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APPARATUS FOR APPLYING LOW PRESSURE ADVANCE AND HIGH PRESSURE SQUEEZE IN THE HYDRAULIC OPERATION OF DIE CASTING DIES

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Fig. 1.

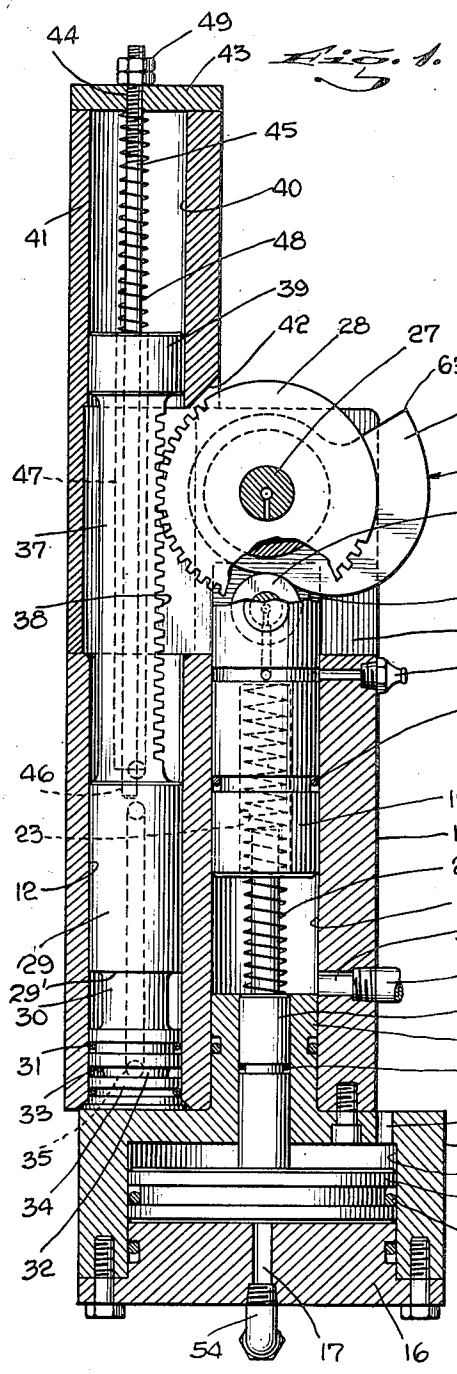
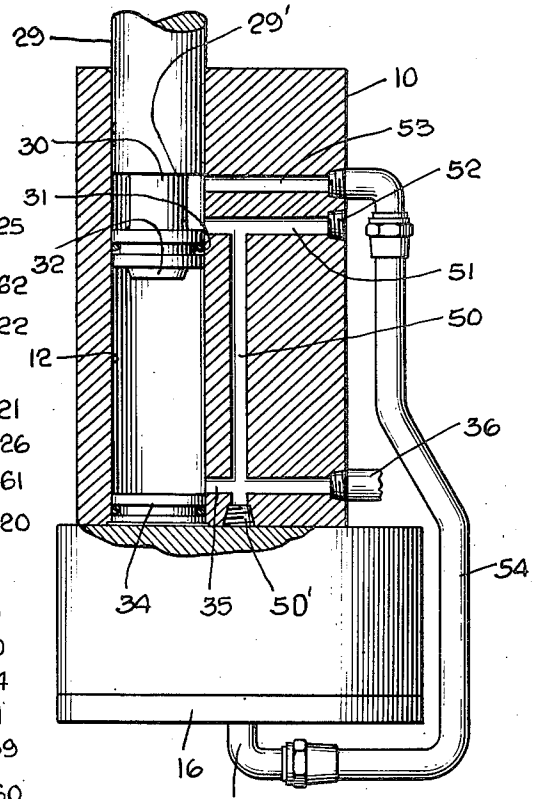


Fig. 2.



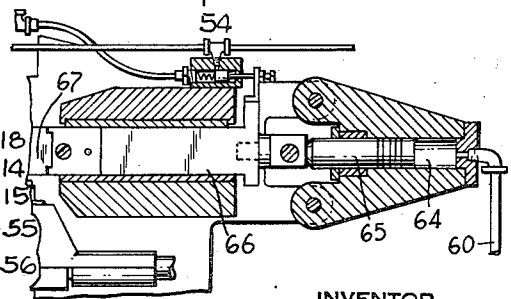


Fig. 3.

