Oct. 2, 1934. R. F. MORRISON 1,975,370

ENGINE FOR OPERATING PRESSES

Filed Aug. 11, 1930 3 Sheets-Sheet 1

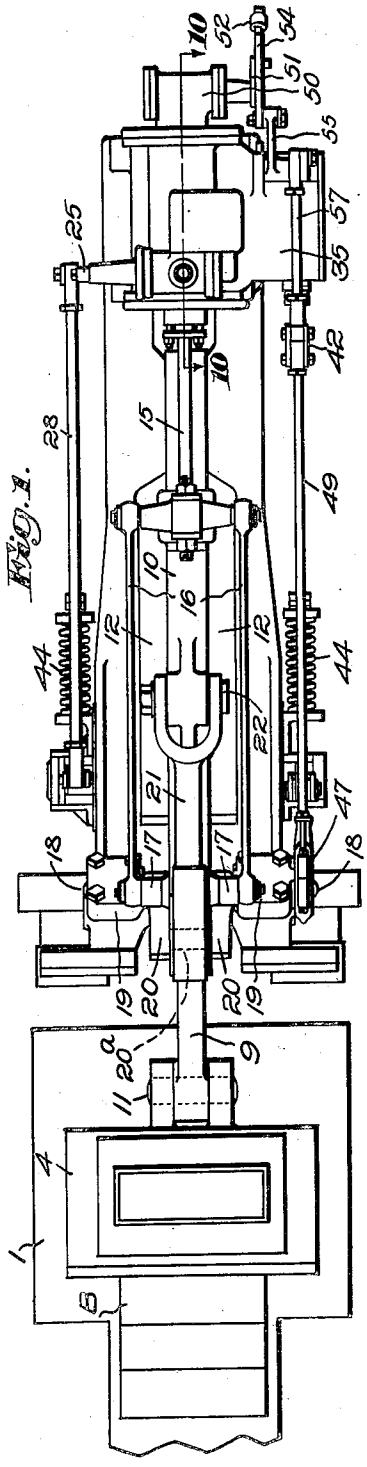


Fig. 1.

