Nov. 16, 1943. A. E. ABBOTT ET AL 2,334,372

DIE CASTING MACHINE

Filed Jan. 21, 1941 6 Sheets-Sheet 1

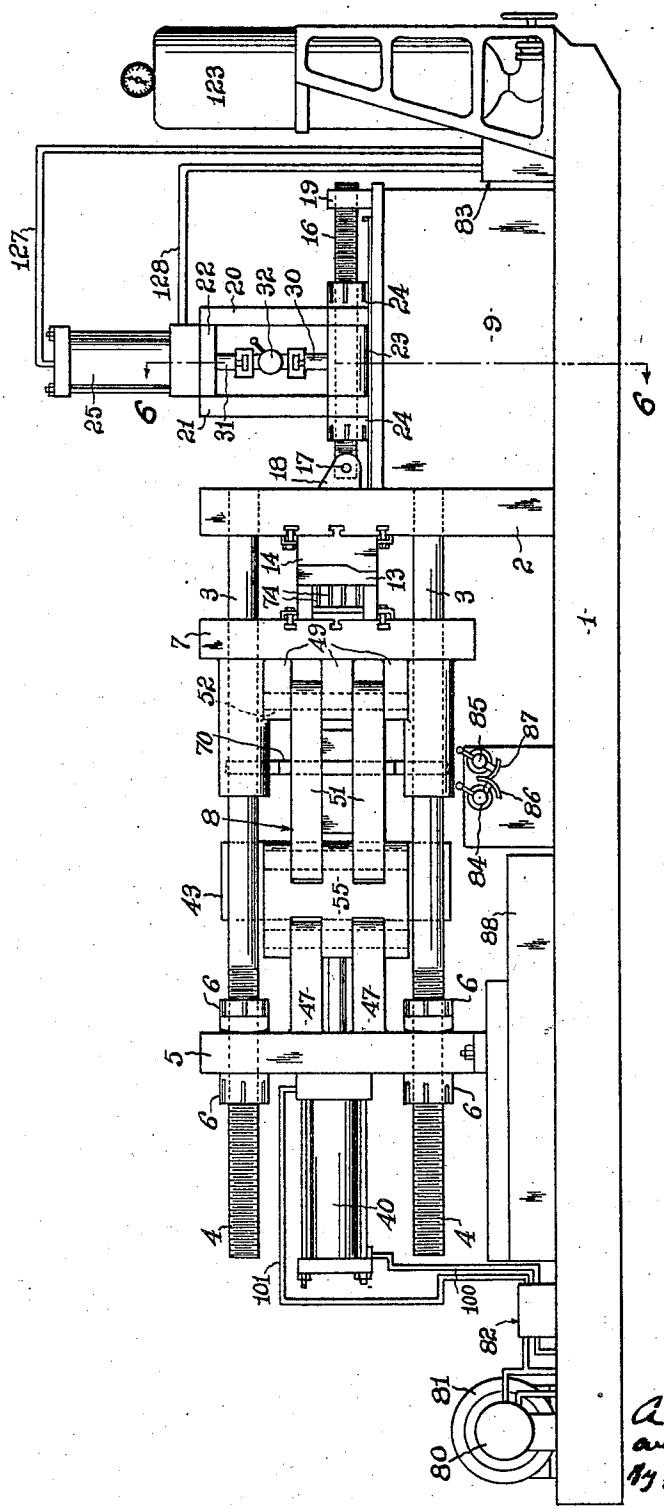


FIG. 1

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DIE CASTING MACHINE

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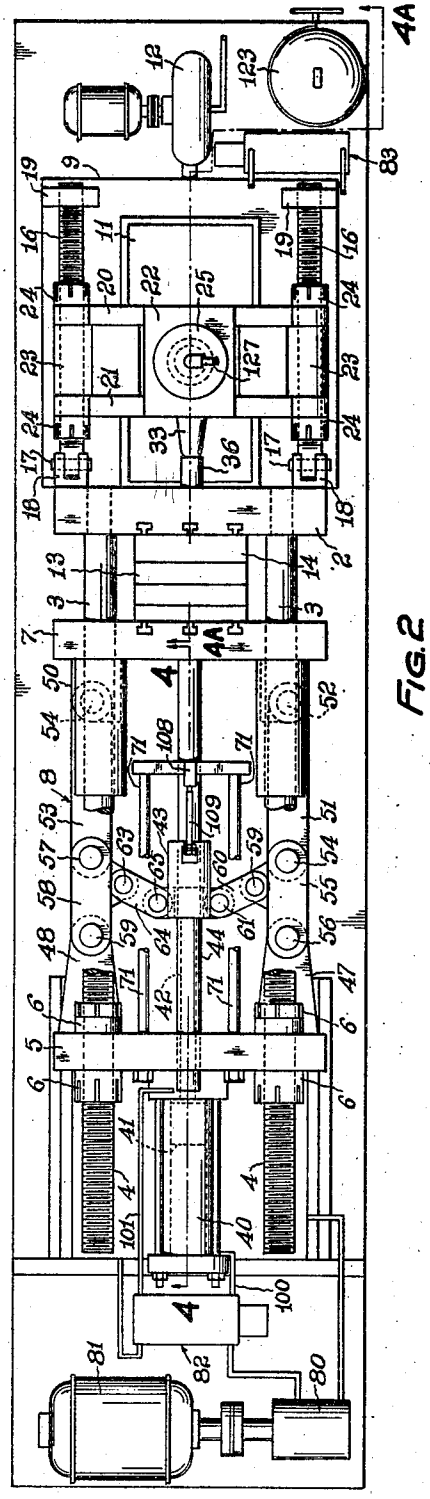


