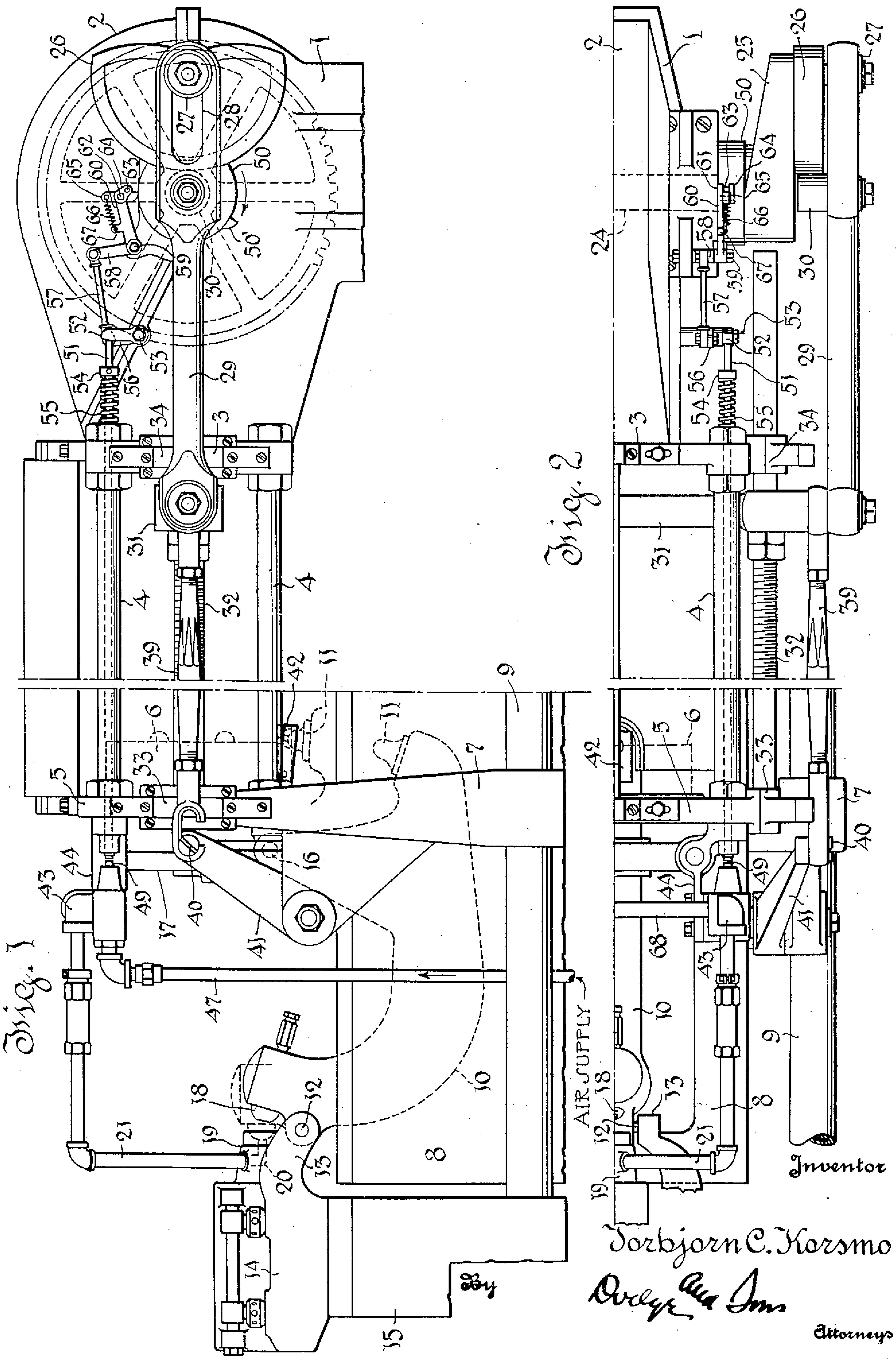
Feb. 14, 1933. T. C. KORSMO 1,897,433

DIE CASTING MACHINE

Filed Dec. 30, 1930 3 Sheets-Sheet 1



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