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APPARATUS FOR APPLYING LOW PRESSURE ADVANCE AND HIGH PRESSURE SQUEEZE IN THE HYDRAULIC OPERATION OF DIE CASTING DIES

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11 Claims. (Cl. 18—30)

This invention relates to an apparatus controlling the operation of a hydraulic medium in such manner as to advance the dies of a die casting machine toward each other under low pressure and, further, in applying a high pressure squeeze in the final stage of die operation in securely retaining the dies in engagement with each other and, further, in accomplishing these results by the use of a minimum amount of air.

More particularly, the invention deals with an apparatus of the character described, comprising an air cylinder and a hydraulic cylinder disposed in parallel relationship to each other with a supplemental large diameter air cylinder at one end portion of the hydraulic cylinder with means for actuating a piston of the hydraulic cylinder through the medium of a cam driven from the piston in the air cylinder and in actuation of a second hydraulic piston through a large diameter piston disposed in the supplemental air cylinder.

The novel features of the invention will be best understood from the following description, when taken together with the accompanying drawing, in which certain embodiments of the invention are disclosed and, in which the separate parts are designated by suitable reference characters in each of the views and, in which:

Fig. 1 is a longitudinal sectional view through a control apparatus made according to my invention, with parts of the construction shown in elevation and with parts broken away;

Fig. 2 is a side and sectional view of a part of the structure, as seen in Fig. 1, and indicating the air piston in raised position; and

Fig. 3 is a fragmentary side view in section of a portion of a hydraulic die casting machine.

In the drawing, 10 represents the cylinder casing of an apparatus made according to my invention and, in this casing is a hydraulic cylinder 11 and an air cylinder 12, these cylinders being arranged in parallel relationship to each other. Mounted and sealed in the lower portion of the cylinder 11 is a cylinder part 13 of a supplemental cylinder casing 14, having a large diameter and shallow supplemental air cylinder 15. The cylinder 15 is closed by a sealed cap 16, the cap having a compressed air admission port 17 for the supply of compressed air to the cylinder 15. The casing 14 has an air exhaust port 18.

Arranged in the hydraulic cylinder 11 is a primary hydraulic piston 19, having an O-ring seal, as at 20, the upper end of the piston 19 being forked, as indicated at 21, and in the forked portion is mounted a roller 22. The lower end portion of the piston 19 is hollow, as indicated at 23, for receiving a coil spring 24 tensioned to maintain the roller 22 in constant engagement with an operating cam 25.

The cam 25 operates in an upper recessed portion 26 of the casing 10 and is arranged upon a shaft 27, to which shaft is secured a segmental gear 28.

Arranged in the air cylinder 12 is a piston 29, the piston having a reduced portion, as indicated at 30, adjacent its lower end and being sealed at the lower end by an O-ring, as seen at 31. The lower end of the piston 29 has a reduced downwardly projecting portion 32, which provides, at the lower portion of the piston 29, an annular air admission passage 33 directly above a sealed disc 34 fixed to the lower end of the cylinder 12.

Registering with the annular air admission passage 33 is an air intake port 35, note Fig. 2, and at 36 is shown a pipe leading to a suitable source of compressed air supply, not shown, which would include an air control valve for supplying and exhausting the air.

The piston 29 has an elongated reduced portion 37 having, on one surface thereof, a rack 38 adapted to mesh with the gear segment 28 and, at the upper end of the reduced portion 37, is a piston head 39, which operates in an extension 40 of the cylinder 12 formed in a supplemental casing part 41, suitably fixed to the casing 10. The casing part 41 has an opening 42 registering with the recess 26 to receive the gear segment 28 and cam 25. In this connection, it will be apparent that the cylinder 12 is disposed at one side of the cylinder 11 for registering alinement with the gear segment 28, which is disposed at one side of the cam 25.

At the top of the casing part 41 is a cap or cover plate 43 having an aperture 44 therein, through which a rod 45 is adapted to pass. The rod 45 is mounted in and secured to the cylinder 29, as indicated at 46, the rod being disposed in a long bore 47 in the reduced portion 37 and the piston head 39 and mounted on the rod 45 and in the bore 47 is a long coil spring 48, tensioned to normally support the piston 29 in the lowermost position, adjustment of which is controlled by adjustable nuts 49 secured to the upper end of the rod 45. This adjustment is provided to definitely control movement of the piston 29 to time the application of the squeeze pressure, as will be apparent. The spring 48 also serves to return the cam 25 to the normal starting position, which is indicated in Fig. 1 of the drawing.