FIG. 2

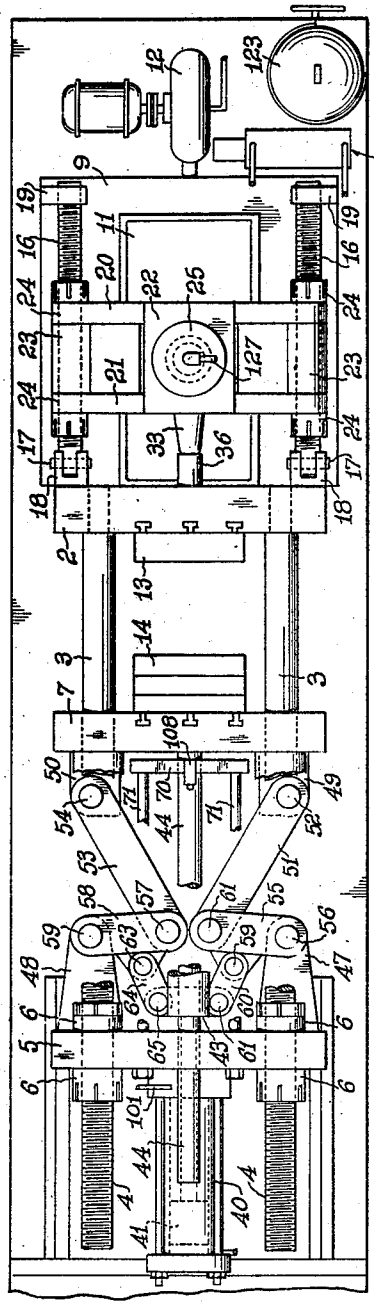


FIG. 3

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DIE CASTING MACHINE

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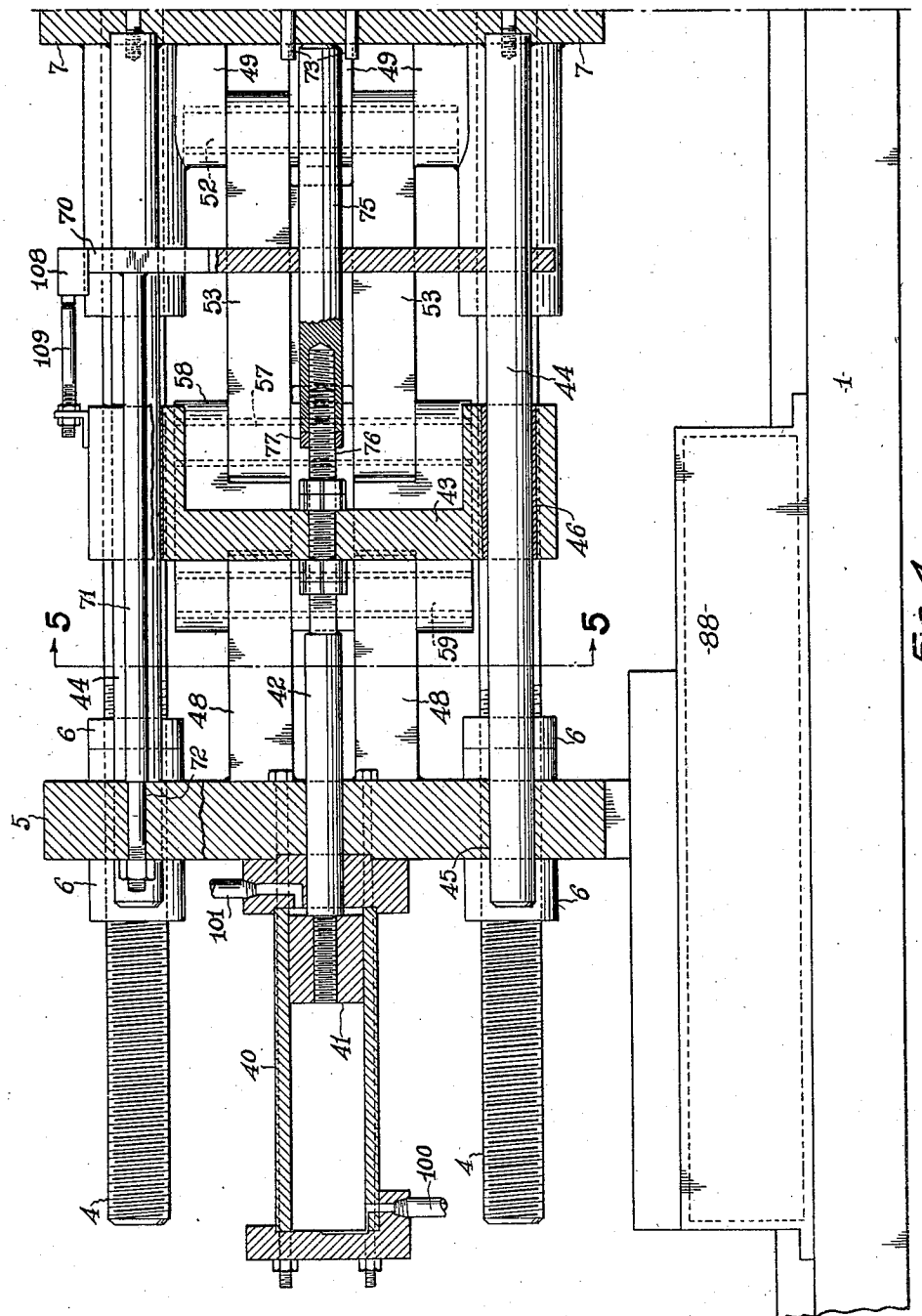