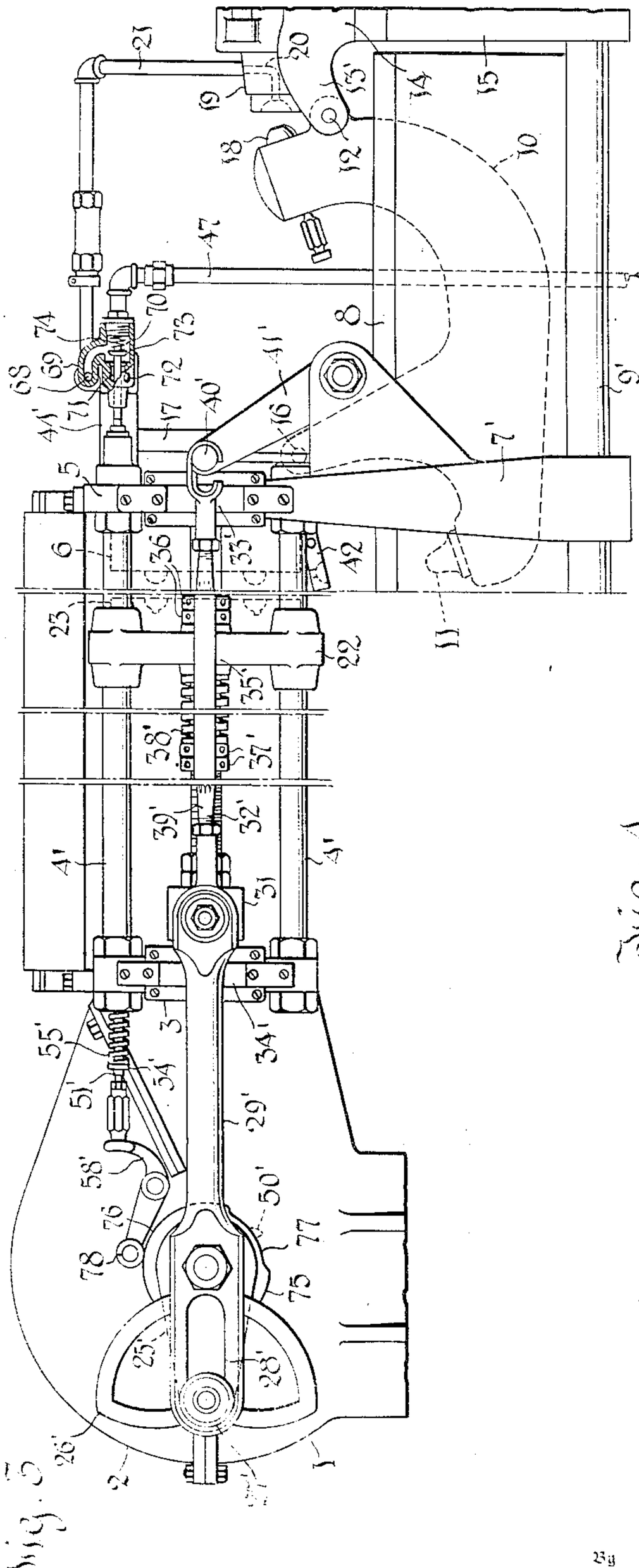
DIE CASTING MACHINE

Filed Dec. 30, 1930 3 Sheets-Sheet 2



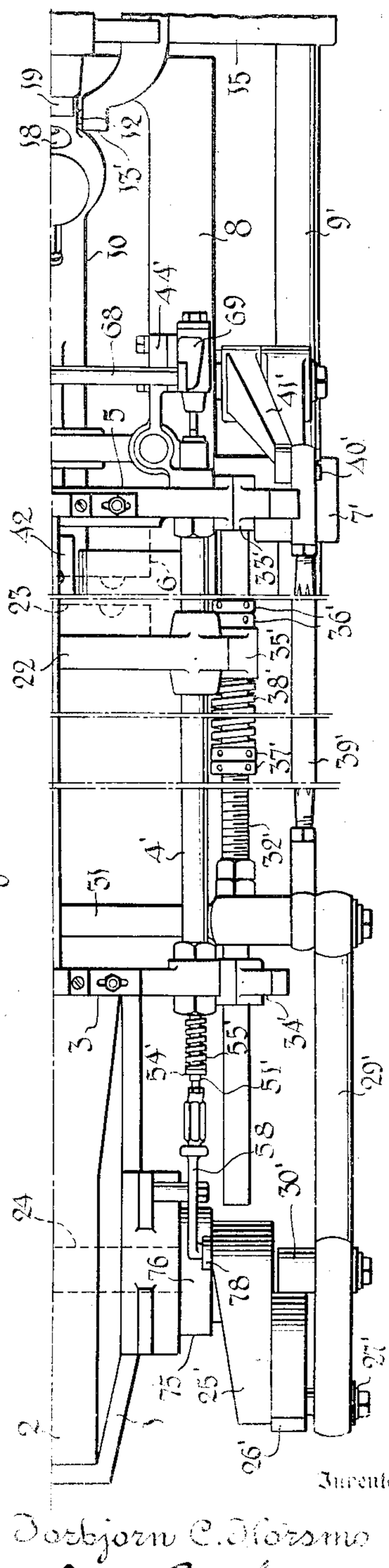


Fig. 4.