Considering Fig. 2 of the drawing, it will be apparent that the casing 10 has a vertical port 50 paralleling the cylinder 12 communicating at its lower end with the port 35, the plug 50' sealing the lower end of the port 50. The upper end of the port 50 communicates with a port 51 opening into the upper end of the cylinder 12. The port 51 has a plug seal, as at 52. Above and closely adjacent the port 51 is another port 53 placed in communication with the intake port 17 of the cylinder 15 through a suitable piping, as at 54. Arranged in the supplemental air cylinder 15 is a large diameter disc-type piston 55 having an O-ring seal, as at 56 in the cylinder 15.

The piston 55 has a small diameter supplemental hydraulic piston 57, which operates in the cylinder part 13 and has an O-ring seal 58 therein. The piston 57 normally rests flush with the inner or upper end of the cylinder part 13 and, communicating with the cylinder 11 adjacent the upper or inner end of the cylinder is a port 59 which communicates through a pipe 60 to suitable hydraulic mechanisms for moving a die member or members of a die casting machine in the required directions.

Hydraulically operated dies of die casting machines are known in the art and reference may be made to my United States Letters Patent No. 2,567,649, issued September 11, 1951, for Hydraulic Die Casting Machine, for a more detailed description of such a machine. Briefly, in such a machine there is a cylinder 64 which is connected to the hydraulic cylinder 11 through the pipe 60. The cylinder 64 contains a piston or plunger 65 upon one end of which the hydraulic fluid acts and the other end of the plunger engages with a movable die-holder 66. The die-holder carries a die member 67 at its end and when fluid under pressure is admitted to the cylinder 64, the plunger and die-holder are moved in a direction to move the die member 67 into engagement with an opposing die member and this mechanism is also employed to maintain the die members in engagement with each other during the casting operation.

The present invention deals basically with the control and operation of the hydraulic medium, so as to provide a low pressure movement of the dies into closed position and, then, momentarily applying the high pressure squeeze at the instant or moment of pressure injecting casting material into the dies and, then, to immediately relieve this pressure. However, it will be understood that, where a pair of movable dies are employed in the die casting machine, both of the die members may be operated by one hydraulic cylinder **11** if desired. Also, after the casting has been completed, the die members may be separated upon the release of the pressure in the hydraulic cylinder **11** in a suitable manner, such as by return springs as shown in said Letters Patent.

It will appear that the spring **24** bears upon the upper end of the piston **57** and, thus, serves to normally maintain the piston **55** in the depressed position, as well as to maintain the roller **22** in engagement with the cam **25**. Any suitable means will be provided for controlling the supply of hydraulic medium to the cylinder **11**. This is not shown, as it is well known in the art of hydraulic systems.

At **61** in Fig. 1 of the drawing I have indicated means for lubrication of the roller **22**, through more or less conventional grooving and port arrangement, as diagrammatically illustrated.

The operation of my improved control mechanism will be understood from the foregoing description, when taken in connection with the accompanying drawing and the following statement.

The position of the parts, as seen in Fig. 1, is at normal or what might be termed initial position of the mechanism, the pressure of the air in the cylinders **12** and **15** having been released through a suitable two-way control valve in the pipe **36**, which is not shown.

In starting the cycle of operation, the control valve in question is opened to admit air under pressure to the port **35**, which results in raising the piston **29** in the cylinder **12**. This operation transmits rotary movement to the cam **25** which gradually moves the piston **19** downwardly in the hydraulic cylinder **11**, operating the hydraulic medium to actuate or close the dies.

This operation continues until the roller **22** reaches a position approximately at the position designated by the arrow **62**, which terminates the active movement of the cam **25** upon the roller **22**. In other words, the surface of the cam **25**, between the arrow **62** and the end **63**, is concentric to the axis **27**.

Upon reaching this position, the dies of the casting machine will have been moved into closed position with respect to each other by the action of the piston **19** upon the hydraulic medium in the cylinder **11**. At that moment, the piston **29** or the lower edge **29'** thereof, forming the top of the recessed portion **30**, will have reached a position just below the port **53**; whereupon, continued motion applied to the piston **29** will raise the same sufficiently to place the ports **51** and **53** in communication through the reduced portion **30**, thus admitting air to the lower end of the cylinder **15** to actuate the piston **55**, thus moving the piston **57** upwardly into the cylinder **11**, which will apply the high pressure squeeze to the dies by action upon the hydraulic medium in the cylinder **11**.

