

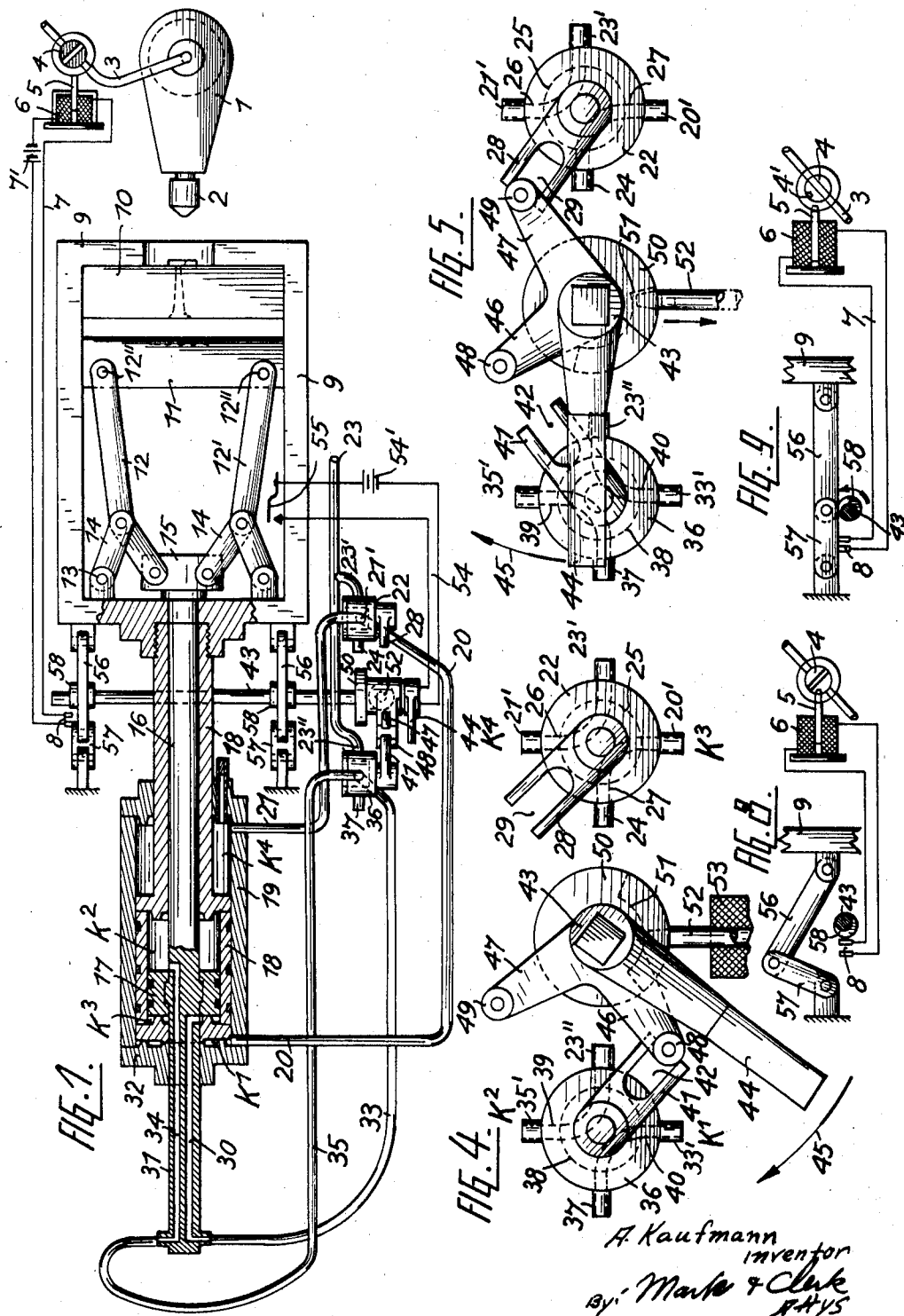
March 13, 1928.

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A. KAUFMANN
DIE CASTING MACHINE

Filed July 17, 1926

4 Sheets-Sheet 1



March 13, 1928.

