse section taken approximately in the vertical plane passing through the ladle arm shaft in Fig. 6, substantially in the plane of the line 7—7 of Fig. 6; and

Fig. 8 is a schematic diagram showing the hydraulic, air, and electrical circuits of a typical apparatus embodying the invention.

Referring first to Fig. 8 of the drawing, the cold chamber die casting machine may be conventional in comprising a front plate 12 on which the cover die (not shown) is mounted, and which carries the cold chamber or shot sleeve 14, the latter having a pour hole 16 through which a charge of molten metal is ladled. The machine further comprises a main clamp cylinder 18 for moving a movable platen 20 which carries the ejector die, the clamp cylinder serving to open or close the die. Conventional toggle mechanism has been omitted in order to simplify the drawing. When the die is closed the charge of metal in the shot sleeve is ejected into the die cavity by means of a shot plunger 22. This is operated by a shot cylinder 24. The cylinders are usually hydraulically operated.

In accordance with the present invention, a ladle (not shown in Fig. 8) is automatically moved between a dipping position and a pouring position, and suitable mechanism is provided for this purpose. While not essential, this mechanism may conveniently be moved hydraulically, and accordingly a third hydraulic cylinder 26 is added for moving the ladle. In practice this cylinder is disposed vertically, as later described, but has been turned as here shown in order to separate the connections in the schematic diagram.

Referring now to Fig. 6 of the drawing, the general idea of the ladling mechanism will be understood from inspection of the drawing. A ladle 30 is carried at the end of an arm 32 which is pivoted at 34 at a point between the melting pot 36 and the pouring hole 16 of the shot sleeve 14. The ladle 30 here shown is enclosed or tubular, and has a pouring spout 38 at one end, and a bowl 40 at the other end. It will be evident from inspection of the drawing that when the arm 32 is in its lefthand position the bowl is immersed in the molten metal 42, as shown at 40', the said metal filling the enclosed lower part of the bowl through the opening 44'. When the ladle is swung from the dipping position 30' to the pouring position 30'' the pour spout assumes the position 38'' directly over the pour hole 16, and the metal flows from the bowl through the ladle into the shot sleeve 14. The arrangement is such that the metal does not begin to pour until fairly near the end of the ladle movement, and at that time the direction of flow of the metal is such that it pours through the pour hole 16.

By mounting the ladle at the end of a relatively long arm the travel of the ladle may be made substantial, and accordingly the furnace or melting pot may be spaced at a desired convenient distance from the shot sleeve. At the same time because the angle through which the arm is swung is substantial, say 135° or more, the bowl 40 may be immersed in the molten metal at a steep angle (substantially perpendicular in the present case). At the completion of the pouring stroke the ladle and discharge spout are at a fairly steep angle which insures rapid and complete discharge of the molten metal. The arrangement is to be contrasted with an arrangement in which it is attempted to bridge the distance between the melting pot and the pour hole by means of a long ladle which is rocked about a pivot located at the middle of the ladle itself, for in such case the ladle could be given only a limited rocking or seesaw movement, and the dipping and pouring angles would be relatively flat or limited.

Considering the particular mechanism of Figs. 6 and 7 in greater detail, the arm 32 is rocked by means of a piston 46 movable in a hydraulic cylinder 48. The piston rod 50 is connected at its upper end to a rack 52 which meshes with a pinion 54 on the shaft 34 of the arm 32. It will be evident that upward or downward movement of the piston serves to swing the arm between its dipping and pouring positions. This, however, would involve substantial elevation of the ladle, and would exert considerable centrifugal force on the molten metal. These difficulties are overcome by the use of a telescopic arm and means to vary its length.

The telescopic arrangement of the ladle arm 32 is best shown in Fig. 7, in which it will be seen that an inner bar 56 is secured at its lower end to the shaft 34. In the present case the shaft has a mating hole milled or broached diametrically therethrough to receive the lower end of the bar 56. The upper part 32 of the arm is hollow, and slidably receives the bar 56. For convenience in manufacture, it may consist of a main casting 58 closed by a cover plate 60. The part 58 carries a cam follower roller 62 received in a stationary cam groove 64. It further carries a guide shoe 66 which is slidably related to a guide track 68 formed integrally with the casting 70 in which the cam groove 64 is formed.

Reverting now to Fig. 6, the cam groove 64 is generally horizontal, but is downwardly curved at the ends. The result of this arrangement is that the telescopic arm is extended to desired full length at the ends of the dipping and pouring stroke, and is very substantially shortened during its movement from one end position to the other.