Immediately after the casting shot has taken place and when the piston **29** has reached its upward limit of travel at a position substantially similar to that shown in Fig. 2, the valve controlling the air supply, which is not shown, will be moved to an exhaust position, thus releasing the air pressure from the cylinder **12** through the pipe **36**. The air pressure in the cylinder **15** is also released in this manner through the ports **53** and **51** which are in communication with each other at this time and with the pipe **36**. As the piston **29** moves downwardly by the spring **48**, the plunger **19** will be returned to normal position by action of the spring **24** which holds

the roller **22** in engagement with the cam **25** as it returns to the position shown in Fig. 1. It will also be understood that the spring **24** returns the piston **55** to the position shown in Fig. 1 and this takes place immediately upon the release of air pressure in the cylinder **15**. In the next cycle of operation, the foregoing steps of actuation of the parts will take place and this is repeated in each cycle of operation of the machine.

Having fully described my invention, what I claim as new and desire to secure by Letters Patent is:

1. In a die-casting machine having a die member that is movable under hydraulic pressure into engagement with the face of an opposing die member and wherein casting material is injected into a casting cavity formed by said die members while said members are held in engagement under increased hydraulic pressure, the combination of a hydraulic cylinder containing a hydraulic fluid, said cylinder having a port therein through which pressure exerted on the hydraulic fluid is transmitted to a movable die member, a pair of pistons movably mounted in the said hydraulic cylinder for exerting pressure on the hydraulic fluid therein, one of said pistons exerting pressure on the hydraulic fluid in movement of the movable die member toward an opposing die member, the other of said pistons exerting pressure on the hydraulic fluid when the die members are in engagement during injection of casting material, the last-mentioned pressure supplementing the pressure exerted by the first piston, pneumatically operated means for moving said first piston in the hydraulic cylinder in a direction to act on the fluid therein, said means including a piston connected to the first-mentioned hydraulic piston, a second pneumatically operated means for moving the second piston in the hydraulic cylinder in a direction to act on the fluid therein, said second pneumatically operating means including a piston connected to the supplementary piston, and valve means for admitting air under pressure to the second pneumatically operated means, said valve means being controlled by movement of the first pneumatic piston.

2. In a die-casting machine, the combination as defined in claim 1 wherein the pistons in the hydraulic cylinder are positioned in opposing relation to each other and which includes a return spring interposed between said pistons.

3. In a die-casting machine, the combination as defined in claim 1 wherein the pistons in the hydraulic cylinder are positioned in opposing relation to each other and which includes a return spring interposed between said pistons, and a second return spring acting on the first pneumatic piston, said second return spring returning the first pneumatic piston and the hydraulic piston connected thereto to their initial positions upon release of air pressure from the first pneumatic piston.

4. An apparatus of the class described, comprising a pair of movable dies, a hydraulic cylinder connected to said dies, said cylinder having piston means therein for actuating a hydraulic medium in movement of said dies into closed position, a supplemental piston movable into said cylinder upon completion of closing movement of the dies to apply high pressure squeeze on said dies when in closed position, means controlling operation of the first named and supplemental pistons in said hydraulic cylinder, a coil spring disposed between said pistons for normally returning the same to inoperative position, the means for actuating the first named piston comprising a cam, an air cylinder at one side of the hydraulic cylinder, and a piston in said cylinder in operative engagement with the cam to actuate said cam.

5. An apparatus of the class described, comprising a pair of movable dies, a hydraulic cylinder connected to said dies, said cylinder having piston means therein for actuating a hydraulic medium in movement of said dies into closed position, a supplemental piston movable

into said cylinder upon completion of closing movement of the dies to apply high pressure squeeze on said dies when in closed position, means controlling operation of the first named and supplemental pistons in said hydraulic cylinder, a coil spring disposed between said pistons for normally returning the same to inoperative position, the means for actuating the first named piston comprising a cam, an air cylinder at one side of the hydraulic cylinder, a piston in said cylinder in operative engagement with the cam to actuate said cam, and means controlled by the air actuated piston for transmitting air to means operating the suplpemental piston of said hydraulic cylinder.

6. An apparatus of the class described, comprising a pair of movable dies, a hydraulic cylinder connected to said dies, said cylinder having piston means therein for actuating a hydraulic medium in movement of said dies into closed position, a supplemental piston movable into said cylinder upon completion of closing movement of the dies to apply high pressure squeeze on said dies when in closed position, means controlling operation of the first named and supplemental pistons in said hydraulic cylinder, a coil spring disposed between said pistons for normally returning the same to inoperative position, the means for actuating the first named piston comprising a cam, an air cylinder at one side of the hydraulic cylinder, a piston in said cylinder in operative engagement with the cam to actuate said cam, means controlled by the air actuated piston for transmitting air to means operating the supplemental piston of said hydraulic cylinder, tensional means for moving the air piston in one direction and for maintaining the same in the normal inoperative position, and adjustable means controlling the inoperative position of said air piston.