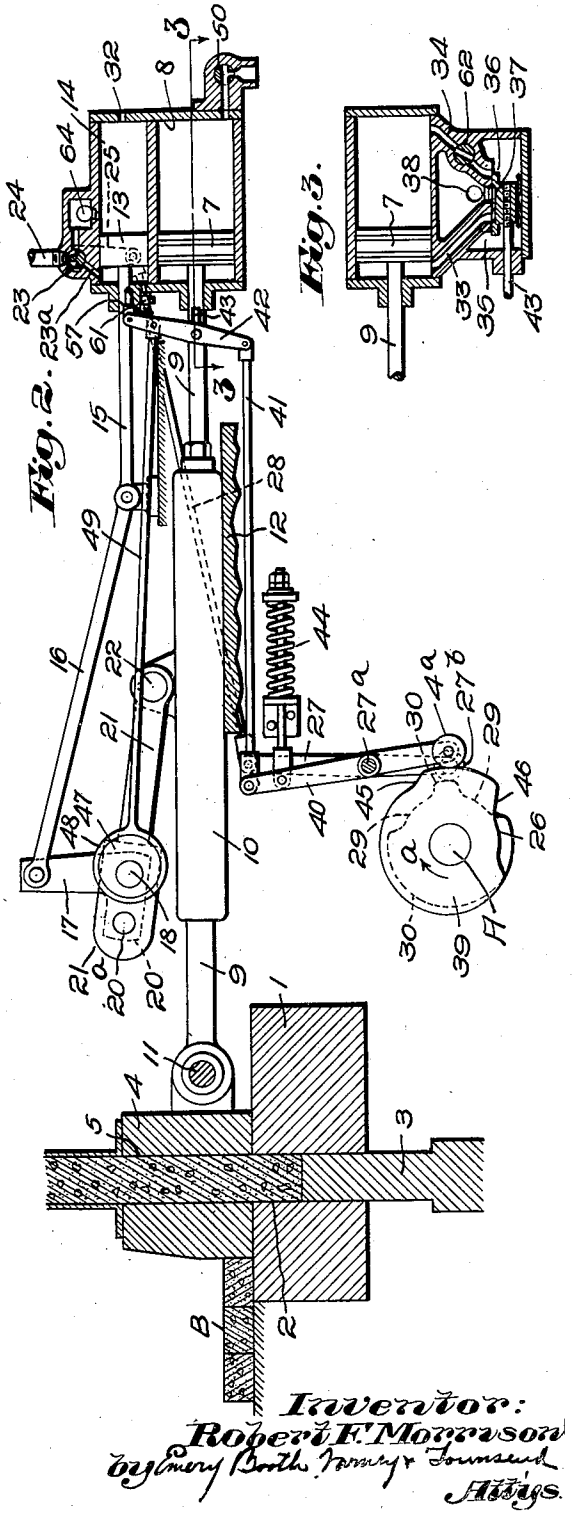


Fig. 2.

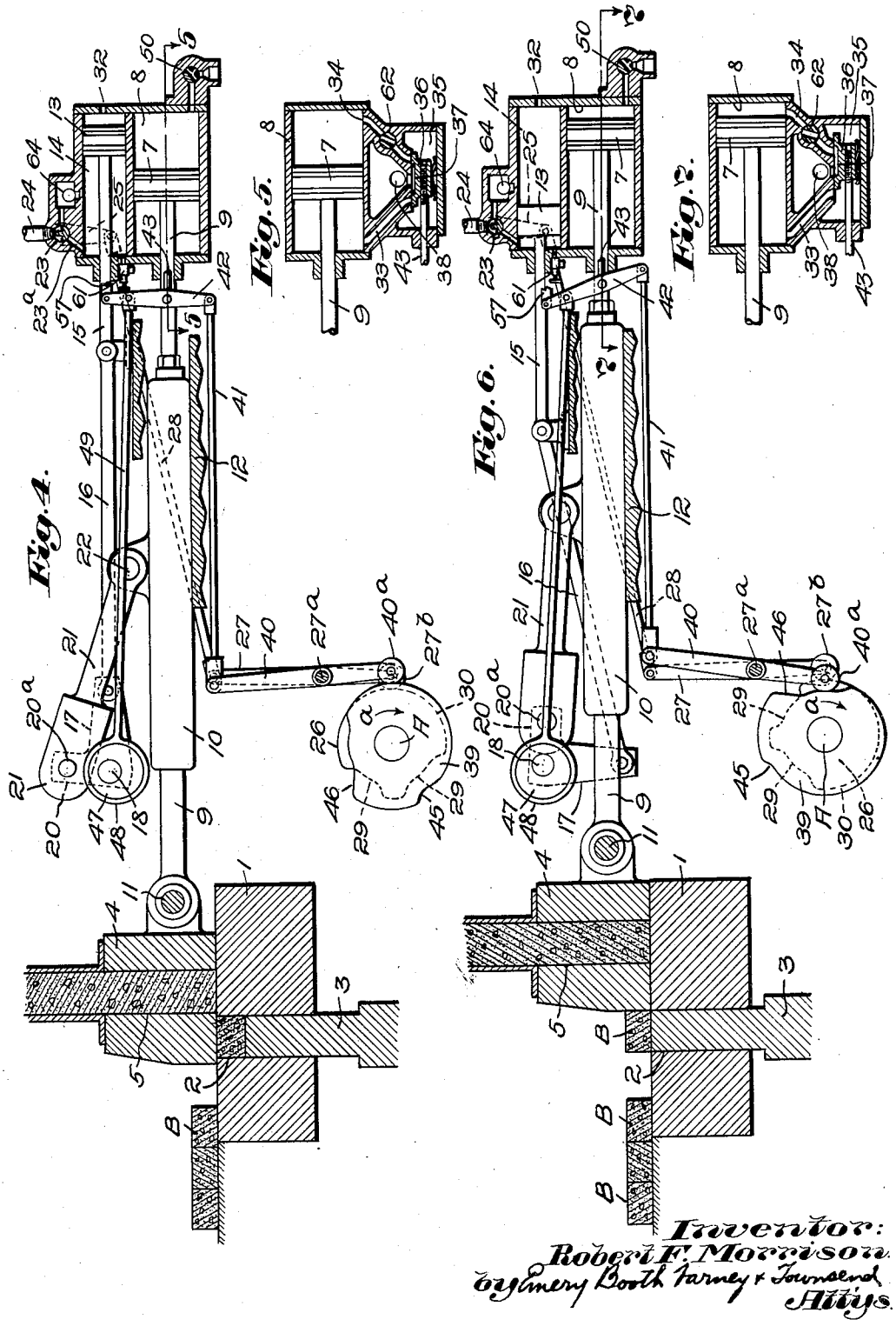
Fig. 3.