This has a number of benefits, one of which is that there is no need to hoist or elevate the heavy ladle and its charge of metal a substantial distance during the desired transportation from the furnace to the shot sleeve. Another is the reduction in centrifugal force applied to the molten metal, so that there is no tendency for the metal to splash out of the open side of the bowl, or to rush prematurely along the ladle to the discharge spout, despite fast motion to retain heat.

The entire bearing assembly 12 (Fig. 6) is mounted on a plate 74 which is rigidly carried at the upper end of a rod 76, which in turn is clamped in supports 78 and 80, mounted in spaced relation on a plate 82, which in turn is se-

cured to the outside shell of the furnace or other melting pot. This may be done by means of blocks 84 which are preliminarily welded to the furnace, and which receive bolts 86 which mount the plate 82 on the side of the furnace.

The particular mounting arrangement shown, with its rod 76, is preferred because of its flexibility of adjustment. For example, the height of the mechanism may be readily varied by moving the rod 76 up or down before tightening the set screw 88 of a rotatable collar 90. A trial height adjustment is selected for best relation to the level of the molten metal in the pot and to the height of the shot sleeve. The entire mechanism then may be bodily moved about the axis of the rod 76 for best aim of the molten metal flowing out of the ladle, whereupon the rod may be locked in position by clamping the clamping bolt 92, it being understood that the bearing 78 is a split clamp bearing. The hydraulic connections to the upper and lower ends of the hydraulic cylinder 48 at 94 and 96 are preferably made through flexible hoses which do not impede the desired adjustments for the aim of the ladling mechanism.

Referring now to Fig. 7, the ladle is itself adjustably mounted on the arm which moves the same. An inverted U-shaped fitting 160 forming a part of the ladle is clamped to the flattened upper end of a rod 162 by means of a bolt 164. This makes it possible to change the angle of the ladle relative to the arm. The rod 162 is fixedly but adjustably secured in a split arm 166 by means of a clamp bolt 168, and this makes it possible to raise or lower the ladle slightly, and to oscillate the same about the axis of rod 162. The arm 166 is stepped as indicated at 110 and 112, the top portion 112 being secured in position by means of a nut 114 threadedly received on the upper end of a stud 116 fixedly secured in and effectively forming a part of the main casting 58 previously referred to.

Fig. 7 also shows how the upper head 118 of cylinder 48 is secured to the main plate 74 by means of a pair of side plates 120 and 122. The lower head 124 of the cylinder is drawn toward the upper head by means of four tie bolts 126 disposed outside the cylinder 48.

In Fig. 6 it will be noted that the intermediate portion 30 of the ladle is convergent or tapering toward the spout 38. The convergence or taper is preferably at the lower side of the ladle, and this, taken together with the bend in the bowl 40, prevents premature disclosure of metal from the ladle. Thus when the ladle is in horizontal position the bowl still slopes downwardly, and even after the ladle moves somewhat further the slope at the bottom of the ladle part 30 tends to itself delay the discharge of metal.

It is not essential to employ a gear and rack arrangement when using a cylinder and piston mechanism for moving the ladle, and a modification of the invention is shown in Figs. 1 through 4 of the drawing, in which a simple linkage is employed for the purpose.

Referring to Figs. 1 and 2, the apparatus comprises an hydraulic cylinder 130 carried by means of support bars 132 on a bearing plate 134 secured at the upper end of a main support plate 136, which in turn may be fastened to any convenient support such as the furnace, or the die casting machine, or members extending therebetween. The ladle 138 is carried at the upper end of a telescopic support arm 140, the lower

end of which is carried on and pivotally mounted by means of a shaft 142.

Referring now to Fig. 3 it will be seen that shaft 142 has an arm 144 projecting sidewardly therefrom, and this is connected by means of a pivot 146 to a bifurcated fitting 148 adjustably secured to the threaded upper end of a piston rod 150. The entire cylinder 130 is pivotally mounted at 152 (Fig. 1), thus taking care of angularity during movement of the piston rod.

The telescopic arrangement of the arm 140 is best shown in Fig. 4 in which it will be seen that an inner bar 154 is slidably housed within the outer arm 140. The bar 154 may, if desired, be provided with anti-friction rollers 156. The bar and its rollers are enclosed within the hollow arm 140 by means of a suitable cover plate 158, which has been removed in Fig. 4, but is shown in Figs. 1 and 2.

The mechanism for automatically varying the effective length of the arm 140 is substantially the same as that previously described, there being a cam roller 160 (Fig. 2) carried by the outer housing or arm 140, and received in a cam groove 162 formed in a casting 164 mounted on the bearing plate 134 previously referred to.