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DIE CASTING MACHINE

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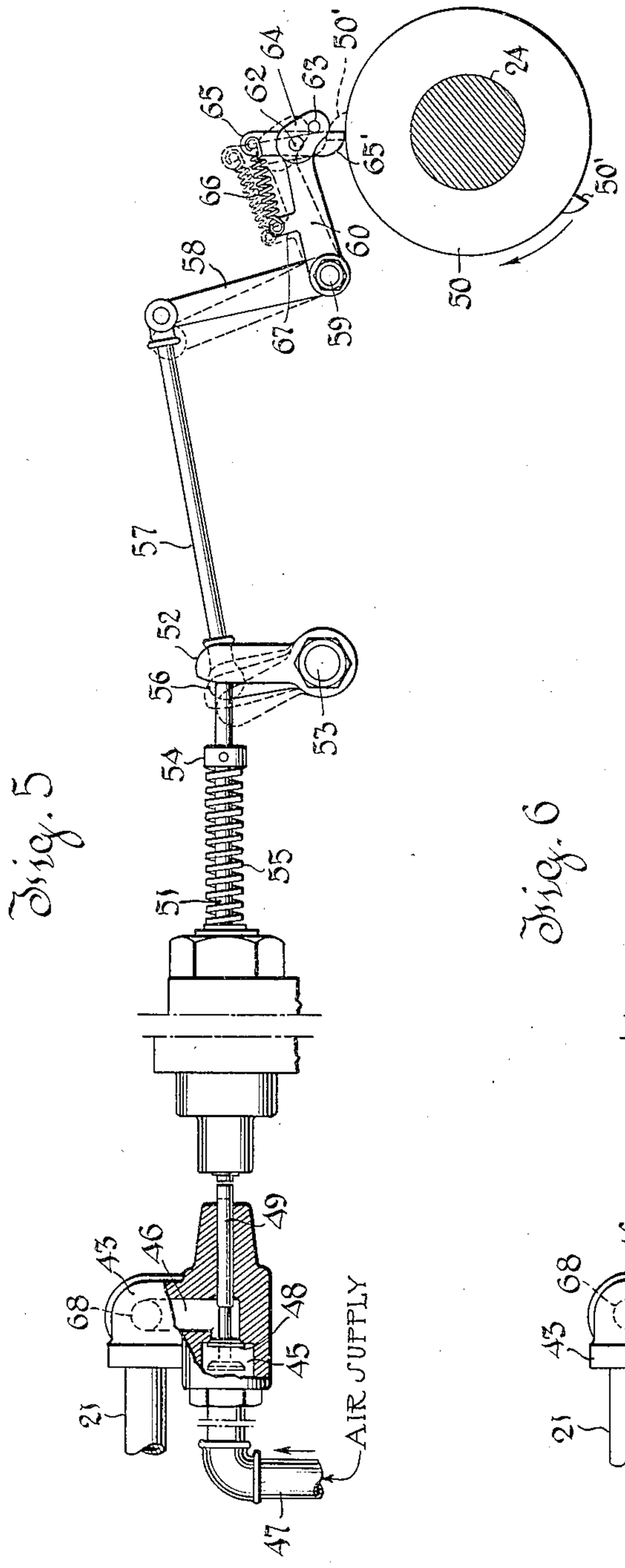

Fig. 5

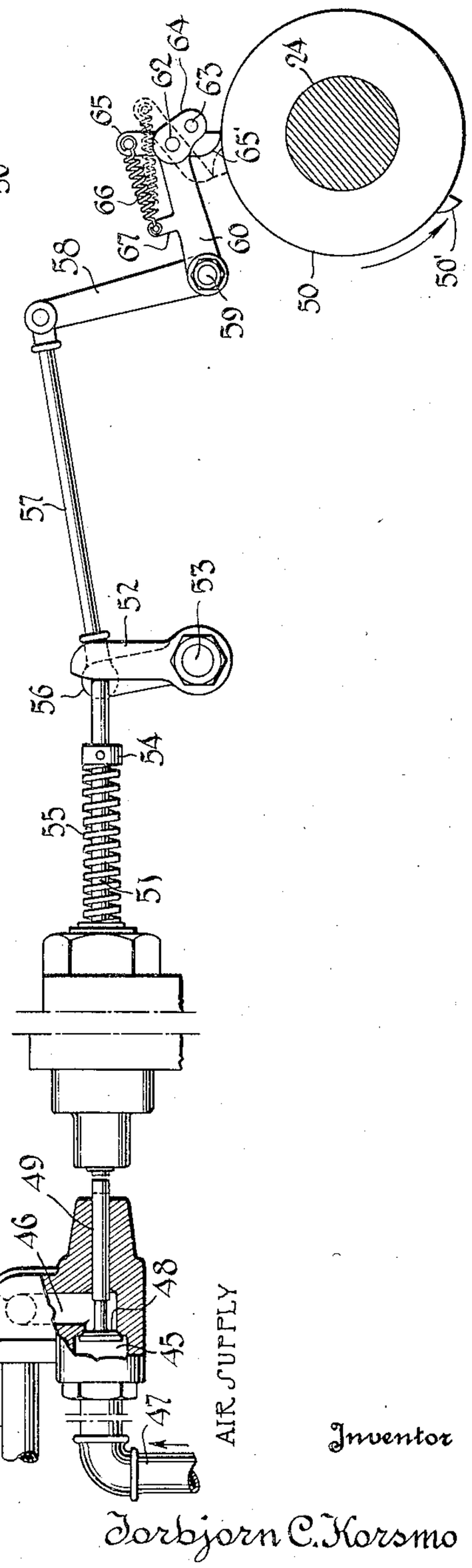

Fig. 6

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UNITED STATES PATENT OFFICE

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DIE-CASTING MACHINE

Application filed December 30, 1930. Serial No. 505,650.

