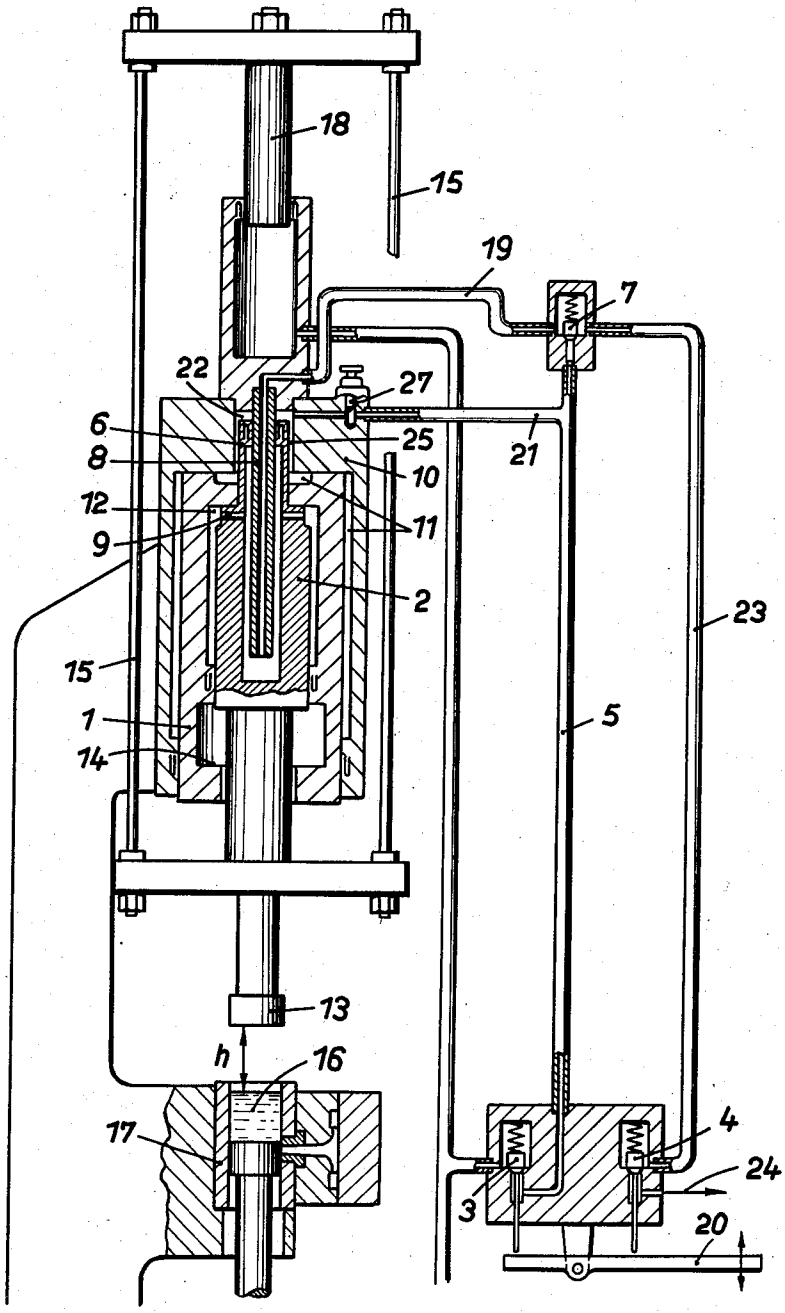
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HYDRAULICALLY DRIVEN WORKING MACHINE FOR DIE-CASTING, INJECTION MOLDING, AND THE LIKE

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HYDRAULICALLY DRIVEN WORKING MACHINE FOR DIE-CASTING, INJECTION MOLDING, AND THE LIKE

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Die-casting machines preferably fed by using hand ladles have in general hydraulically driven injection plungers. Thus the plunger has to perform a considerable idle stroke before it forces the filled-in material into the die cavity. This occurs especially in those constructions of machines where the material travels with the piston touching its surface for a considerable part of the stroke, before it is forced into the die, no pressure being exerted on the material during a part of the stroke. With this kind of machines, that part of the working stroke within which the material is forced into the die, is only a small part of the full stroke. Therefore, if the stroke is performed with full pressure, a very high amount of pressure fluid will be wasted in consequence of the large idle portion of the stroke consuming the main part of the pressure fluid.

It has already been suggested to move the plunger during the idle stroke by applying pressure fluid of lower pressure and to change to high pressure when the plunger touches the casting material, the high resistance of said material being used for control. As, on the one hand, the movements are performed with high speed and, on the other hand, the inertia of the pressure fluid to be moved under high pressure is considerable and working speeds varying within a wide range are required, the full pressure could not become effective precisely at the moment desired.