7. An apparatus for hydraulically operating a mechanism and to apply predetermined high pressure on the mechanism at a predetermined moment, comprising a hydraulic cylinder with means for placing the hydraulic medium of the cylinder in operative communication with said mechanism to be actuated, a primary piston in the hydraulic cylinder for actuation upon the hydraulic medium to control initial operation of said mechanism, a supplemental piston movable into the hydraulic cylinder in application of the high pressure operation upon said mechanism at said predetermined moment, means controlling operation of said primary and supplemental pistons, said last named means comprising an air cylinder having a piston, means for placing the piston in direct operative engagement with said primary piston to impart movement thereof, means for admitting air to the air cylinder for actuation to the piston therein, said supplemental piston having a large piston element arranged and operating in a supplemental large diameter air cylinder, and means controlled by the piston in the air cylinder for directing air under pressure to the supplemental air cylinder in actuation of said supplemental piston in the hydraulic cylinder.

8. An apparatus for hydraulically operating a mechanism and to apply predetermined high pressure on the mechanism at a predetermined moment, comprising a hydraulic cylinder with means for placing the hydraulic medium of the cylinder in operative communication with said mechanism to be actuated, a primary piston in the hydraulic cylinder for actuation upon the hydraulic medium to control initial operation of said mechanism, a supplemental piston movable into the hydraulic cylinder in application of the high pressure operation upon said mechanism at said predetermined moment, means controlling operation of said primary and supplemental pistons, said last named means comprising an air cylinder having a piston, means for placing the piston in direct operative engagement with said primary piston to impart movement thereof, means for admitting air to the air cylinder for actuation to the piston therein, said supplemental piston having a large piston element arranged

and operating in a supplemental large diameter air cylinder, means controlled by the piston in the air cylinder for directing air under pressure to the supplemental air cylinder in actuation of said supplemental piston in the hydraulic cylinder, and a coil spring operatively engaging the primary and supplemental pistons for movement thereof into inoperative positions in the hydraulic cylinder.

9. An apparatus for hydraulically operating a mechanism and to apply predetermined high pressure on the mechanism at a predetermined moment, comprising a hydraulic cylinder with means for placing the hydraulic medium of the cylinder in operative communication with said mechanism to be actuated, a primary piston in the hydraulic cylinder for actuation upon the hydraulic medium to control initial operation of said mechanism, a supplemental piston movable into the hydraulic cylinder in application of the high pressure operation upon said mechanism at said predetermined moment, means controlling operation of said primary and supplemental pistons, said last named means comprising an air cylinder having a piston, means for placing the piston in direct operative engagement with said primary piston to impart movement thereof, means for admitting air to the air cylinder for actuation to the piston therein, said supplemental piston having a large piston element arranged and operating in a supplemental large diameter air cylinder, means controlled by the piston in the air cylinder for directing air under pressure to the supplemental air cylinder in actuation of said supplemental piston in the hydraulic cylinder, a coil spring operatively engaging the primary and supplemental pistons for movement thereof into inoperative positions in the hydraulic cylinder, and a coil spring for operating the air piston in one direction in said air cylinder.

10. An apparatus for hydraulically operating a mechanism and to apply predetermined high pressure on the mechanism at a predetermined moment, comprising a hydraulic cylinder with means for placing the hydraulic medium of the cylinder in operative communication with said mechanism to be actuated, primary and supplemental pistons at opposed ends of said cylinder, tensional means between said pistons normally maintaining the same in spaced relationship to each other, cam means for moving the primary piston in said cylinder in normal operation of said mechanism, and means comprising a large diameter piston in an air cylinder, including a supply of air to actuate the piston in said air cylinder in operating the supplemental piston in the hydraulic cylinder in applying high pressure operation to said mechanism.

11. An apparatus for hydraulically operating a mechanism and to apply predetermined high pressure on the mechanism at a predetermined moment, comprising a hydraulic cylinder with means for placing the hydraulic medium of the cylinder in operative communication with said mechanism to be actuated, primary and supplemental pistons at opposed ends of said cylinder, tensional means between said pistons normally maintaining the same in spaced relationship to each other, cam means for moving the primary piston in said cylinder in normal operation of said mechanism, means comprising a large diameter piston in an air cylinder, including a supply of air to actuate the piston in said air cylinder in operating the supplemental piston in the hydraulic cylinder in applying high pressure operation to said mechanism, an air actuated piston controlling operation of said cam means, and means on said last named piston controlling supply of air to said first named air cylinder.

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