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ENGINE FOR OPERATING PRESSES

Filed Aug. 11, 1930 3 Sheets-Sheet 3

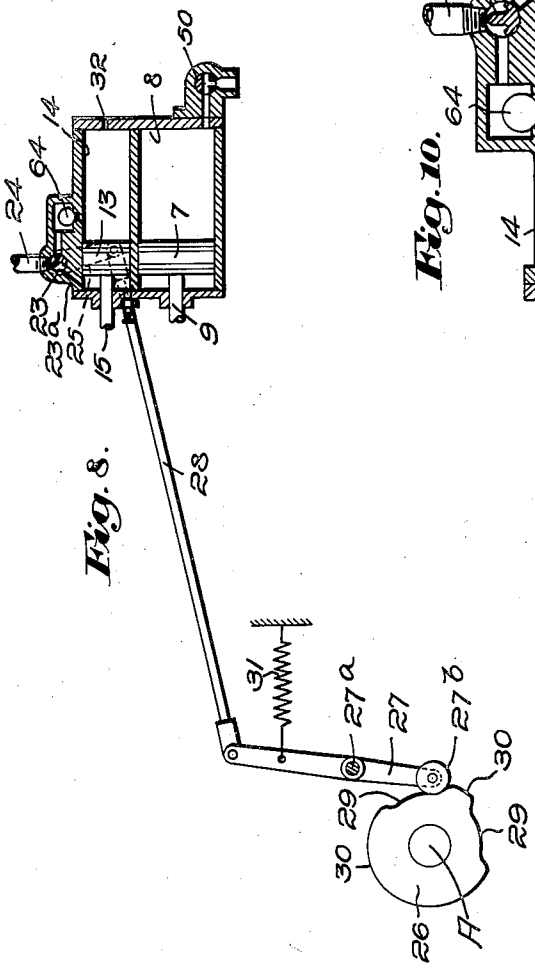


Fig. 8.

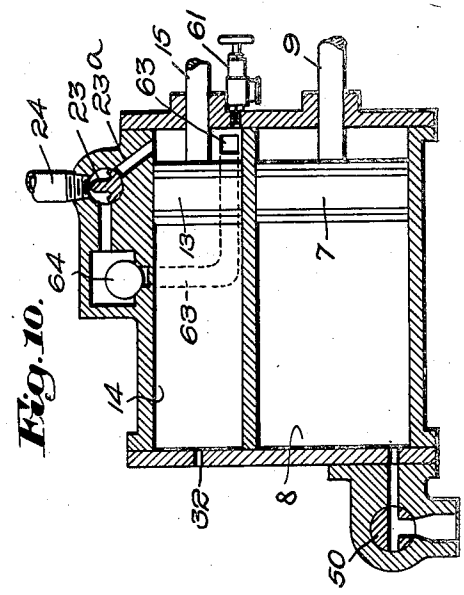


Fig. 10.

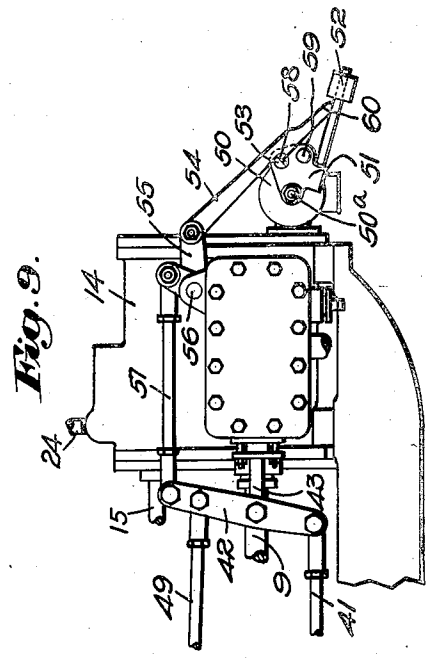


Fig. 9.