This invention relates to die-casting apparatus, and particularly to that type of machine in which fluid pressure is utilized to force the molten metal into the die.

Die-casting machines of this type generally include a pressure chamber or goose neck to which molten metal is supplied from the melting pot. Compressed air, or other suitable pressure fluid, is then admitted to the goose neck and forces the molten metal therefrom into the closed die. Automatically operated inlet and exhaust valves are provided for releasing the pressure fluid to the goose neck from a pressure line when the parts are in proper casting position, and for venting the parts to relieve any fluid pressure therein before the die opens.

In addition to the opening and closing movements of the die in the above type of machine, provision is made often for movement of the goose neck between an active or die-charging position in which the goose neck is in engagement with the closed die, and an inactive or charge-receiving position in which the mouth of the goose neck is submerged in the molten metal in the melting pot. Suitable actuating means, usually power driven, are provided, of course, for opening and closing the die and for operating the goose neck so that the movements of the various parts take place in properly timed relation to each other.

In use, it is quite often necessary for purposes of adjustment, or for various other reasons, to reverse the operation of the machine. This reverse movement also may be caused unintentionally, due to accidental operation of the control means. With the valve operating mechanism heretofore used, such reverse movement resulted in actuation of the inlet valve, as in the normal, forward operation of the machine, to cause ejection of the molten metal from the goose neck.

The primary purpose of the present invention is to overcome the danger of ejecting metal when the machine is operated reversely. This is accomplished by providing a machine having valve actuating mechanism which serves to operate the air inlet valve only upon normal, forward movement of the parts of the machine. Hence, should the operator run the machine in reverse direction, intentionally or otherwise, the inlet valve will not be opened and no metal will be ejected from the goose neck.

A further object is the provision of improved mechanism for more accurately controlling the desired operation of the inlet valve. Other objects will appear hereinafter.

Reference is had to the accompanying drawings, in which:—

Fig. 1 is a front elevation of a machine embodying the invention, the parts thereof being shown, in full, in charge-receiving position with the goose neck lowered into the melting pot, the inlet valve closed and the die open (only the fixed half of the die being shown).

Fig. 2 is a plan view of the same, showing only the front half of the machine.

Fig. 3 is a rear elevation of the machine, including the complete die and movable die carriage, with the parts occupying the same positions as in Figs. 1 and 2, the exhaust valve and its actuating mechanism being shown in open position for venting the parts.

Fig. 4 is a plan view of the same, showing only the rear half of the machine.

Fig. 5 is an enlarged front elevation, similar to Fig. 1, of the pressure fluid inlet valve and its actuating mechanism in closed position, the movement of the parts when the inlet valve is opened as a result of normal, forward operation of the machine, being indicated in dotted lines.

Fig. 6 is a similar view of the inlet valve and its actuating mechanism, in which is indicated, in dotted lines, the manner in which the mechanism functions, upon reverse operation of the machine, so as not to open the inlet valve.

Inasmuch as a complete disclosure of the invention requires that it be described in combination with a die and actuating mechanism therefor, the devices described and claimed in my prior Patents No. 1,590,246, dated June 29, 1926, and No. 1,631,686, dated June 7, 1927, have been selected for this purpose. Hence, such devices are not claimed herein. Also, certain other features of the machine herein set forth are fully described and

claimed in my prior Patents No. 1,607,677, dated November 23, 1926, and No. 1,627,784, dated May 10, 1927, and in the prior application of Raymond J. Schultz, Serial No. 505,159, filed December 27, 1930. While such reference to these related features of the complete machine will be made herein as is essential to a complete understanding of the present invention, the details of these features are to be found in the patents mentioned.

The drawings show the machine as comprising a gear housing 1 having a cover 2, the gear housing being supported by the bed of the machine (not shown). The inner wall 3 of the gear housing 1 supports the ends of a series of four horizontal guide rods 4, 4, 4′, 4′, which carry a reciprocating carriage for the movable die part, as explained hereinafter.

Since a large number of the parts of the machine, including the guide rods just referred to, are duplicated at the front and the rear of the structure, it is necessary to describe only the front set, correspondingly primed reference characters being used to indicate the parts at the rear.