FIG. 4

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DIE CASTING MACHINE

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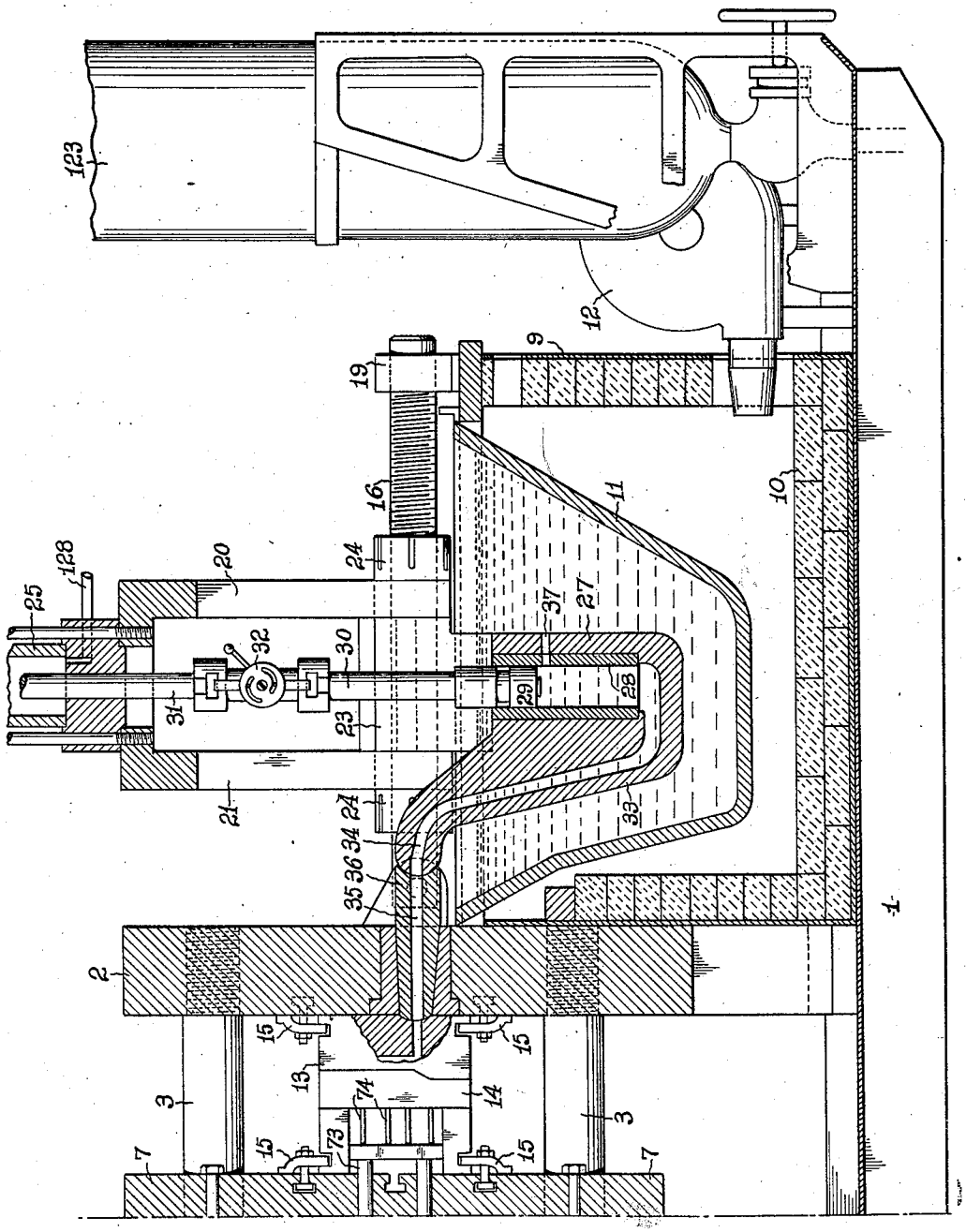


FIG. 4A

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DIE CASTING MACHINE

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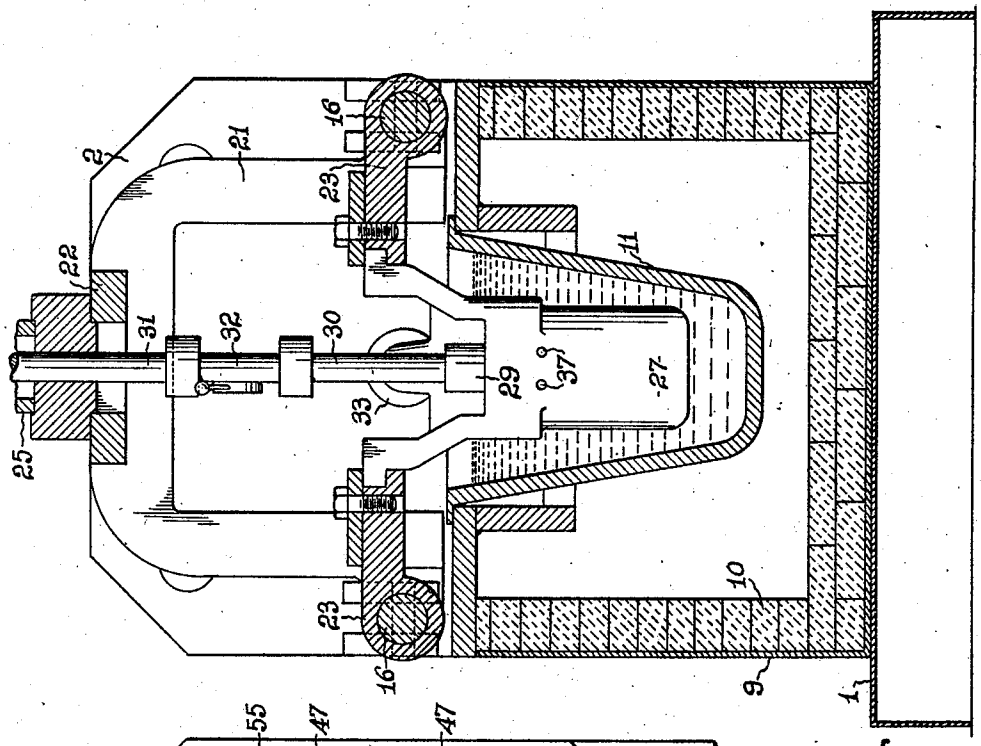