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UNITED STATES PATENT OFFICE

1,975,370

ENGINE FOR OPERATING PRESSES

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Application August 11, 1930, Serial No. 474,579

10 Claims. (Cl. 121—1)

My invention relates to improvements in block forming presses and other devices and machines having moving parts to be quickly accelerated and decelerated. More particularly, though not exclusively, the invention relates to improvements for effecting relative movement between the head of the press and the mold block of that type of press disclosed by United States patent to Whitney No. 1,003,561, issued September 19, 1911.

In the accompanying drawings I have shown one illustrative embodiment of my invention wherein:

Fig. 1 is a plan view of the sliding head of a press and instrumentalities for moving the same to its various positions;

Figs. 2, 4 and 6 are more or less diagrammatic elevations of the press according to Fig. 1 showing the sliding head and mold of the press and instrumentalities for imparting relative movement thereto arranged in positions representing successive stages in the operation of the head;

Figs. 3, 5 and 7 are sections on the lines 3—3, 5—5 and 7—7 respectively of Figs. 2, 4 and 6;

Fig. 8 is a longitudinal section of the cylinders according to Fig. 1 showing the mechanism for operating the fluid valve for the low pressure cylinder in valve opening position;

Fig. 9 is a side elevation of the cylinders for operating the sliding head showing the auxiliary valve for relieving the pressure in the high pressure cylinder; and

Fig. 10 is a detailed vertical section taken on the line 10—10 of Fig. 1.

As shown, the press comprises a stationary mold block 1 formed with a mold chamber 2 in which latter reciprocates a vertically moving plunger 3. Resting upon the mold block is a reciprocatory sliding head 4 herein provided with a passage 5 for feeding asphaltic or other material to the mold chamber, in which latter said material is compressed by the plunger 3.

In the preferred operation of the press, the mold filling passage 5 registers with the mold chamber 2 when the sliding head 4 is at one end of its stroke as shown by Fig. 2, hereinafter referred to as the "filling position". In this position the plunger 3 is at the lower portion of its stroke permitting the mold chamber to be filled. From its filling position the sliding head is moved from rest through part of its stroke in one direction to its "mold covering position", shown by Fig. 4, and permitted to remain stationary in the latter position to permit the mold plunger to be raised for compressing the block, whereupon the sliding head is moved through the remainder of its stroke in the same direction to its "block ejecting position" shown by Fig. 6, in which latter position it uncovers the mold chamber and permits the plunger 3 to be raised to eject the block. The sliding head is then moved through its stroke in the opposite direction to push away the block B formed by the preceding steps and to place the sliding head again in its filling position shown by Fig. 2.

As economic considerations make it necessary to make from 15 to 50 blocks per minute, it will be observed that the sliding head must in consequence be moved and brought to rest with great rapidity, and, as said head in practice may weigh in the order of several thousand pounds, exceedingly great destructive forces are set up due to the inertia of said head, which inertia must be overcome in accelerating and decelerating said head to cause it to come to rest in its several positions of operation and to move it from these positions.

The present invention is concerned more particularly with the instrumentalities for reciprocating the sliding head. The instrumentalities for moving the mold plunger 3 form no part of the present invention and therefore are not described. The latter, however, may be those described in the Whitney patent above referred to, which patent discloses a power actuated cam shaft, herein designated at A, for coordinating and controlling the operation of the sliding head and mold plunger. In the practice of the present invention this cam shaft may likewise be utilized for coordinating and controlling the operation of both the sliding head and plunger.

Herein, the sliding head 4 is moved by instrumentalities including a fluid actuated piston 7, the latter reciprocating in a cylinder 8 and connected by a piston rod 9 and cross head 10 directly with said sliding head at 11, the cross head 10 being arranged to slide in appropriate guides 12, 12. As shown, a second piston 13, of smaller diameter than the piston 7, and reciprocating in a cylinder 14, which latter is arranged above the cylinder 8 and formed integral therewith, is operatively connected by a piston rod 15 and twin connecting rods 16 to crank arms 17, 17, the latter carried by a shaft 18 journalled to rock in suitable stationary bearings 19, 19 carried by the frame of the machine. In addition to the crank arms 17, the shaft is also provided with a double crank arm 20 having a common crank pin 20^a, these latter crank arms as shown being spaced from the crank arms 17 slightly less than 90° and being connected by a connecting rod 21 and pin 22 with the cross head 10. As shown, the two

connecting rods 16 straddle the connecting rod 21, thereby more evenly transmitting the power supplied by the piston 13 to the shaft 18 than would be possible with a single crank 17 and connecting rod 16.