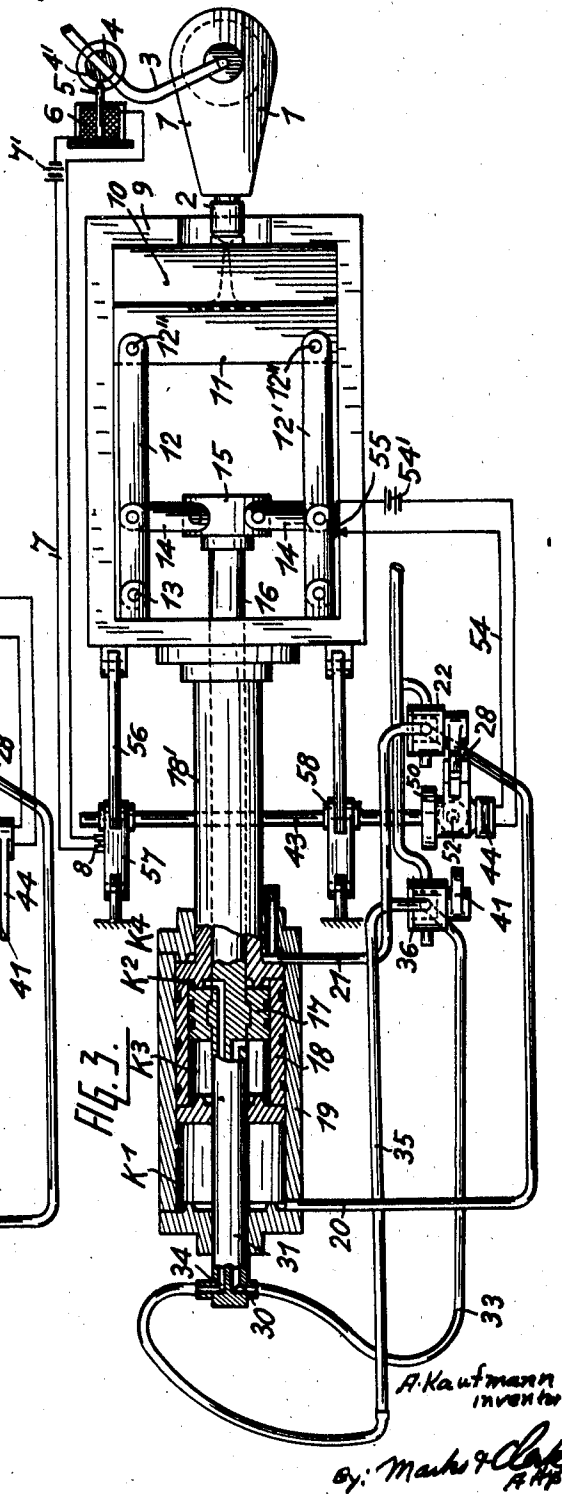
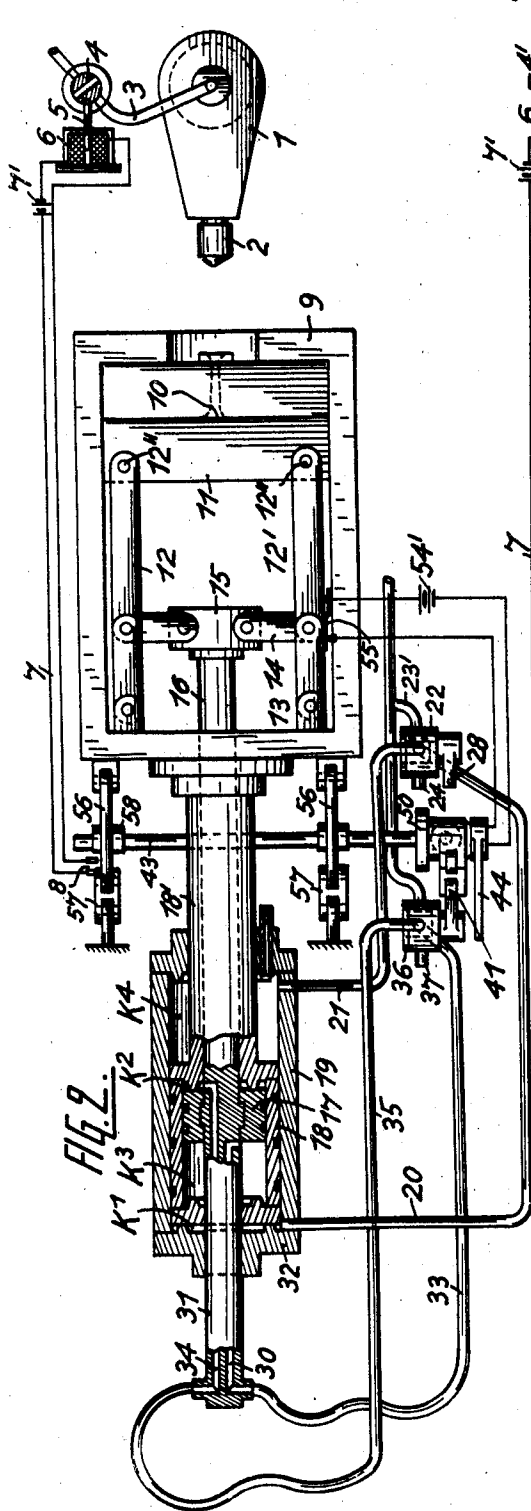
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DIE CASTING MACHINE