FIG. 6

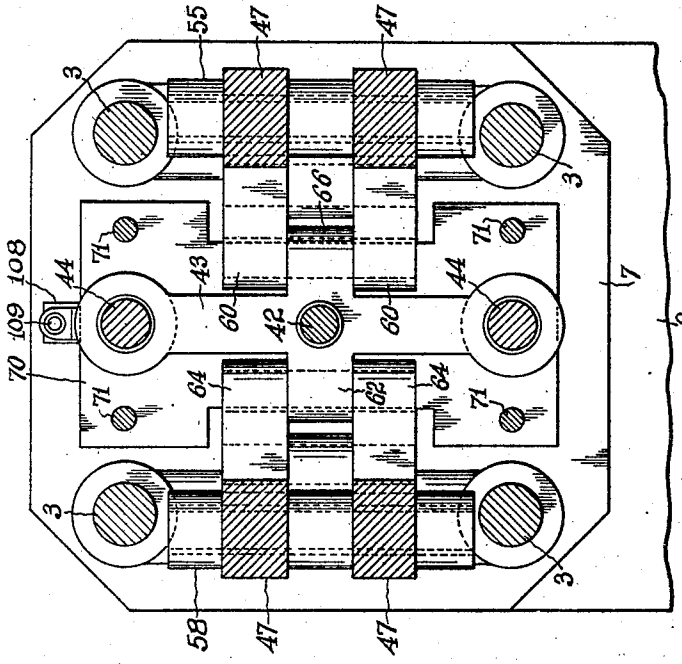


FIG. 5

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DIE CASTING MACHINE

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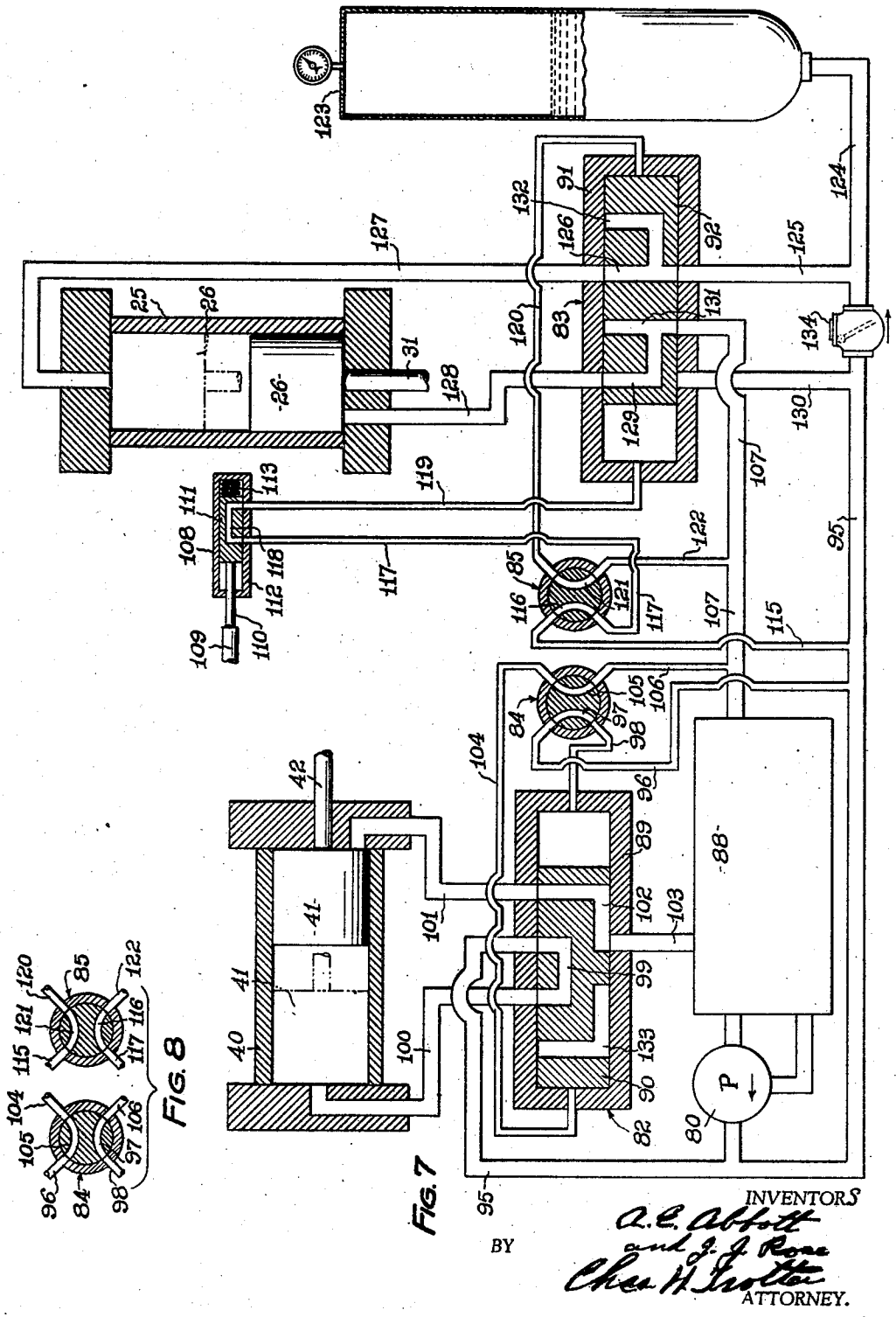


FIG. 7

FIG. 8

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2,334,372

UNITED STATES PATENT OFFICE

2,334,372

DIE-CASTING MACHINE

Albert E. Abbott, Cleveland, and John J. Rose, Lakewood, Ohio

Application January 21, 1941, Serial No. 375,148

4 Claims. (Cl. 22—68)

This invention relates generally to die casting machines of the horizontally moving die type.