As shown, the crank 20, which as above described is connected to the cross head 10, while the latter is directly connected to the sliding head 4 and piston 7, is about one-half as long as the crank 17 connected to the piston 13. Consequently the shaft 18, carrying these cranks, when oscillated through one-half a revolution by said pistons, will necessitate one stroke of the piston 7 and two strokes of the piston 13. During each cycle of operation of the sliding head the shaft 18 will make a complete forward and back movement of oscillation, and the piston 7 will make two complete strokes and the piston 13 four complete strokes.

As illustrated, an oscillating distributing valve 23 is provided to supply pressure fluid, preferably steam, from a supply pipe 24 to the crank end of the cylinder 14 by way of a port 23ª, the stem of this valve being secured to an arm 25 to which a rocking movement is imparted at proper times in the operation of the machine by a cam 26 on the cam shaft A. As shown, the cam 26 operates upon a cam lever 27 which is pivoted at 27ª to a fixed part of the press and is connected by a link 28 with the arm 25, said cam being provided with appropriate depressions 29 in its periphery (see particularly Fig. 8), which depressions as the cam is rotated permit the cam follower 27ᵇ carried by the cam lever 27 to drop at appropriate times in the cycle of operations of the press from the high plane 30 of said cam under the action of a spring 31 to cause the valve 23 to open as shown in Fig. 8. When open the valve causes admission of pressure fluid to the crank end of the cylinder 14, thus causing the piston 13 to move toward the head end of the cylinder. The head end of the cylinder 14 herein is provided with an air vent 32 to permit the gradual escape of air when the piston 13 is moved toward said end and thus cause a smooth action of said piston.

The cylinder 8 as shown is provided with ports 33 and 34 leading respectively from points near opposite ends thereof to a steam chest 35, the latter herein provided with a reciprocating distributing valve 36 for controlling the admission and exhaust of pressure fluid to and from opposite ends of the cylinder. The valve 36, as shown, is of the conventional D-type, being provided with an exhaust cavity 37 in constant communication with an exhaust port 38.

Herein, for actuating the reciprocating distributing valve 36 a cam 39 is provided on the cam shaft A, said cam arranged to operate upon a cam lever 40, which latter is pivoted to a fixed part of the machine at 27ª. As shown, a link 41 operatively connects the upper free end of the cam lever 40 with the lower end of a floating lever 42, which latter at an intermediate portion thereof is connected to the valve 36 by a valve rod 43. A spring 44 maintains the cam follower 40ª of the cam lever 40 against the periphery of said cam 39 causing said follower to enter the depressions 45 and 46 of the cam during rotation of the latter, thus rocking said lever and causing movement of said valve. For further controlling the operation of the valve 36 the crank shaft 18 is provided with an eccentric 47 having an eccentric strap 48, which strap is operatively connected by an eccentric rod 49 to the floating lever 42 near the upper end of the latter.

In addition to the valve 36 and the ports controlled thereby, the cylinder 8 is herein shown as provided with a relief valve 50 timed to open during certain periods in the operation of the piston 7 to relieve the pressure in said cylinder. Herein, for operating the valve 50, an arm 51 (Fig. 9) is provided, which arm is attached to the spindle 50ª of the valve 50 to rock therewith. As shown, the arm 51 carries a weighted arm 52 which acts to maintain the valve 50 normally in closed position. On the arm 51 is a laterally projecting stud 53, and slidably resting on said stud is a pawl 54 pivotally secured to one arm of a bell crank lever 55, the latter pivoted at 56 to the engine cylinder or other stationary part of the apparatus. The other arm of the bell crank lever 55 is connected by a link 57 with the upper end of the floating lever 42, so that movement of said upper end of said lever to the left, as viewed in Fig. 9, will cause the tooth 58 on said pawl 54 to engage with the stud 52 and rock the valve 50 to its open position. As shown, the arm 51 also carries a laterally projecting pin 59, which as said arm 51 is swung upward, by engagement of the tooth 58 of the moving pawl 54 with the stud 53, will move into engagement with the under side of a tail-piece 60 of said pawl and cause the tooth 58 to be raised out of engagement with the stud 53, whereupon the weight 52 causes said arm to drop and the valve again to close.