Filed July 17, 1926

4 Sheets-Sheet 2



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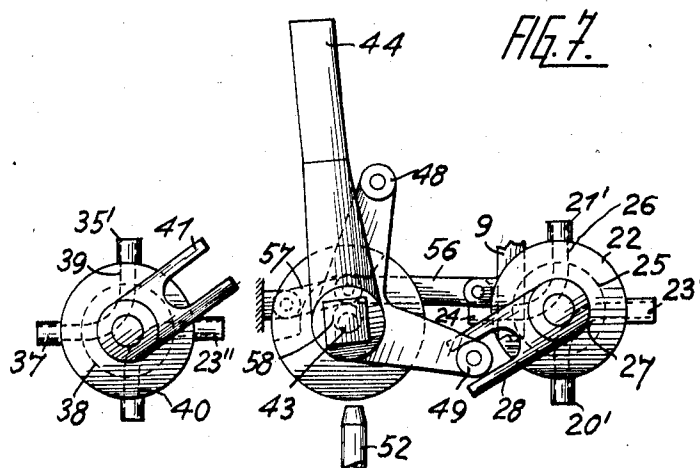
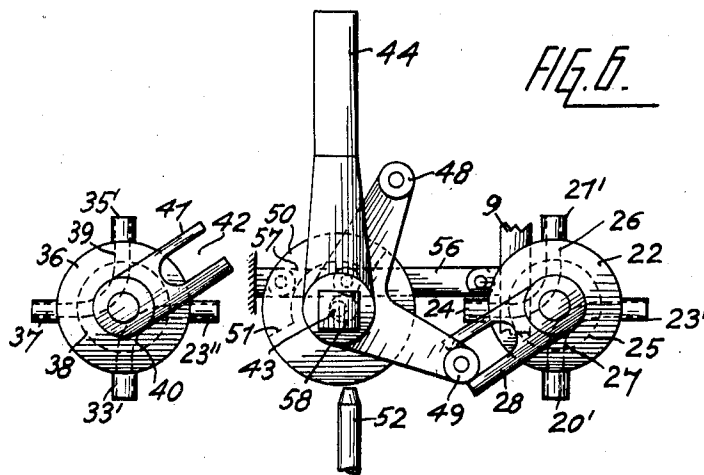
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DIE CASTING MACHINE