The principal object of the invention is to provide in a machine of this character improved means for accurately controlling the movement of the movable die carrier.

Another object of the invention is the provision of toggle mechanism for reciprocating the movable die carrier, in combination with means for preventing the toggles being moved past a certain predetermined position when they are operating the movable die carrier to close the dies.

Another object of the invention is to provide means which are readily adjustable so as to adapt the machine for use with various types and sizes of dies.

Another object of the invention is to provide mechanism of this type which will eliminate breakage of the toggle mechanism which is inherent in machines of this type now generally in use.

Another object of the invention is the provision of a machine of this character which is simple in construction and efficient in operation and one which can be readily adapted for use with various different types and sizes of dies.

Other and more limited objects of the invention will be apparent from the following specification and accompanying drawings forming a part thereof, wherein Fig. 1 is a side elevation of a die casting machine embodying my invention, the dies being shown in their closed position; Fig. 2 is a plan view of the device, the parts being in the same position as shown in Fig. 1; Fig. 3 is a view similar to Fig. 2 showing the various parts in the position they assume when the dies are opened; Fig. 4 is an enlarged section on the line 4—4 of Fig. 2 and Fig. 4ª is an enlarged section taken on the line 4ª—4ª of Fig. 2, Figs. 4 and 4ª taken together showing a complete central longitudinal section through the machine; Fig. 5 is a transverse section taken on the line 5—5 of Fig. 4; Fig. 6 is a transverse section taken substantially on the line 6—6 of Fig. 1; Fig. 7 is a diagrammatic view of the hydraulic control mechanism for operating the machine and Fig. 8 is a sectional view through the control valves showing them in the opposite position from that shown in Fig. 7.

Referring to the drawings by reference characters, 1 indicates a base extending beneath the whole machine. Extending from and rigidly secured to the base 1 is a stationary die support 2 which has a plurality of rods 3, four in number, rigidly secured thereto and extending rearwardly therefrom. The rear ends of the rods 3 are threaded as indicated at 4 and extend through a supporting plate 5 which is slidably mounted upon the base 1, as indicated at 6. The plate 5 may be adjusted to any desired position and rigidly secured in this position by nuts 6 on the threaded ends 4 of the rods 3.

Slidably mounted on the rods 3 between the stationary die support 2 and the supporting plate 5 is a movable die carrier 7 which is adapted to be reciprocated through toggle mechanism generally indicated by the numeral 8 which is connected at one end to the supporting plate 5 and at the other end to the die carrier 7.

A furnace 9 lined with suitable refractory material 10 is secured to the base 1 adjacent the forward face of the stationary die support 2. A melting pot 11 is suitably secured within the furnace 9 and heat is supplied thereto by a conventional burner and blower, generally indicated by the numeral 12.

Complementary dies 13 and 14 are carried by the adjacent faces of the stationary die support 2 and the movable die carrier 7 and are secured thereto by suitable clamps 15. A pair of rods 16 extend rearwardly from the stationary die support 2 above the furnace 9, one rod being adjacent each side of the support 2. The forward ends of these rods 16 are secured at 17 to brackets 18 on the rear face of the support 2 and the other ends of the rods 16 are slidably mounted in the supports 19 extending upwardly from and secured to the upper face of the furncae 9. A pair of U-shaped members 20 and 21, secured together at their closed end by a cross member 22 and at their open ends by apertured connecting links 23, are adjustably mounted upon the rod 16 and are maintained in any desired position by nuts 24 threaded on the rods 16.

Secured to and extending upwardly from the cross member 22 is a hydraulic cylinder 25 having a piston 26 reciprocably mounted therein. Secured to and extending downwardly into the melting pot 11 between the links 23 is a cylinder 27 having a suitable liner 28. A plunger 29 is mounted for reciprocation within the liner 28 and is operatively connected to the piston 26 through connecting rods 30 and 31 which are detachably secured together by suitable connecting means 32. A "gooseneck" 33 is formed integral with one side of the cylinder 27 and has therein a bore 34 connecting the open lower end of the liner 28 with an orifice 35 in a nozzle 36 which is suitably secured in the stationary die

support 2. The other end of the orifice 35 communicates with the die chamber formed by the dies 13 and 14.

The metal from which the die castings are to be made is placed within the pot 11 and is heated to and maintained in a molten state by the burner 12. This molten metal will flow into the cylindrical liner 28 and the passageway 34 through an opening 37 when the plunger 29 is in the position shown in Fig. 4a. After the dies have been brought together, as is shown in the various figures, the piston 26 is moved downwardly within the cylinder 25 by mechanism to be hereinafter described. This will move the plunger 29 downwardly within the cylindrical liner 28 and will force the molten metal through the orifice 35 into the die chamber under the desired pressure. After the plunger 29 has been returned to the position shown in Fig. 4a, more molten metal will flow into the opening 37 in readiness for the next casting to be formed.