As the piston 13 moves toward the right, as viewed in Figs. 1 and 2, under the action of pressure fluid admitted by the valve 23 to the crank end of said cylinder 14, only slight resistance will be presented to this movement from air within the head end of the cylinder because of the air vent 32 which is made large enough to permit the gradual escape of air therethrough. During the reverse movement of the piston 13, that is toward the left in Fig. 2, the valve 23 will obviously be closed to prevent admission of pressure fluid to the cylinder, and as no provision has herein been made for the valve 23 exhausting fluid from the crank end of the cylinder, a bleed valve 61 (Fig. 10) is provided for the purpose, which bleed pipe may at all times be open sufficiently to allow restricted escape of fluid from the crank end of the cylinder without to any appreciable extent impairing the power of the working stroke of the piston.

The arrangement of the pistons 7 and 13 and of the cranks 17 and 20 is preferably such that when the sliding head is in its mold filling position, as shown by Fig. 2, said pistons are both at the left hand end of the cylinders as viewed in Fig. 2. The crank arms 17 will, at this time, be approximately at right angles to the direction of movement of the piston 13, so as to present a favorable leverage for accelerating the sliding head to move it toward its "block pressing position", and the crank arms 20 will be on dead center position with respect to their connecting rod 21, and, by reason of this latter position, the filling passage of the sliding head will be definitely determined in registry with the mold chamber 2. At this time the valves 23, 36 and 50 will preferably be closed, but upon rotation of the shaft A in the direction of the arrow *a* the cam 26 will cause the valve 23 to open and admit pressure fluid to the crank end of the cylinder 13, forcing the piston 13 to the right hand end of the cylinder 14 and causing the shaft 18 to rotate approximately a quarter turn, and move the sliding head into block pressing position shown by Fig. 4. When the parts are in this latter posi-

tion it will be noticed that the cranks 17 will have been moved into their dead center positions, thus definitely determining the block pressing position of said sliding head, and that the cranks 20 have been moved from their dead center positions shown by Fig. 2 to their approximate mid-stroke positions enabling them to exert a favorable leverage on the sliding head upon admission of pressure fluid into the crank end of the cylinder 8.

The piston 13, which herein, due to its smaller diameter, constitutes in effect a low pressure cylinder, is enabled to perform the operation just referred to with advantageous application of forces to the sliding head because the crank 17 and shorter crank 20 are in their most advantageous positions for applying such forces. The crank 17, when the sliding head is accelerated to initiate movement thereof from its mold filling position (Fig. 2), is, as above described, at right angles to the direction of movement of the piston, while the shorter crank is on dead center position, and as a result of these two positions the piston 13 exerts its most favorable leverage on the crank shaft 18 while the latter exerts its most favorable leverage on the cross head 10 directly connected to the sliding head. Also, it will be observed, that as movement of the sliding head is initiated from block filling position, a large amount of movement of the piston 13 results in only a small amount of movement of the sliding head, and further, that as the maximum effort on the shaft 18 exerted by the piston 13 occurs when the crank 17 and connecting rod 16 are approximately at right angles, which condition is reached only after initiation of movement of the parts from their positions shown by Fig. 2, the force exerted on the sliding head will be maintained as it is accelerating from said position and will be decreased as it is decelerating into its position shown by Fig. 4, and that therefore the sliding head in effect is gradually accelerated under a maximum force, which latter gradually is diminished as the velocity of said head is to be decreased, which are the most favorable conditions for overcoming the inertia of said sliding head during acceleration and deceleration without shock and setting up of destructive vibratory or other harmful stresses on the machine when operated rapidly.