Filed July 17, 1926

4 Sheets-Sheet. 3



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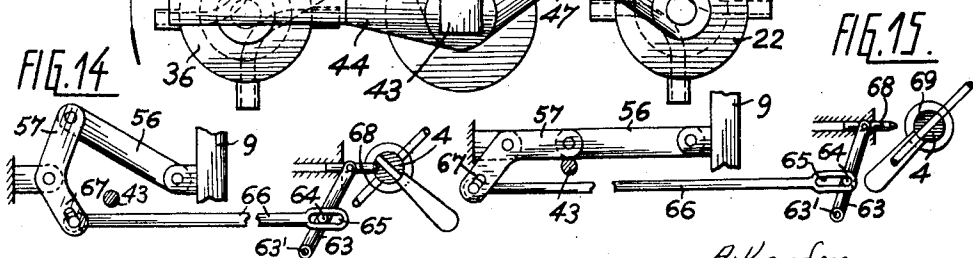
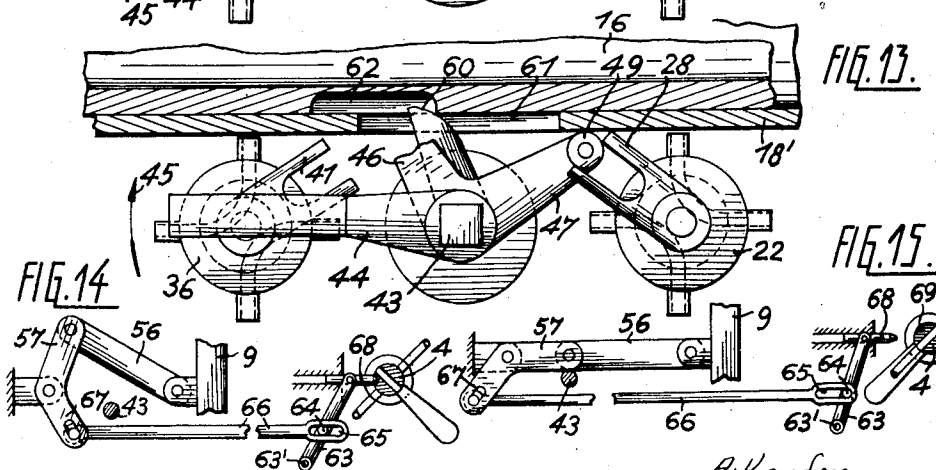
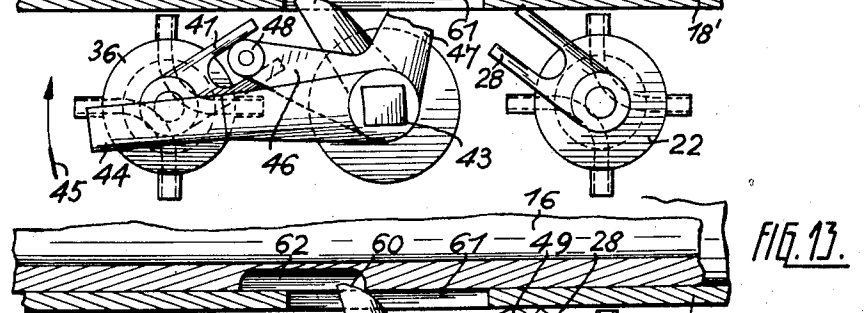
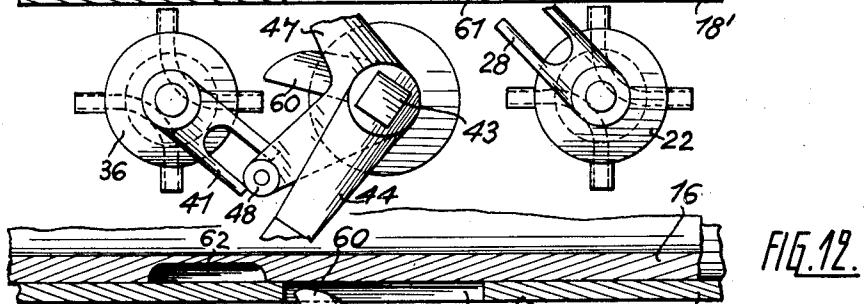
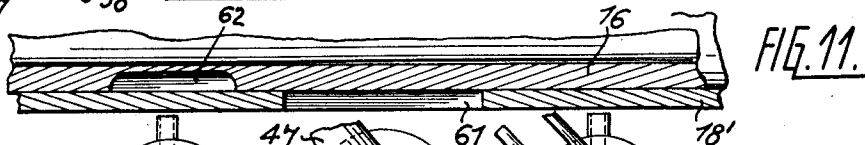
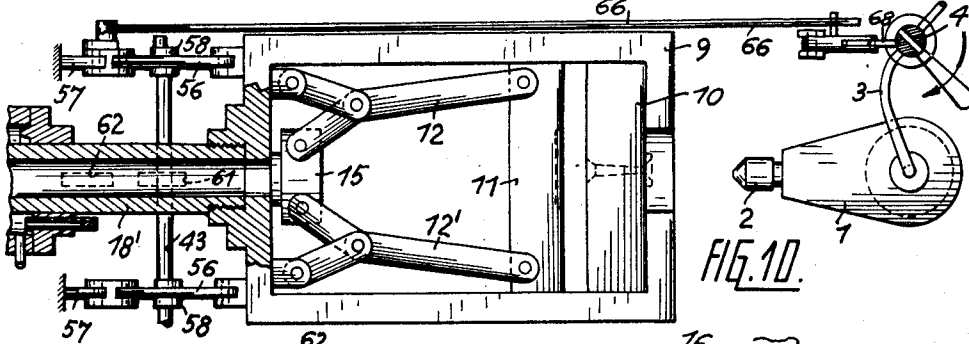
1,662,750