Secured to and projecting rearwardly from the adjustable supporting plate 5 is a hydraulic cylinder 40 in which is reciprocably mounted a piston 41. Extending outwardly from the piston 41 is a connecting rod 42 which is connected at its forward end to a cross-shaped member 43 which is reciprocably mounted on a pair of rods 44 which have their forward ends rigidly secured to the movable die carrier 7 and have their other ends slidably mounted in bores 45 in the adjustable supporting member 5, and which pass through bores 46 in the vertical arms of the cross-shaped member 43.

The adjustable support 5 has a pair of ears 47 projecting forwardly from one side thereof and a pair of similar ears 48 projecting forwardly from the other side thereof, and the movable die carrier 7 has ears 49 secured thereto and projecting rearwardly from one side thereof and similar ears 50 secured thereto and projecting rearwardly from the other side thereof. Links 51 are pivotally connected by a pin 52 at one end to the ears 49 and links 53 are pivotally connected by a pin 54 to the ears 50. The other ends of the links 51 are connected by a pin 54 to a link 55 which in turn is connected by a pin 56 to the ears 47; and the links 53 are connected by a pin 57 to a link 58 which in turn is connected by a pin 59 to the ears 48. The link 55 is pivotally connected by a pin 59 to a pair of links 60 which in turn are connected by a pin 61 to one of the horizontal arms 62 of the cross-shaped member 43; and the link 58 is pivotally connected by a pin 63 to a pair of links 64 which are in turn connected by a pin 65 to the other horizontal arm 66 of the cross-shaped member 53.

From the above construction, it will be apparent that as the piston 41 is forced forwardly within the cylinder 40, the cross-shaped member 43 which is rigidly secured thereto will likewise be moved forwardly. As the cross-shaped member 43 is moved forwardly, it will straighten out the toggles, which are composed on one side of the links 51 and 55 and on the other side of the links 53 and 58, from the position shown in Fig. 3 to the position shown in Fig. 2. This straightening of the toggles will in turn move the movable die carrier 7 forwardly and will close the dies 13 and 14 and when the piston 41 is moved rearwardly from the position shown in Fig. 2 to the position shown in Fig. 3, it will move the toggle mechanism from the position shown in Fig. 2 to the position shown in Fig. 3 which, in turn, will move the movable die carrier 7 rearwardly and will separate the dies 13 and 14. Conventional knockout mechanism is provided for knocking the casting out of the die 14 and comprises a plate 70 supported on the forward end of rods 71 which have their other ends secured, as indicated at 72, to the adjustable support 5. The plate 70 is so positioned and supported that pins 73 will be brought into contact with the plate 70 on the rearward movement of the movable die carrier 7 which will force these pins 73 forwardly and they in turn will operate suitable knockout pins 74 carried by the die which will force the casting out of the die.

Means are provided for preventing the cross-shaped member 43 from being moved forwardly beyond a certain definite position by the piston 41. It will be apparent from Fig. 2 that if the cross-shaped member 43 is moved beyond the position shown in Fig. 2, the toggle links would start to break in the opposite direction which would cause the movable die carrier 7 to start moving rearwardly again after it had reached the limit of its forward movement and thereby tend to open the dies 13 and 14 a slight amount. This mechanism comprises a rod 75 which is adjustably secured to a threaded reduced extension 76 on the connecting rod 42 and is locked in the desired position by a lock nut 77. The rod 75 is adjusted so that its forward end will come in contact with the rear face of the movable die carrier 7 when the cross-shaped member 43 has been moved forwardly to the desired position. It will be seen by reference to Fig. 4 that the piston 41, connecting rod 42, cross-shaped member 43 and the rod 75 will all move as a unit when the piston 41 is reciprocated within the cylinder 40. It will also be seen by reference to Fig. 4 that the rod 75 is connected to the aforesaid mechanism in such a manner that it can be readily adjusted so as to come into contact with the rear face of the movable die carrier 7 at any desired time and that, upon coming in contact with the die carrier 7, it will prevent any further movement of the piston 41 and the toggle mechanism which is connected thereto and operated by the cross-shaped member 43. This will accommodate the machine to various different types and sizes of dies and enable the machine to be so adjusted that the movable die support 7 and the die carried thereby can only be moved a certain definite predetermined distance and will prevent any undue strain being placed upon either the dies or the operating mechanism for the movable die carrier.

It will also be apparent that in order to accommodate the mechanism for either larger or smaller dies than are shown in the accompanying drawings, it is only necessary to adjust the position of the movable supporting member 5 upon the rods 3, as all of the operating mechanism for the movable die carrier 7 is directly connected to and movable with the adjustable support 5. By adjusting it in one direction from the position shown in the drawings, the machine will be adapted for smaller dies than those shown and by moving it in the opposite direction, the machine may be adapted for larger dies than those shown.

The mechanism for operating the pistons 26 and 41 will now be described. This mechanism comprises a pump 80 of conventional standard design which is operated by an electric motor 81 and a series of operating and control valves so constructed and arranged that the piston 26 can-

not be moved downwardly in the cylinder 25 when the piston 41 is in its rearmost position. In other words, the operating mechanism is so arranged that it will be impossible to force a charge of molten metal from the cylinder 27 when the dies 13 and 14 are in open position. The mechanism is also so arranged that it will be impossible to move the piston 41 rearwardly from the position shown in Fig. 2 until the piston 26 is in its uppermost position or, in other words, it will be impossible to open the dies 13 and 14 until after the piston 26, and consequently the plunger 29, have been moved from the lowermost position back to the position shown in Fig. 4a. This mechanism includes an operating valve 82 for the piston 41 and an operating valve 83 for the piston 26, these valves in turn being operated by manually operating valves 84 and 85, the valve 84 controlling the operation of the valve mechanism 82 and the valve 85 controlling the operation of the valve mechanism 83.