The opposite ends of guide rods 4, 4, 4′, 4′ are supported by a hot plate 5. This hot plate carries the stationary part 6 of the separable die, while the hot plate itself surmounts a frame member 7. Member 7, which is bifurcated at its lower end to straddle the combined furnace and melting pot 8, is supported by guide rods 9, 9′ mounted on the bed of the machine.

The usual goose neck or pressure chamber 10, having an outlet nozzle 11, is shown pivotally mounted by means of a pin 12 between a pair of perforated extensions 13, 13′ formed on the inner end of a casting 14. Casting 14 is carried by a second frame member 15 also mounted on guide rods 9, 9′ carried by the machine bed. The discharge end of the goose neck is pivotally supported at 16 in a vertically reciprocable yoke 17, whereby the goose neck through movement of the yoke may be swung up and down about its pivot 12. As it appears in Fig. 1, nozzle 11 of the goose neck is submerged in the molten metal in the melting pot 8, as a result of which a quantity of metal flows into the goose neck preparatory to charging the die.

The opposite end of goose neck 10 is provided with an air nozzle 18 which serves, as indicated in dotted lines in Fig. 1, to connect the goose neck to a pressure fluid connection 19, when the goose neck is in its elevated, or die-charging position. Generally, the pressure fluid connection member 19 is yieldingly mounted on the supporting casting 14, so as to effect an air-tight seal between the connection and air nozzle 18, when the parts are in position to "shoot" a casting. Pressure connection 19 has a passage 20 therethrough which is adapted to be connected periodically by means of a pipe 21 with a source of pressure fluid for the purpose of ejecting the metal from the goose neck 10 into the die, as will be explained in detail later.

As shown in Figs. 3 and 4, die carriage 22 is mounted for reciprocation on guide rods 4, 4, 4′, 4′, and has secured thereto the movable die part 23. The die carriage and movable die part are omitted from Figs. 1 and 2 for the sake of clearness. Power for reciprocating die carriage 22 is derived from a drive shaft 24, the ends of which are journaled in the sides of gear housing 1. Housing cover 2 conceals the gearing which drives shaft 24 from any suitable source of power, such as an electric motor.

Each end of shaft 24 carries a crank 25 having a cam 26 firmly secured thereto. Cam 26 carries a roller 27 engaging a slot 28 in the end of a connecting rod 29. A roller 30 mounted on the inner face of connecting rod 29 engages at all times with the periphery of cam 26.

The inner ends of the front and rear connecting rods 29, 29′ are joined together by a cross member 31, the connections between the parts being adapted for pivotal movement. Cross member 31 is fixedly mounted on a pair of die carriage pusher rods 32, 32′, these rods being extended on either side of cross member 31, so as to project through suitable guides 33, 34 provided for this purpose on the front and rear edges of hot plate 5 and inner end 3 of gear housing 2.

Each of pusher rods 32, 32′ extends through a split bearing 35 provided on the edge of die carriage 22 (see Figs. 3 and 4). Pusher rod 32 is threaded for a part of its length to receive a pair of nuts 36 to the right and a pair of nuts 37 to the left of the die carriage. A coil spring 38 located between nuts 37 and die carriage 22 serves to urge the carriage against nuts 36. The purpose of this arrangement will be explained below.

Pivotally connected at one end to cross member 31, as shown in Figs. 1 and 2, is an elevator pusher rod 39. This pusher rod, together with the corresponding rear pusher rod 39′ (Figs. 3 and 4), serves to operate the goose neck 10 between its charge-receiving and die-charging positions, motion therefor being derived from the reciprocatory movement of connecting rods 29, 29′ and cross member 31, as explained in detail later. The opposite end of each of elevator pusher rods 39, 39′ has a pin and slot connection at 40 with the upper arm of a bell crank 41. The other arm of the bell crank and the corresponding arm of the rear bell crank 41′ serve, when the machine is operating, to effect the necessary raising and lowering of yoke 17 to move goose neck 11

between its active and inactive positions, as will be readily understood.

No claim is made herein to the mechanisms so far described, since they are fully covered by the prior patents to Korsmo, supra.

In general, the operation of the machanism described is as follows: Assuming the parts are in the position of Figs. 1 and 3, with the die open and a quantity of metal in goose neck 10, when power is applied to shaft 24, connecting rods 29 and 29′ will move inwardly toward the goose neck and impart a corresponding movement to cross member 31, die carriage pusher rods 32, 32′, and elevator pusher rods 39, 39′. As a result, die carriage 22 will be moved on guide rods 4, 4, 4′, 4′ towards the goose neck, until the movable die part 23 engages the fixed die part 6. Simultaneously with the movements mentioned, discharge nozzle 11 of the goose neck is raised by the connections described into contact with an inclined, perforated nipple plate 42 pivotally mounted on the under side of the fixed die part 6 (see Figs. 1 and 3). Following this, the goose neck nozzle 11, as explained below, is given a final, short upward movement which carries nipple plate 42 into contact with the closed die, and, thus, connects the interior of the goose neck with the die cavity through the opening in nipple plate 42 and the sprue opening in the die.