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DIE CASTING MACHINE

Filed July 17, 1926

4 Sheets-Sheet 4



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UNITED STATES PATENT OFFICE.

ALBERT KAUFMANN, OF BERLIN, GERMANY.

DIE-CASTING MACHINE.

Application filed July 17, 1926, Serial No. 123,157, and in Germany August 3, 1925.

My invention relates to die-casting machines and it is an object of my invention to improve machines of this type in which a fluid under pressure, generally air, is employed for displacing the die with regard to the injection nozzle and for opening and closing the die. Separate cylinders were provided for displacing and for controlling the die, and in the machines of the usual type the die control cylinder was arranged on the frame by which the die was displaced and this required a very rugged frame and a corresponding power input for displacing it.

In my invention, I overcome this drawback of the existing machines by combining the two cylinders into a single unit which is carried on the frame of the machine, the die control cylinder for closing and opening the die constituting the hollow piston of the frame control cylinder, the latter being stationary.

By this novel combination of the two cylinders into a single unit not only the die and the frame are moved in exactly parallel relation but it is also possible to provide automatic, positive and reliable means for regulating the operation of the machine so that the frame can only be advanced toward the injection nozzle after the die has been completely closed, and air can only be admitted to the injection nozzle when the die is in proper position with respect to said nozzle.

In the drawings accompanying this specification a die-casting machine embodying my invention is illustrated by way of example.

Figs. 1, 2 and 3 are plan views, partly in section, showing somewhat diagrammatically three phases of operation of the machine,

Figs. 4, 5, 6 and 7 are enlarged end elevational details showing various positions of the valves controlling the two cylinders of the unit,

Figs 8 and 9 are enlarged elevational details showing two positions of the system of toggle levers by which the supply of fluid under pressure to the injection nozzle is locked against untimely operation, this being effected by electrical means,

Figs 10, 11 12 and 13 are enlarged fragmentary details partly in section showing various positions of the cylinder control valves in combination with mechanical means for regulating the operation, and

Figs. 14 and 15 are enlarged elevational details showing two positions of mechanical means for preventing untimely operation of the fluid supply to the injection nozzle.

I will now proceed to describe my novel machine and its operation, it being understood that notwithstanding the fact that the fluid under pressure will be referred to as "air", any other fluid may be employed.

Referring to the drawings, and first to Figs. 1, 2 and 3, 1 is a reservoir containing molten metal, 2 is its injection nozzle, 3 is a pipe for supplying compressed air to the reservoir, 4 is a control valve in the pipe 3, 5 is the core of an electromagnet coil or a solenoid 6 which core is provided with means—not shown—for causing it to enter a notch 4' in the body of the valve unless attracted by its coil, 7' is a source of energy, and 8 is a contact in the circuit 7 of the coil 6. The means for controlling the contact 8 will be described below.

The frame of the machine is not shown. A die frame 9 is adapted to be displaced on the frame. The front part 10 of the die which is adapted to be connected with the nozzle 2 is secured in the frame 9 and its rear part 11 is adapted to slide in the frame under the control of two pairs of toggle levers 12, 12' which are hinged to the rear part 11 at 12'' and to the rear stay of the frame 9 at 13. 14 are levers linked to the pivots connecting the toggle levers at one end and to a cross head 15 at the other, 16 is a piston rod on which the cross head is secured, 17 is a piston on said rod, and 31 is its integral tail rod which extends through the rear cover 32 of a cylinder 19. The piston 17 is the die control piston and 18 is its cylinder which constitutes the hollow piston of the frame control cylinder 19 which is secured to the frame of the machine, and 18' is the tubular piston rod of this frame control cylinder which rod is adapted to slide on the solid piston rod 16 of the die control cylinder and is secured to the rear stay of the frame at its outer end.