Preferably, at the beginning of the movement of the sliding head from mold filling to block pressing position, the valve 36 for the cylinder 8 will slightly open the passage 34 to supply the head end of said cylinder with a small amount of steam for cushioning the piston 7, and therefore to cushion the sliding head to which said piston is directly connected, so as to aid in bringing the sliding head to rest in its block pressing position without shock. As shown, a manually adjustable valve 62 for restricting the flow of steam through the passage 34 may be set to regulate this cushioning action. Shortly after the sliding head begins to move, the depression 45 in the cam 39 causes the lever 40 to move the valve 36 to the right to close the passage 34 against admission of steam thereto. When the piston 7 reaches its mid-stroke position the eccentric 47 acting through the connecting rod 49 on the floating lever moves the latter to the position shown by Fig. 4 and causes the mechanism shown by Fig. 9 to exhaust the right end of the cylinder 8 so as to remove this cushioning steam acting on the piston 7.

The next or return stroke of said piston 13 is preferably an idle movement and takes place when its crank 17 moves from its dead center position shown in Fig. 4 to its lowermost position of Fig. 6, and, in order to effect the last mentioned movement and the corresponding movement of the sliding head 4 from block pressing to block ejecting position, fluid is admitted to the crank end of the piston 7 while at rest in its mid-stroke position in the cylinder 8, by opening the valve 36 through the action of the rotating cam 39, thereby admitting fluid through the port 33 to the crank of said cylinder 8 and exhausting the head end of said cylinder through the port 34.

At the beginning of the last mentioned movement of the sliding head, the crank 20 is in its mid-stroke position approximately at right angles to the direction of movement of the cross head 10. Therefore said crank will be moved approximately another quarter turn to its opposite or second dead center position with its piston 7 at the extreme right end of the cylinder 8 (see Fig. 6). The arrival of the crank 20 at its dead center position definitely determines the extreme right hand limit of movement or block ejecting position of the sliding head 4, and, because at this time the valve 50 is closed and the passage 34 is restricted by the valve 62, whatever fluid may have remained in said cylinder 8 will function to check or cushion the piston 7 and with it the sliding head and bring the latter gradually to rest. The fluid remaining at the left hand side of the piston 13 in the low pressure cylinder 14 will also assist in checking the movements of said sliding head 4 through the train of mechanism operatively connecting said piston with the cross head 10 because the restricted exhaust afforded by the bleed valve 61 will check a too rapid discharge of fluid from said cylinder.

From its block ejecting position, shown by Fig. 6, the sliding head is moved to its filling position, shown by Fig. 2, preferably in one continuous stroke. To accomplish this the valve 23 is opened to admit pressure fluid to the crank end of the cylinder 8 to cause the piston 7 to make a complete stroke from its crank end to its head end, which will move the piston 7 to its mid position, whereupon the valve 36 is operated to cause the piston 7 to move from its mid position to the crank end of its cylinder and thus complete the movement of the sliding head and move the piston 13 back to the crank end of its cylinder. It will be observed that when the parts are in the position shown by Fig. 6, the cranks 17 and 20 are at the opposite ends of their travel as compared to their positions shown by Fig. 2, but that they are in the same relative positions in each figure, and that therefore the same effects in respect to velocity and forces occur in moving the sliding head from its block ejecting to its mold filling position as hereinbefore described in connection with moving it from its mold filling to its block pressing position.

For causing the admission of steam to the two cylinders for moving the sliding head from block ejecting to mold filling position, the valve 23 is actuated by the cam 26 to open the valve in the position of parts shown by Fig. 6, and before the piston 13 reaches the head end of its stroke the cam closes said valve and maintains it closed during the return stroke of said piston. Just before the valve 23 is opened as above described the cam 39 cooperating with the lever 40 moves the valve 36 to the left slightly to open the passage 33 to the exhaust so as to permit the piston 7 to move toward its crank end initially under slight compression, but by the time the piston 7 has

reached mid position the eccentric 47 acting upon the floating lever moves the valve 36 to mid travel, whereupon the cam 39 acts on the lever 40 to swing the floating lever to the left and cause the valve 36 to move to the left hand end of its travel and thus admit steam to the head end of the cylinder 8 and connect the crank end thereof to exhaust.

Herein, to relieve pressure in the crank end of the cylinder 14 should said pressure at any time become greater than boiler pressure, a relief passage 63 (Fig. 10) is formed in the walls of the cylinder, said passage placing the supply pipe 24 in connection with said cylinder at the crank end of the latter. In said passage is shown a check valve 64 normally held to its seat by boiler pressure, but arranged to open and relieve the pressure in the cylinder when the return stroke of the piston 13 causes such pressure to exceed boiler pressure.