By reference to Fig. 1, it will be seen that the operating valve 84 has a segment 86 connected thereto and movable therewith which cooperates with a segment 87 carried by and movable with the valve 85 and that these segments are so arranged with relation to each other that the valve 85 cannot be operated until the valve 84 has been operated to move the segment 86 out of engagement with the segment 87 rigidly secured to and movable with the valve 85. Fig. 7 shows diagrammatically the valves 82, 83, 84 and 85, together with their connections to the cylinders 25 and 40 and the pump 80 which will supply oil under pressure from a tank 88 which is secured to and forms a part of the base 1.

The valve generally indicated by the numeral 82 comprises a casing 89 in which is slidably mounted a valve member 90 having a series of passageways therein which will cooperate with ports in the casing 89; and the valve generally indicated by the numeral 83 comprises a casing 91 in which is slidably mounted a valve member 92 having a series of passageways therethrough which will cooperate with ports in the casing 91.

The pump 80 is of conventional standard design and is of the type which is continually operated having a by-pass through which oil is returned to the reservoir after a certain predetermined pressure has been reached in the system. This will enable the oil throughout the system to always be maintained under a certain predetermined pressure which will cause the various parts operated thereby to move quickly upon operation of any of the control valves.

The operation of the device will now be explained, having reference to Fig. 7 which, as has been stated, shows diagrammatically the various control valves and piping for operating the pistons 26 and 41. Fig. 7 shows the various control and operating valves and the pistons 26 and 41 in the position they assume at the completion of the operating stroke of the piston 26 which forces the molten metal under pressure from the pot 11 into the die space formed between the dies 13 and 14, and before they have been returned to their initial positions. That is, the dies are still closed and the plunger 29 is in its lowermost position, having forced the molten metal out of the cylindrical member 27 and not yet having been returned to its initial position which will allow a new charge of molten metal to flow into the cylindrical liner or sleeve 28.

Fig. 8 shows the position of the manually operating valves 84 and 85 when the parts are in their initial position, that is, when the dies 13 and 14 are open and the piston 26 is in its uppermost position, as is shown in Fig. 4a. To operate, the valve 84 is first turned from the position shown in Fig. 8 to the position shown in Fig. 7. Oil will then be drawn by the pump 80 from a tank 88 and forced through the conduit 95 into the conduit 96, thence through the passageway 97 and through conduit 98 into the valve casing 89, forcing the valve member 90 to the position shown in Fig. 7. Oil will then be forced from the conduit 95 through the passageway 99 in the valve member 90 and out through the conduit 100 and into the rear of the cylinder 40 behind the piston 41 which will force the piston 41 from the dotted line position in Fig. 7 to the full line position therein. As the piston 41 is moving forwardly, the oil in front of the piston 41 will be forced out of the cylinder 40 through the conduit 101, through the passageway 102 in the valve member 90 and back to the reservoir 88 through the conduit 103. As the valve member 90 is being moved to the position shown in Fig. 7 by the admission of oil to the valve casing 89 through the conduit 98, the oil on the other side of the valve member 90 will be forced outwardly through the conduit 104, passageway 105 in the control valve 84 and back to the supply tank 88 through the conduits 106 and 107. This forward movement of the piston 41 will operate the toggle mechanism to move the movable die carrier 7 forwardly and close the dies 13 and 14.

The forward movement of the piston 41 and consequently the cross-shaped member 43 will operate a safety valve generally indicated by the numeral 108 which is secured to and supported by the plate 70. This valve is operated in one direction, that is, to the open position as is shown in Fig. 7, by a rod 109 which comes in contact with the rod 110 carried by the valve member 111 mounted within the casing 112 of the valve 108. The valve member 111 is moved in the opposite direction by a spring 113 when the rod 109 is moved out of engagement with the rod 110 when the piston 41 is operated to open the dies 13 and 14.

After the valve 84 has been operated from the position shown in Fig. 8 to the position shown in Fig. 7, the valve 85 can then be operated, being moved from the position shown in Fig. 8 to the position shown in Fig. 7. As stated before, this valve 85 controls the operation of the control valve 83 but even though it may be operated before the dies are completely closed, it will have no effect upon the operation of the piston 26 until the valve member 111 of the valve 108 has been moved to the position shown in Fig. 7. After the valve 85 has been turned to the position shown in Fig. 7 and the dies 13 and 14 have been closed, which will in turn move the various parts of the valve 108 to the position shown in Fig. 7, oil will be forced by the pump from the conduit 95 through conduit 115, passageway 116 in the valve 85 and thence through conduit 117, passageway 118 in the valve member 111 and thence through conduit 119 into the valve casing 91 which will move the valve member 92 to the position shown in Fig. 7. As this valve member 92 is moving to this position, the oil ahead of the valve member 92 will be forced out through the conduit 120 and through the passageway 121 in the chamber 85 and thence back to the reservoir 88 through conduits 122 and 107. After the valve 92 has been moved to the position shown, oil which is maintained in a pres-

sure tank 123 under a certain definite predetermined pressure will be forced rapidly out of the pressure tank 123, through conduits 124, 125 and passageway 126, thence through conduit 127 into the upper end of the cylinder 25 which will force the piston 26 rapidly downwardly to the position shown in dotted lines in Fig. 7 to that shown in full lines. This will force the molten metal out of the cylindrical sleeve or liner 28 and into the mold cavity very rapidly and under a definite predetermined pressure and will allow that pressure to be maintained upon the metal for the desired time. As the piston 26 is moved downwardly, it will force the oil ahead of it out of the cylinder 25 and through the conduit 128 and passageway 129 in the valve member 92 and thence back to the reservoir through the conduit 107. The pressure upon the oil within the tank 123 is maintained by a compressible gas, preferably nitrogen, which is placed therein under a definite pressure, as is standard practice in devices of this character.