22 and 36 are four-way valves controlling the supply of air to the cylinders 18 and 19. 23 is an air pipe and 23' and 23'' are branch pipes connecting this pipe to the cases of the valves 22 and 36, respectively.

The body 25 of the valve 22 is provided with two passages 26 and 27. 20 is a pipe connecting the rear chamber K' of the frame control cylinder 19 with a pipe 20' of the

valve case 22, and 21 is a pipe connecting the front chamber K⁴ of the cylinder with a pipe 21' of the valve case 22. 24 is a pipe connecting the valve case 22 with atmosphere. 28 is a lever on the body 25 of the valve 22, and 29 is an elongated open eye at the end of the lever.

The other valve 36 comprises a valve body 38 with two passages 39 and 40. 33' and 35' are pipes on the case of the valve and 33 and 35 are flexible pipes connecting the pipes 33' and 35' with passages 30 and 34 in the tail rod 31. The passage 30 opens into the chamber K³ of the hollow piston 18 at the rear of the die control piston 17 and the passage 34 opens into the chamber K² at the front of the piston 17. 37 is a pipe connecting the valve case with atmosphere. 41 is a lever having an open elongated eye 42 and secured on the body 38 of the valve 36.

43 is a horizontal control shaft carried in the frame intermediate the valves 22 and 36, 44 is a handle secured on the square front end of the shaft 43, and 46, 47 is a bell crank lever keyed on the shaft 43 and provided with rollers 48 and 49 which are adapted to engage the slotted eyes of the levers 41 and 28, respectively.

50 is a cam also secured on the shaft 43 and adapted to cooperate with the core 52 of an electromagnet or solenoid coil 53 which tends to enter a recess 51 of the cam 50 unless attracted by its coil. 54 is the circuit of the coil, 54' is a source of electric energy, and 55 is a contact, both in the circuit 54, the contact being normally open and adapted to be closed by the toggle levers 12' when such levers are straightened out as shown in Figs. 2 and 3.

56, 57 are two more pairs of toggle levers which are pivoted to the rear stay of the frame 9 at one end and to the machine frame at the other, and 58 are eccentrics on the shaft 43 which move the toggle levers out of their straightened position. The pair of toggle levers at the left is adapted to cooperate with the contact 8 of the circuit 7, the lever 57 closing the contact when the levers are straight as shown in Fig. 9.

The operation of my machine is as follows:

In the initial position shown in Fig. 1, the frame 9 is at a predetermined distance from the injection nozzle 2, the toggle levers 12, 12' and the toggle levers 56, 57 are at an angle to each other, the die is open and the circuits 7 and 54 are broken at their respective contacts 8 and 55. The core 5 of the coil 6 locks the valve 4 against rotation by entering the notch 4' and the core 52 of the coil 53 is in the recess 51 of the cam 50. The handle 44 is in the position shown in Fig. 4 in which the roller 48 at the arm 46 is about to enter the open eye 42 of the lever 41. Air from 23 and 23' enters the chamber K² of the die control cylinder 18 via 39, 35', 35 and 34, holding the piston 17 in its rear end posi-

tion in the hollow piston 18. At the same time, air is supplied to the chamber K⁴ of the cylinder 19 via 23, 23', 26, 21' and 21 so that the piston 18 is also held in its rear end position in the cylinder 19. The chamber K' and K³ are connected to atmosphere via 20, 20', 27, 24 and 30, 33', 40 and 37, respectively.