In setting the machine up for operation, die carriage 22 is adjusted on its pusher rods 32, 32′ and secured by nuts 36, 37 and coil spring 38, so that, when the machine is operated, die parts 6 and 23 will be brought into contact shortly before cross member 31 completes its inward movement towards the goose neck. Hence, when the die parts 6 and 23 contact, cross member 31 and pusher rods 32, 32′, continuing their inward movement, cause coil springs 38, 38′ to be compressed against die carriage 22. Die carriage pusher rods 32, 32′ slide freely through their bearings on die carriage 22 to permit this action. As a result, the die parts 6 and 23 are held yieldingly in contact with each other. During the relative movement between cross member 31 and die carriage 22 just mentioned, the final, short, upward movement of nozzle 11 takes place and brings nipple plate 42 and the goose neck into the die-charging position indicated in dotted lines in Fig. 1.

Thus, it will be seen that the die is closed simultaneously with the raising of the goose neck nozzle 11 into contact with nipple plate 42, following which nozzle 11 forces the nipple plate against the bottom of the closed die. The purpose of nipple plate 42 is to prevent the die parts being forced apart by the goose neck discharge nozzle 11.

During the described movement of the parts into die-charging position, air nozzle 18 of the goose neck seals against pressure fluid connection 19. Certain automatically operated valve mechanism, to be described shortly, is then actuated to admit pressure fluid through connection 19 to the goose neck behind the molten metal therein and thereby force the metal from the goose neck into the die. The supply of pressure fluid is then automatically cut off and the pressure fluid vented from the goose neck and the connected parts before the die opens.

Sufficient time having elapsed for the casting to "freeze", the die actuating mechanism then moves in the opposite direction, carrying connecting rods 29, 29′ outwardly away from the goose neck, cross member 31 being moved therewith. As a result, goose neck nozzle 11 begins its descent and nipple plate 42 swings downwardly into the inclined position of Fig. 1. As cross member 31 and die carriage pusher rods 32, 32′ continue their movement away from the goose neck, nuts 36, 36′ positively engage die carriage 22 and move it on guide rods 4, 4, 4′, 4′, so as to separate the die parts 6 and 23. As goose neck 10 continues its descent, the seal at the rear air nozzle 18 is broken and the parts vented at this point.

Movement of the parts as described continues, the casting is removed and finally the full open position of Figs. 1 and 3 is reached. The machine is now ready for the next casting operation.

The means for supplying pressure fluid to displace the molten metal from the goose neck into the die and for venting the goose neck and connected parts will now be described. As indicated hereinbefore, this is the portion of the apparatus which includes the features of the present invention.

Pipe 21 leading from pressure fluid connection 19 connects at its opposite end to an inlet valve casing 43 at the front of the machine (see Figs. 1 and 2). Valve casing 43 is carried by a bracket 44 attached to hot plate 5. The interior of valve casing 43 is divided into two chambers 45, 46, chamber 46 communicating with pipe 21 leading to pressure connection 19 and goose neck 10. Chamber 45 of valve casing 43 is connected by means of a pipe 47 to a source of pressure fluid supply.

Communication between chambers 45 and 46 of valve casing 43 is controlled by an inlet valve 48 having an elongated stem 49, the outer end of which projects somewhat beyond the valve casing, as shown clearly in Figs. 5 and 6. Normally, inlet valve 48 is maintained in the full-line closed position of Figs. 5 and 6 by the pressure fluid supplied by pipe 47.

The mechanism for operating inlet valve 48 is controlled by a cam 50 mounted on main drive shaft 24 for rotation therewith. The operating mechanism comprises a thrust rod

51 extending through upper guide rod 4, which is made hollow for this purpose. The ends of thrust rod 51 extend beyond hot plate 5 and inner end 3 of gear housing 1. The inner end of the thrust rod is arranged in close proximity to stem 49 of inlet valve 48, so that upon inward movement of the thrust rod the inlet valve will be opened, as indicated in dotted lines in Fig. 5.

The opposite end of thrust rod 51 engages a pusher arm 52 swingably mounted on a fixed pivot 53 on the side of gear housing 1. This end of thrust rod 51 is provided with a fixed collar 54. Interposed between the collar and end wall 3 of the gear housing is a coil spring 55. This spring serves to keep the outer end of thrust rod 51 always in engagement with pusher arm 52. Also swingably mounted on pivot 53 with pusher arm 52 and arranged for rigid movement with the pusher arm, is a second arm 56. A link rod 57 pivotally connects the outer end of arm 56 with one arm of a bell crank 58 pivoted at 59. Lower arm 60 of the bell crank is formed with an extension 61 on the outer face of which are rigidly mounted a pivot pin 62 and a stop pin 63 (see Figs. 1 and 2). The outer ends of pins 62 and 63 rigidly support a small plate 64 in spaced relation to bell crank extension 61.