The ladle 138 is somewhat different from that previously described. It comprises a frusto-conical portion 138 communicating with a deep trough-shaped portion 166 at one end, and with a bowl 168 at the other end. The bowl is generally cylindrical, and is open at its upper or righthand end, and closed with a substantially hemispherical shape at its lower or lefthand end. One face of the bowl is cut away for a substantial distance, as is indicated at 170. The upper or cylindrical end is received in the cylindrical collar portion 172 of the ladle. It is detachably mounted in place, being secured by one or more set screws 174. It will be understood that with this arrangement the bowl may be made of a material different from the ladle itself, preferably one which is highly refractory or resistant to the molten metal in which it is immersed. Moreover, the bowl is readily removed and replaced by another of greater or lesser capacity, as determined, for example, by simply changing the size of the cut-away portion 170. A bowl may be selected which provides a charge of molten metal commensurate with the size of the casting being made, allowing, of course, an excess or "cushion" of metal which forms a slug or residue at the end of the shot sleeve, and which is removed with the casting and gate when the casting is ejected from the die.

One typical relation between the die casting machine, the furnace, and the ladle is schematically shown in Fig. 5, in which the stationary head of the press is shown at 180 with a shot sleeve at 182 and a shot plunger 184 actuated by a shot cylinder 186. The furnace is shown at 188 with an exposed part of the melting pot at 190. The ladle 138 is shown in horizontal position approximately midway between the dipping and pouring positions.

While no mention was made of it earlier, it will be understood that the ladle in Figs. 6 and 7 is similarly arranged, in that the bowl 40 is detachably secured to the ladle 30, as by means of one or more set screws 41. Here again there is the convenience of making the bowl of any desired material, which may be different from that of the ladle, and of readily changing from one size bowl to another in order to change the quantity of metal transported. A substantial

number of bowls 40 may be cast with a minimum opening, as at 44, and the opening may be enlarged on successive bowls to make up a series having progressively different capacities.

The operation of the apparatus may be briefly described with reference to Fig. 8 of the drawing. At a convenient point on the apparatus the operator is provided with a control panel having a number of control switches or push-buttons. These are shown at the top of Fig. 8, and function as follows. The buttons 202 and 204 must be simultaneously depressed by the left and right hands of the operator to start the apparatus. This is a safety precaution. Button 206 opens the die closing circuit, and thus may be used for promptly opening the die in the event of emergency. The button 208 is a manual shot safety button. Button 210 is a manual chopper button. These are used only when the apparatus is fitted with a so-called "sliding adapter plate" such as that set forth in copending application of John J. McGarigal, Serial No. 652,105, filed March 5, 1946, since issued as Patent No. 2,612,666, dated October 7, 1952. The button 212 is a manual shot button which provides for manual operation of the shot cylinder when desired. In some cases the slug or residue of metal in the shot cylinder may adhere to the cylinder instead of being removed therefrom with the casting and gate. In such case the operator may press the manual shot button 212 while the die is open, thus causing the shot plunger to eject the residue. The switch 214 is an overall control switch which controls the supply of electrical power and thus makes it possible to de-energize the circuits which provide the normal automatic operation.

In the present case the machine is automatic for one cycle at a time. In order to start the machine the operator pushes buttons 202 and 204 simultaneously with his left and right hands. Button 202 opens certain safeties (not shown) on the main tie bars of the machine so that the die can be closed. Button 204 is electrically connected by a line schematically represented at 215 to a solenoid operated air valve 216, which actuates a single action air cylinder 218, which in turn operates hydraulic four-way valve 220. This controls the hydraulic cylinder 18 which opens and closes the die, and which now closes the die. The movable platen 20 has connected thereto a limit switch rod 222. This is stepped at 224 for cooperation with a limit switch 226, and is provided with cam projections 228 and 230 for cooperation with limit switches 232 and 234. The switch 226 is normally open but closes as soon as the die starts to close, and this starts the ladle movement, as described later. The limit switch 232 has both left and right contacts. The left contacts are normally closed and prevent a manual shot from being made with the aid of the manual shot button 212 when the die is closed. The right contacts start a shot delay timer 236, as is described later. The limit switch 234 functions to control the holding circuit of a relay 238, as will be described later.

As the die starts to close, the normally open limit switch 226 is closed by the limit switch rod 222 and electrically energizes a solenoid operated four-way air valve 240 to supply air to air cylinder 242, which in turn shifts hydraulic four-way valve 244. This controls the hydraulic cylinder 26 which then moves the ladle toward its pouring position.

As the die approaches its closed position, limit

switch 234 closes, thereby completing an electrical holding circuit to the coil of a relay 238.