To operate the machine, the handle 44 is turned in the direction of the arrow 45 until it assumes the position shown in Fig. 5 in which further operation of the handle is prevented by the end of the recess striking the core 52. In this position the arm 46 turns the lever 41 of the valve 36 so that the passages of its body 38 make the following connections: 23'', 40, 33', 33, 30 and chamber K³, chamber K², 34, 35, 35', 39, 37 and atmosphere. The roller 48 now releases the lever 41 and air enters the chamber K³ of the piston 18, forcing the piston 17 forward, straightening out the toggles 12, 12' and closing the die as shown in Fig. 2. This causes the circuit 54 to be closed at 55, the coil 53 is energized and withdraws its core 52 from the recess 51 of the cam 50 so that the handle 44 may be turned further in the direction of its arrow 45. The roller 49 at the end of the lever 47 now enters the eye of the lever 28, rotating the lever arm and the body of the valve 22 makes the following connections when the parts are in the position shown in Fig. 6: 23', 27, 20', 20 chamber K', and chamber K⁴, 21, 21', 26, 24. The position of the valve 36 is not affected. The air in the chamber K' now pushes forward the hollow piston 18 in which the position of the piston 17 remains unchanged, and the frame 9, so that the die 10, 11 is connected with the nozzle 2 as shown in Fig. 3. The motion of the frame 9 causes the toggle levers 56, 57 to become straightened and the lever 57 in the pair at the left closes the contact 8 of the circuit 7 so that the coil 6 is energized and attracts its core 5 which now releases the body of the valve 4 so that it may be operated to admit air to the reservoir 1 through the pipe 3.

When the casting operation has been completed the handle 44 is turned against the arrow 45. When it has been turned through a slight angle as shown in Fig. 7 the eccentrics 58 on the shaft 43 raise the toggle levers 56, 57 which is necessary as otherwise the frame 9 could not be returned to its initial position. This also opens the contact 8 and the core 5 tends to return into its initial position in which it locks the valve 4 against rotation. Upon further turning of the handle 44 against the arrow 45 the position in Fig. 5 will be reached. Air now enters the chamber K⁴ and is discharged from K' through the valve 22 and the hollow piston 18 is returned to its initial position, withdrawing the frame 9 from the injection nozzle 2. However, the die remains closed

until the valve 36 has been returned to its initial position in Fig. 4 upon further rotation of the handle 44. Air is now supplied to the chamber K^2 and discharged from the chamber K^3 in the hollow piston through the valve 36, returning the piston 17 to its initial position and opening the die. The parts are now again in the position of Fig. 1, and ready for another operation.

Referring now to Figs. 10 to 15, these show a mechanical locking device for preventing untimely operation of the valve 4. In this device, a pawl 60 is secured on the shaft of the handle 44 which is in the axial plane of the piston rods 16 and 18'. A longitudinal slot 61 is formed in the hollow piston rod 18' and a recess 62 is formed in the solid piston rod 16 and adapted to register with the slot 61 when the die has been closed. Only when the slot and the recess register in this manner as shown in Fig. 13, the handle 44 can be turned so as to advance the frame 9 towards the injection nozzle 2. It will appear from Figs. 11 and 12 that the handle 44 can be turned freely until the valve 36 has been operated so as to close the die, as described with reference to Figs. 4 to 7. The positions of the handle 44 are the same in Figs. 4 and 11, and 5 and 12, respectively, and the registering of the slot 61 and the recess 62 in Fig. 13 corresponds to the withdrawal of the core 52 from the recess 51 of the cam 50 in Fig. 6. When the slot and the recess register, it is possible to turn the handle further and to operate the valve 22, as the pawl 60 is no longer obstructed, and this registering will occur only when the toggles 12, 12' have been fully straightened so as to close the die. In other words, the valve 22 cannot be operated before the die has been closed. When it is so closed, air will be supplied to K' in the manner described above, and the frame 9 will be urged forwardly by the hollow piston 18 and into engagement with the nozzle 2.

The mechanical means for locking the air inlet valve 4 are shown in two positions in Figs. 14 and 15. The toggle levers 56, 57 are constructed as described but in this case one of the levers 57 is provided with an arm 67 the slotted eye of which engages a rod 66 having a slotted eye 64 at its other end which engages a pin 64 on a lever 63 fulcrumed in the frame of the machine—not shown—at 63'. This lever cooperates with a locking pin 68 which corresponds to the core 5 in Figs. 8 and 9 and is adapted to enter a notch 69 in the valve 4 so as to lock the valve when the toggles 56, 57 are at an angle as in Fig. 14 and to release the valve when they have been straightened as in Fig. 15 and the pin 68 has been withdrawn. When the handle 44 is reversed the eccentrics 58 on the shaft will first throw out the toggles 56, 57 and then the frame 9 will be withdrawn and the

die opened as described with reference to Figs. 1 to 7.