Pivotally mounted between its ends on pin 62 and between extension 61 and plate 64 is a latch 65. The upper end of latch 65 is connected by a coil spring 66 to an extension 67 on arm 60 of the bell crank. It will be noted that latch 65 normally is in a substantially vertical position with its lower end bearing on cam 50. This serves to hold the valve actuating mechanism in the full line position of Fig. 5. The lower end of latch 65, as shown in Fig. 5, is located to the left of stop pin 63. Thus, coil spring 66, which is placed in position under tension, serves normally to maintain the lower end of latch 65 yieldably against stop pin 63.

With this arrangement, when main drive shaft 24 revolves in its normal, clockwise direction, as indicated by the arrow in Fig. 5, to cause the parts of the machne to move forward, the curved portion of cam segment 50′ engages the lower rounded corner of latch 65, tending to force the latch to the right. Since latch 65 cannot swing further in this direction because of stop pin 63, bell crank 58 and the other interconnected parts of the inlet valve-actuating mechanism will be moved to the dotted-line position to open the inlet valve. The parts being in die-charging position at this time, the pressure fluid released functions to eject the molten metal from the gose neck into the closed die. The lower extremity 65′ of latch 65 and cam segment 50′, are shaped so as to accomplish a relatively abrupt, but steady, opening movement of the valve and a very sharp or instantaneous closing thereof. This accurate and certain functioning of the inlet valve is one of the advantages of operating the air inlet valve from a cam placed on the main drive shaft. The abrupt, but steady, opening movement of the inlet valve is highly desirable in order to permit this operation to take place at exactly the proper time after the parts have moved into casting position and to cause a steadily increasing feed of pressure fluid to the pressure chamber. Instantaneous closing of the valve is necessary to allow sufficient time for venting the parts before the die opens. After cam segment 50′ has passed latch 65, coil spring 55, which was compressed when the valve actuating mechanism operated to open the inlet valve, functions to return the valve mechanism to the normal, full line position of Fig. 5.

If the machine is operated reversely, either intentionally or otherwise, the main drive shaft 24 will revolve in a counterclockwise direction, as indicated by the arrow in Fig. 6. As a result, the flat face of cam segment 50′ will engage the corresponding face of the lower end of latch 65, causing the latch to swing to the left against the resistance of spring 66, as indicated in dotted lines. Such action will impart no movement whatsoever to bell crank 58 and the other parts of the valve actuating mechanism to open the inlet valve. As cam segment 50′ slides under the lower yielding end of latch 65, coil spring 66 returns the latch to its normal full-line position of Fig. 5. In this manner, opening of the inlet valve 48 is prevented upon reverse operation of the machine, and, the inlet valve actuating mechanism is always automatically reset for its normal operation to open the valve upon forward movement of the parts.

Inlet valve casing 43 at the upper part of chamber 46 is connected by means of a pipe 68 to an exhaust valve casing 69 (see Figs. 3 and 4). Exhaust valve casing 69 also is supported by a bracket 44′ attached to hot plate 5. The interior of exhaust valve casing 69 is divided into two chambers 70, 71, chamber 71 being connected by an exhaust port 72 with the atmosphere. An exhaust valve 73, which is urged towards closed position by a coil spring 74, controls communication between chambers 70 and 71.

Exhaust valve 73 is controlled by a cam 75 on the rear end of drive shaft 24. Cam 75 has a raised operating surface 76 and a depressed operating surface 77 which function through the valve operating mechanism to be described to open exhaust valve 73 or permit it to remain in closed position at the proper intervals.

The exhaust valve operating mechanism is practically the same as that for operating the inlet valve, except for the omission of a safety trip device, such as the latch 65. Thrust rod 51′, which operates the exhaust

valve through its stem 73′, extends through the hollow rear guide rod 4′. Bell crank 58′ is provided with a roller 78 engaging the periphery of cam 75. Coil spring 55′ functions to urge the parts towards the left (Fig. 3) and thus maintain roller 78 in contact with the cam 75. It will thus be seen that, while roller 78 rests on raised surface 76 of cam 75, exhaust valve 73 through thrust rod 51′ and the connected parts, is held open so as to vent chamber 70 and the passages connected thereto to the atmosphere. Since chamber 70 connects not only with inlet valve casing 43 by means of pipe 68, but also with goose neck 10 by means of pipe 21 and pressure connection 19, this serves to vent all of these interconnected parts.

When cam 75 revolves so as to bring roller 78 opposite depressed portion 77 of the cam, spring 55′ functions to move the exhaust valve actuating mechanism towards the cam and thus permit coil spring 74 to close the exhaust valve 73. It is during this interval when the exhaust valve is closed, that cam segment 50′ of cam 50 functions to open the air inlet valve 48. Compressed air entering past inlet valve 48 fills the passages between the inlet and exhaust valves and also those leading to the goose neck 10, thereby forcing the metal into the die.