When the die has closed and the machine locks, the right contacts of limit switch 232 close the starting circuit of the electrical shot delay timer 236. This starting circuit also includes a limit switch 246 which is closed by a cam on the ladle shaft when the ladle reaches the end of the pouring stroke. The cam for this purpose is shown at 248 in Figs. 1 and 2, and at 250 in Fig. 7. This starts the shot delay timer 236. After a brief interval, say one second delay, a load circuit of timer 236 closes and energizes the magnet coil of relay 238. This closes an electrical circuit which operates a solenoid operated four-way air valve 252. That operates an air cylinder 254 and a four-way hydraulic valve 256 for the hydraulic shot cylinder 24. The latter is operated to drive the plunger 22 and so to produce the casting shot.

As the hydraulic valve 256 moves to produce the shot it closes a limit switch 258 which closes a circuit to and which starts a machine opening timer 260. This is the main timer, and is set for much longer interval than timer 236. After the desired cooling interval, for the casting to solidify, the timer 260 energizes a solenoid operated air valve 262, by means of a connection schematically shown at 263. This operates the air cylinder 264, which in turn shifts the four-way hydraulic valve 220 of the clamp cylinder 18. The hydraulic cylinder 18 then opens the die for ejection of the casting, the gate and the plug or residue.

As the machine starts to open, the limit switch 232 is returned to its normal position which, by reason of the left contacts, will allow a manual shot to be made when the machine is open. This is sometimes necessary when the gate plug has stuck in the sleeve instead of being ejected with the casting, as was previously mentioned. The right contacts are in the starting circuit of timer 236, and are normally open, but close when the die is closed, and so start the delay timer 236. This insures that the automatic shot will not start until a desired time, say one second, after the die is closed.

Limit switch 234 opens when the die is opening and so drops out relay 238 which in turn de-energizes the solenoid operated four-way air valve 252, and so admits air to cylinder 266. This reverses the four-way hydraulic valve 256, and causes shot cylinder 24 to draw the shot plunger back to retracted position preparatory for the next shot.

Limit switch 226 which was the first to close is now the last to open, and de-energizes the solenoid operated four-way air valve 240. This causes air cylinder 268 to reverse the four-way hydraulic valve 244 and that in turn causes hydraulic cylinder 26 to return the ladle to its dipping position. As the ladle returns to dipping position, the ladle operated limit switch 270 is closed, which because of its electrical connection to solenoid operated air valve 216 for the main or clamp cylinder, prevents the die from being closed unless the ladle is in dipping position in the melting pot of the furnace. This interlock prevents a dry shot from being made.

To summarize the foregoing sequence of operation, the machine is started by pressing the starting buttons. The die starts to close, and shortly after the die starts to close the ladle starts to move from dipping position to pouring position. When the die is closed, as indicated by limit

switch 232, and provided also that the ladle has

reached its pouring position, as indicated by limit switch 246, the shot delay timer 236 is started. After a brief precautionary delay the timer 236 runs out and the shot is started.

The actuation of the shot plunger, or in this case more specifically of the hydraulic valve controlling the same, starts the main timer 260, which is timed for a substantial period adequate to permit solidification of the molded piece prior to ejection. When the time on clock 260 runs out the clamp cylinder is reversed and the die starts to open. The beginning of the die opening movement causes retraction of the shot plunger, and when the die has fully opened the ladle is moved back to its dipping position, thus completing the cycle.

It is believed that the improved die casting machine with automatic ladle mechanism, as well as the advantages thereof, will be apparent from the foregoing detailed description. The automatic ladle mechanism makes possible an increased number of cycles hourly. It makes the successive cycles uniform. It results in uniformity in respect to the gate plugs. It results in the maintenance of a more uniform die temperature. It results in a more uniform temperature of the metal supplied to the shot sleeve and to the die cavity. It permits removal of the operator from the furnace so that he is not subjected to heat, with consequent fatigue and loss of efficiency. There is also a reduction in fatigue of the operator because of elimination of the physical labor of transporting the metal. It permits removal of the operator from the shot end of the machine and also from the parting line of the die, with consequent increase in safety. It permits operation of the machine by a comparatively inexperienced operator, with excellent and uniform results. It allows more time for the operator to concern himself with and to take care of the die, as well as other parts of the equipment. It contributes greatly toward the production of more homogeneous as well as uniform castings.

It will be apparent that while we have shown and described our invention in several preferred forms, changes may be made in the structures disclosed, without departing from the spirit of the invention as sought to be defined in the following claims.