It will be understood from the foregoing description that both the electrical and mechanical locking means absolutely prevent untimely operation of the inlet valve 4 so that any danger to the operator is absolutely eliminated.

It will be understood as well that I am not limited to the construction shown and described as it might be modified in various ways without departing from the spirit of my invention.

I claim:

1. Die-casting machine comprising an injection nozzle, a frame, a die on said frame, a cylinder adapted to displace said frame with respect to said nozzle, a cylinder inserted in said first cylinder and adapted to control the opening and closing of said die, means for supplying fluid under pressure to said two cylinders, and means for regulating the operation of said supplying means.

2. Die-casting machine comprising an injection nozzle, a frame, a die on said frame, a stationary cylinder comprising a hollow piston adapted to displace said frame with respect to said nozzle, a solid piston adapted to be displaced in said hollow piston, means operatively connecting said solid piston with said die so as to control its opening and closing means for supplying fluid under pressure to said cylinder and said hollow piston, and means for regulating the operation of said supplying means.

3. Die-casting machine comprising an injection nozzle, a frame, a die on said frame, a cylinder adapted to displace said frame with respect to said nozzle, a cylinder inserted in said first cylinder and adapted to control the opening and closing of said die, a supply of fluid under pressure, valves for regulating the access of such fluid to each one of said cylinders, and a manually operated shaft for operating said valves in succession.

4. Die-casting machine comprising an injection nozzle, a frame, a die on said frame, a die comprising a part fixed on said frame and a part movable thereon, toggle levers inserted between said movable part and said frame, means for operating said toggle levers so as to control said die, means for displacing said frame, toggle levers adapted to lock said frame in its final position, means for supplying fluid to said displacing and controlling means and said injection nozzle, means for regulating the fluid supply to said displacing and die controlling means, a contact in a circuit operatively connected with said die controlling means, means in said circuit for temporarily locking said regulating means against operation, a contact in a circuit operatively connected with said frame locking toggle levers, and means

in said circuit for temporarily locking the injection nozzle supplying means against operation.

5 5. Die-casting machine comprising an injection nozzle, a frame, a die on said frame, a cylinder adapted to displace said frame with respect to said nozzle, a cylinder inserted in said first cylinder and adapted to control the opening and closing of said die, a
10 supply of fluid under pressure, a four-way cock connected to each cylinder and to said supply, a manually operated shaft, a lever on said shaft adapted to cooperate with each four-way cock, and levers on said cocks
15 adapted to be engaged by said lever on said shaft during part of a rotation of said shaft only.

6. Die-casting machine comprising an injection nozzle, a frame, a die on said frame, a stationary cylinder comprising a hollow piston adapted to displace said frame with respect to said nozzle, a solid piston adapted to be displaced in said hollow piston, a piston rod comprising a tail rod connected with said solid piston, means operatively connecting said solid piston with said die so as to control its opening and closing, means for supplying fluid under pressure to said cylinder and said hollow piston, said latter means being partly constituted by longitudinal passages defined in said tail rod, and

means for regulating the operation of said supply means.

7. Die-casting machine comprising an injection nozzle, a frame, a die on said frame, 35 a die comprising a part fixed on said frame and a part movable thereon, toggle levers inserted between said movable part and said frame, means for operating said toggle levers so as to control said die, means for 40 displacing said frame, toggle levers adapted to lock said frame in its final position, means for supplying fluid to said displacing and controlling means and said injection nozzle, means for regulating the fluid supply to said 45 displacing and die controlling means, said regulating means comprising a manually operated shaft, a cam on said shaft defining a recess, a locking bolt in an electric circuit normally entering said recess, a contact in 50 said circuit adapted to be closed by said die controlling toggle levers so as to withdraw said bolt from said recess when said levers have become straightened, and means operatively connected with said frame locking 55 toggle levers for temporarily locking the injection nozzle supplying means against operation.

In testimony whereof the foregoing specification is signed.

ALBERT KAUFMANN.