It is necessary, of course, that the mechanism described for controlling the inlet and exhaust valves be arranged to operate the valves in properly timed relation to the movements of the goose neck and the opening and closing of the die. With the arrangement of parts described, the general sequence of operations of the complete machine is as follows.

Starting with the charge-receiving position of goose neck 10, as indicated in full lines in the various figures, it will be seen that at this time the die is open and the seal broken between air nozzle 18 and pressure connection 19 to permit venting. The position of exhaust valve cam 75 at this time is such that exhaust valve 73 is held open to permit further venting, as explained. At the same time the position of valve actuating cam 50 permits pressure fluid in supply pipe 47 to hold inlet valve 48 closed.

As drive shaft 24 revolves, nozzle 18 seals against pressure connection 19, the die is closed, and discharge nozzle 11 of the goose neck engages nipple plate 42. Die carriage pusher rods 32, 32′ then move relatively to die carriage 22, effecting the final upward movement of goose neck 10, and, thereby, connecting the latter with the die through the nipple plate. By this time cam 75 has rotated so as to permit coil spring 74 to close the exhaust valve. Shortly after this, cam segment 50′ functions to open the inlet valve for a brief period, it being quickly closed by the air pressure as cam segment 50′ slides from under latch 65. During this operation, the exhaust valve has remained closed to permit the compressed air to act on the metal in the goose neck and discharge it into the die. The casting having "frozen", cam 75 operates to open the exhaust valve and vent the parts before the die starts to open or the goose neck to descend.

Shortly after the opening of the exhaust valve, pusher rods 39, 39′ operate to lower goose neck nozzle 11 and permit nipple plate 42 to resume its original, inclined position. Pusher rods 32, 32′ then open the die and the connection at the rear of the goose neck with the pressure fluid system is broken as the goose neck continues its descent. Continued movement of the parts returns them to their original positions.

As already fully explained, operation of the machine in the reverse direction for any purpose whatsoever is absolutely safe and cannot possibly cause the air inlet valve to open; nor will the parts be thrown out of position so as to interfere with proper opening of the inlet valve upon normal, forward operation of the machine.

What is claimed is:—

1. A pressure fluid system for die casting machines of the type in which molten metal is displaced from a pressure chamber into a die by fluid pressure, comprising pressure fluid supply means adapted for operation to furnish pressure fluid to the pressure chamber; actuating means for said fluid supply means; and driving means for said actuating means, said actuating means serving to operate the supply means upon normal forward movement of the driving means but being ineffective to operate said supply means upon reverse operation of the driving means.

2. A pressure fluid system for die casting machines of the type in which molten metal is displaced from a pressure chamber into a die by fluid pressure, comprising means, including an inlet valve, adapted for operation to supply pressure fluid to the pressure chamber; actuating means for the inlet valve; and driving means for the valve actuating means, said actuating means being operative only upon normal forward movement of the driving means to open the inlet valve.

3. A pressure fluid system for die casting machines comprising pressure fluid supply means adapted for operation to furnish pressure fluid for forcing molten metal from a pressure chamber into a die; actuating means for said fluid supply means; and driving means for said actuating means, said actuating means serving to operate the fluid supply means upon normal, forward movement of the driving means, but being inoperative to actuate said supply means when the driving means are operated reversely.

4. A pressure fluid system for die casting machines of the type in which molten metal is displaced from a pressure chamber into a

die by fluid pressure, comprising pressure fluid supply means adapted for operation to furnish pressure fluid to the pressure chamber; actuating means for said fluid supply means, including a trip mechanism; and driving means for said actuating means adapted to operate the supply means upon normal, forward movement of the driving means, said trip mechanism functioning to prevent operation of said supply means upon reverse operation of the driving means.

5. A pressure fluid system for die casting machines of the type in which molten metal is displaced from a pressure chamber into a die by fluid pressure, comprising pressure fluid supply means adapted for operation to furnish pressure fluid to the pressure chamber; actuating means for said fluid supply means, including a bell crank, a lever pivotally mounted intermediate its ends on one arm of said bell crank, a stop on said arm for preventing rotation of said lever in one direction, and a spring for normally holding said arm in engagement with the stop; and driving means for said fluid supply actuating means, said driving means, upon normal, forward movement thereof, engaging said pivoted lever to operate the fluid supply actuating means, said lever yielding upon engagement by the driving means upon reverse movement thereof to prevent operation of the fluid supply actuating means.

6. A force feed system for die casting machines comprising means to force molten metal from a pressure chamber into a die; and operating means for said forcing means serving to actuate the forcing means upon normal, forward movement of the operating means, said operating means being ineffective to actuate the forcing means upon reverse movement of the operating means.

In testimony whereof I have signed my name to this specification.

TORBJORN C. KORSMO.