We claim:

1. Automatic ladling mechanism for a cold chamber die casting machine including a melting pot and a shot sleeve, said mechanism comprising a ladle and an oscillatable support arm carrying said ladle near the upper end of said arm and pivotally mounted at the lower end of said arm in order to move the ladle between a dipping position and a pouring position, said arm being of substantial length and thereby affording adequate space between the melting pot and the shot sleeve, said arm being made of two telescoping members, and said apparatus being provided with means for substantially shortening the arm during the middle portion of its travel and lengthening the arm at the end portions of its travel so that the metal may be transported a substantial distance without being lifted a commensurate distance.

2. Automatic ladling mechanism for a cold chamber die casting machine including a melting pot and a shot sleeve, said mechanism comprising a ladle having a bowl at one end and a discharge spout at the other end, an oscillatable support arm carrying said ladle near the upper

end of said arm and pivotally mounted at the lower end of said arm, and means for oscillating said arm over a substantial angle in order to move the ladle between a dipping position and a pouring position, said arm being of substantial length and thereby affording adequate space between the melting pot and the shot sleeve, said arm being made of two telescoping members, the upper or ladle-carrying portion thereof having a cam follower, said apparatus further comprising a stationary cam track receiving said cam follower, said cam track being appropriately shaped for substantially shortening the arm during the middle portion of its travel and lengthening the arm at the end portions of its travel.

3. Automatic ladling mechanism for a cold chamber die casting machine including a melting pot and a shot sleeve, said mechanism comprising a ladle having a bowl at one end and a discharge spout at the other end, said bowl having a filling opening, and said spout and its connection to the bowl being tubular, an oscillatable support arm connected at its upper end to said ladle intermediate the bowl and spout and pivotally mounted at its lower end, and means for oscillating said arm in order to move the ladle between a dipping position for filling the bowl with molten metal and a pouring position for discharging the molten metal into the pouring hole in the shot sleeve, said arm being of substantial length and thereby affording adequate space between the melting pot and the shot sleeve, said arm being made of two telescoping members, the upper or ladle-carrying portion thereof having a cam roller, and said apparatus further comprising a stationary cam track receiving said cam roller, said cam track being substantially horizontal in the middle and downwardly curved at the ends, the arrangement substantially shortening the arm during the middle portion of its travel and lengthening the arm at the end portions of its travel so that the metal may be transported a substantial distance without being lifted a commensurate distance.

4. Automatic ladling mechanism for a cold chamber die casting machine including a melting pot and a shot sleeve, said mechanism comprising a relatively long ladle and an oscillatable support arm carrying said ladle near the upper end of said arm, said arm being pivotally mounted at its lower end in order to move the ladle between a dipping position and a pouring position, said ladle having a bowl at one end and a discharge spout at the other end, the upper end of said arm being fixedly connected to the ladle to form a rigid assembly, said arm being of substantial length and thereby affording adequate space between the melting pot and the shot sleeve, said arm being made of two telescoping members, and said apparatus being provided with means for substantially shortening the arm during the middle portion of its travel and lengthening the arm at the end portions of its travel, so that the metal may be transported a substantial distance without being lifted a commensurate distance.

5. Automatic ladle mechanism for a cold chamber die casting machine having a melting pot, and a shot sleeve and plunger spaced well away from said melting pot, said mechanism comprising a ladle having a bowl at one end and a discharge spout at the other end, a stationary guide track disposed between the melting pot and the shot sleeve, a substantial portion of said guide track being horizontal and the ends of said guide track

being turned downward, means engaging said track and connected to said ladle for guiding said ladle along said track, and a transport arm rigidly connected to said ladle for moving it along the guide track, said arm being carried in a fixed pivot beneath the track, so that the arm and track turn the ladle angularly with the bowl end downward at the melting pot, and with the discharge spout downward at the shot sleeve, and yet because of the horizontal portion of the track the ladle is moved substantially horizontally between the melting pot and the shot sleeve.

6. Automatic ladle mechanism for a cold chamber die casting machine having a melting pot, and a shot sleeve and plunger spaced well away from said melting pot, said mechanism comprising a ladle having a bowl at one end and a discharge spout at the other end, a stationary guide track disposed between the melting pot and the shot sleeve, a substantial portion of said guide track being horizontal and the ends of said guide track being curved downward, means engaging said track and connected to said ladle for guiding said ladle to follow a path determined at least in part by said track, and transport means operating on said ladle for moving it along the guide track, said means and said guide track with its down-

turned ends being so relatively arranged as to move the ladle angularly with the bowl end downward at the melting pot for filling the bowl with molten metal, and with the discharge spout downward at the shot sleeve for discharging the molten metal into the pouring hole of the shot sleeve, and yet because of the horizontal portion of the track the ladle is moved substantially horizontally between the melting pot and the shot sleeve.

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