In order to return the parts back to the initial position and eject the casting from the mold, the valve 85 is turned from the position shown in Fig. 7 to the position shown in Fig. 8. Oil will then be forced by the pump 80 through the conduits 95, 115, passageway 121 and the valve 85 and thence through conduit 120 into the valve casing 91 which will force the valve member 92 to the left from the position shown in Fig. 7. As this valve member moves to the left, under this pressure the oil ahead of the valve will be forced outwardly through the conduit 119, passageway 118 and the valve member 111 and thence through the conduit 117 and thence through the passageway 116 in the valve 85 into the conduit 122 and thence back to the reservoir through the conduit 107. After the valve member 92 has moved to the left, oil will be forced by the pump 80 through conduits 95 and 130 and thence through the passageway 131 and into the cylinder 25 through the conduit 128. This will move the piston 26 upwardly from the position shown in full lines in Fig. 7 to the position shown in dotted lines. As the piston moves upwardly, oil will be forced out of the cylinder 25 through conduit 127, passageway 132 and thence back to the reservoir 88 through the conduit 107. The valve 84 will now be turned from the position shown in Fig. 7 to that shown in Fig. 8. When this is done, oil will be forced by the pump through the conduits 95, 96, passageway 105 and conduit 104 into the valve casing 89 to move the valve member 90 to the right from the position shown in Fig. 7. As the valve member 90 is moving to the right, oil will be forced out of the valve casing 89 and back to the reservoir 88, through conduit 98, passageway 97, conduit 106 and conduit 107. After the valve member 90 has moved to the right, the pump will force oil through the conduit 95, passageway 99, conduit 101 and thence into the cylinder 40 which will move the piston 41 from the position shown in full lines to that shown in dotted lines. As the piston 41 is being moved to the dotted line position, it will force oil out of the cylinder 40 through the conduit 100, passageway 133 in the valve member 90 and conduit 103, back to the reservoir 88. The parts now are in position to repeat the operation.

Oil will be forced back into the pressure tank 123 by the pump 80 through conduits 95 and past check valve 134 and through conduit 124 into the tank 123.

Having thus described our invention, what we claim is:

1. In a die casting machine the combination of a base, a stationary die supporting member rigidly secured to said base and extending upwardly therefrom, a support slidably mounted on said base, a plurality of rods rigidly secured at one end to said stationary die supporting member and extending through apertures in said support, inter-engaging means between said support and said rods for adjustably securing said support in fixed relation to said stationary die support, a movable die carrier slidably mounted on said rods between said stationary die supporting member and said support, a pair of guide rods rigidly secured at one end to said movable die carrier and slidably extending through apertures in said support, a crosshead slidably mounted on said rods between said support and said movable die carrier, a pair of toggle mechanisms each comprising a pair of links pivotally connected to each other at one of their ends and having their other ends connected to said support and said movable die carrier respectively, links pivotally connected to said crosshead and to said toggle mechanisms, power means carried by said support and operatively connected to said crosshead for reciprocating said crosshead to open and close said toggle links and move said movable die carrier toward and away from said movable die support, and adjustable means carried by said crosshead for engaging said movable die carrier after a predetermined movement thereof in one direction.

2. In a die casting machine the combination of a base, a pair of relatively movable dies, means for forcing molten metal into said dies when in closed position, means for supporting and opening and closing said dies comprising a stationary die support rigidly secured to said base and extending upwardly therefrom, a support adjustably secured to said base in spaced relation to said stationary die support, a plurality of rods extending between said stationary die support and said support and secured thereto, a die carrier slidably supported on said rods, a pair of guide rods secured to said die carrier and slidably extending through apertures in said support, a crosshead slidably mounted on said guide rods, power means carried by said support and operatively connected to said crosshead for reciprocating said crosshead on said guide rods, toggle links connected to said support and to said die carrier, operative connections between said crosshead and said toggle links through which the toggle links are opened and closed by the reciprocation of said crosshead and adjustable means for limiting the movement of said crosshead in one direction.

3. In a die casting machine the combination of a base, a stationary support rigidly secured to said base and extending upwardly therefrom, an adjustable support slidably secured to said base in spaced relation to said stationary support, a plurality of rods secured to and extending between said stationary support and said adjustable support, a movable die carrier slidably mounted on said rods between said stationary support and said adjustable support, a pair of guide rods rigidly secured to said movable die carrier and slidably extending through apertures in said adjustable support, a pair of complementary dies one secured to said stationary support and the other to the movable die carrier in operative relation to each other, means for forcing

molten metal into said dies when in closed position, toggle mechanism connected to said die carrier and said adjustable support and operative to reciprocate said die carrier to open and close said dies, means for operating said toggle mechanism comprising a crosshead slidably mounted on said pair of guide rods, power means carried by said adjustable support, operative connections between said power means and said crosshead for reciprocating said crosshead, operative connections between said toggle mechanism and said crosshead, and adjustable means for limiting the movement of said crosshead in one direction.

4. In a die casting machine the combination of a base, a stationary support rigidly secured to said base and extending upwardly therefrom, an adjustable support slidably secured to said base in spaced relation to said stationary support, a plurality of rods secured to and extending between said stationary support and said adjustable support, a movable die carrier slidably mounted on said rods between said stationary support and said adjustable support, a pair of guide rods rigidly secured to said movable die carrier and slidably extending through apertures in said adjustable support, a pair of complementary dies one secured to said stationary support and the other to the movable die carrier in operative relation to each other, means for forcing molten metal into said dies when in closed position, means including a crosshead slidably mounted on said pair of guide rods for reciprocating said movable die carrier to open and close said dies, and adjustable means for limiting the movement of said crosshead in one direction.

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