Having thus described one illustrative embodiment of the invention, it is to be understood that although specific terms are employed they are not used in a limiting sense, the scope of the invention being set forth in the following claims.

I claim:

1. Operating means for a heavy movable machine part having a cycle of movement with stationary operating positions for finite periods of time during said cycle comprising, in combination, a plurality of fluid actuated pistons, mechanism connecting said pistons to each other and to said part, said mechanism having a plurality of variable force applying means with dead center positions corresponding to the same stationary operating positions of said part in successive cycles of its movement, one of said means being in its dead center positions when the other is in its favorable force applying positions.

2. Operating means for a heavy movable machine part having a cycle of movement with stationary operating positions during said cycle comprising, in combination, a fluid pressure actuated piston for moving said part with one of said stationary operating positions corresponding to the end of a stroke of said piston and another of said stationary operating positions corresponding to an intermediate portion of a stroke of said piston, a second fluid pressure actuated piston, and connections between the latter and said part having a dead center position for determining the last mentioned position of said part.

3. Operating means for a heavy reciprocatory machine part having stationary operating positions at the ends of its strokes and during one of its strokes comprising, in combination, a plurality of fluid pressure actuated pistons for moving said part, crank means operatively connected to said part and said pistons having dead center positions for determining said stationary positions of said part.

4. Operating means for a heavy reciprocatory machine part having stationary operating positions at the ends of its strokes and during one of its strokes comprising, in combination, a plurality of fluid pressure actuated pistons for moving said part, crank means operatively connected to said part and said pistons having dead center positions for determining said stationary positions of said part, one of said pistons being directly connected to said part.

5. Operating means for a heavy reciprocatory machine part having stationary operating positions at the ends of its strokes and during one of its strokes comprising, in combination, a plurality of fluid pressure actuated pistons for moving said part, a system of crank means operatively connected to said part and pistons, said system having dead center positions for determining said stationary positions of said part and having favorable leverage positions for moving said part from said positions.

6. Operating means for a heavy reciprocatory machine part having stationary operating positions at the ends of its strokes and during one of its strokes comprising, in combination, a plurality of fluid pressure actuated pistons for moving said part, a system of crank means operatively connected to said part and pistons, said system having dead center positions for determining said stationary positions of said part and having favorable leverage positions for moving said part from said positions, one of said pistons being directly connected to said part.

7. Operating mechanism for a heavy reciprocatory machine part having a stationary operating position during its stroke in one direction comprising a fluid pressure actuated piston directly connected to said part, means forming a pair of crank arms set approximately in quartering relation, an operative connection between one of said crank arms and said part, a second fluid pressure actuated piston operatively connected to the other of said crank arms, said last mentioned piston and its connection to said part being in dead center position when said part is in said stationary operating position.

8. Operating mechanism for a heavy reciprocatory machine part having a stationary operating position during its stroke in one direction comprising a fluid pressure actuated piston directly connected to said part, means forming a pair of crank arms set approximately in quartering relation, an operative connection between one of said crank arms and said part, a second fluid pressure actuated piston operatively connected to the other of said crank arms, said last mentioned piston and its connection to said part being in dead center position when said part is in said stationary operating position, and said first mentioned piston and its connection to said part being in dead center position when said part is at the opposite ends of its stroke.

9. Operating mechanism for a heavy reciprocatory machine part comprising a fluid pressure actuated piston, means forming a pair of crank arms in constant approximately quartering relation, means connecting said piston with one of said crank arms, means connecting said part with the other of said crank arms, said crank arm connected to said piston being in a favorable leverage position when said part is at each end of its stroke and said other crank arm being in approximately dead center position when said part is at each end of its stroke.

10. Operating mechanism for a heavy reciprocatory machine part comprising a fluid pressure actuated piston, means forming a pair of crank arms in approximately quartering relation, means connecting said piston with one of said crank arms, means connecting said part with the other of said crank arms, said crank arm connected to said piston being in a favorable leverage position when said part is at the ends of its stroke and said other crank arm being in approximately dead center position when said part is at the ends of its stroke, and a second fluid pressure actuated piston directly connected to said part.

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