This aforesaid method fails with all hydraulically operated machines working with a pressure fluid delivered by one pressure source. To avoid this drawback it has been sugggested to move the plunger during its idle stroke by an auxiliary plunger. As soon as said auxiliary plunger touches the material, a resistance is built up serving to change the pressure supplied to the main plunger. For the reasons mentioned above, this method did not give satisfactory service, especially as during the whole pressing stroke the maximum pressure was not available. Moreover, the released pressure became, due to the inertia of the control means and of the pressure fluid, effective too late if only released at the moment when the resistance in the cylinder has reached a predetermined amount.

Furthermore, the main piston has been connected with the auxiliary piston in such a way

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as to automatically transfer the pressure to the main piston as soon as the speed had become undesirably low. This, too, is not advantageous, for, as the speed decreases because of the material beginning to solidify in the sprue thus slacking the movement, the transfer to the main piston is effected too late as to positively counteract the solidifying.

One object of the invention is to avoid this drawback and to provide an improved driving device for hydraulically operated machines such as die-casting machines, press-casting machines, etc., comprising an auxiliary piston and a main piston, the latter immediately following said auxiliary piston, and operating under the same fluid pressure as said piston in such a manner that the auxiliary piston opens by its own movement the inlet channel for the pressure fluid to the main plunger, and that the main plunger now starting its working movement automatically shuts off the pressure fluid having previously entered the cylinder of the auxiliary plunger, by increasing the pressure therein.

Another object of the invention is to provide the cylinder of the auxiliary plunger in the interior of the main plunger itself and to supply both plungers with pressure fluid from a common pressure fluid conduit, one branch of which leading through a check valve to the auxiliary plunger and the other branch leading directly to the main plunger, the cylinder of which being opened by the movement of the auxiliary plunger. Thus the continually moving pressure fluid is led, without any interruption, via a second branch to the working piston instead of through a branch meanwhile closed by a check valve. To release the cylinder of the auxiliary plunger of the fluid pressure therein, a controlled outlet valve which by-passes the check valve, is provided in the emptying conduit leading to the outlet conduit.

Other objects and features of novelty to be hereinafter described will be apparent from the following specification.

In the accompanying drawing which schematically shows an illustrative embodiment of the present invention

1 is a main plunger in which an auxiliary plunger 2 is provided. 3 is an inlet valve from which pressure fluid conduit 5 with branch 19

leads via check valve 7 through a telescopic tube 8 and bores 9 into cylinder space 12 of auxiliary plunger 2. Another branch 21 of conduit 5 leads into space 22, which is situated above hollow elongation 6 of auxiliary plunger 2 and is with some clearance slidably guided in a bore of main cylinder 10.

As soon as by a clockwise movement of lever 20 valve 3 has been opened and a second or outlet valve 4 has been closed, pressure fluid will enter through conduit 5 via branch 19 and bore 9 into cylinder space 12 above auxiliary piston 2. Inside cylinder space 12 pressure will build up which forces main piston 1 upward against the bottom of main cylinder 10 and shifts auxiliary piston 2 connected with piston head 13 downward until said auxiliary piston 2 will be stopped by abutment 14 of main piston 1. This is the case when piston head 13 has traveled distance *h* and reached the surface of the molten casting or injection material 16 filled into filling and compression chamber 17.

Preferably, elongation 6 of auxiliary plunger 2 as well as abutment 14 will be made adjustable (not represented in the drawing). The adjustment is such that elongation 6 extending with some clearance 25 into the bore of cylinder 10, leaves said bore shortly before the portion *h* of the stroke is completed. Thereby, the pressure fluid passing through conduit 5 with full velocity, has free admission to cylinder space 11 of main piston 1. The sudden and rapidly entering of the pressure fluid causes main piston 1 to begin its downward or working movement with high speed. Momentarily it presses thereby with its full downward pressure upon the pressure fluid in cylinder space 12, thus increasing the pressure of the fluid which immediately (outlet valve 4 remaining closed) shuts off check valve 7. By means of said pressure fluid enclosed in space 12 and acting like a solid body, the piston head is now subjected to the full pressure exerted by fluid acting in space 11 or the upper effective area of main piston 1 via auxiliary piston 2, said piston head thus being able to perform its working stroke with high pressure, especially so because the still moving pressure fluid, hitherto traveling via check valve 7 to auxiliary piston 2, may now be supplied directly and momentarily to working space 11 of main piston 1 via branch 21 and space 22.

After piston head 13 has finished its downward stroke and thus forced the material, preferably metal, into the die cavity, inlet valve 3 will be closed by anticlockwise rotation of lever 20, and outlet valve 4 will be opened. Therefore, under the effect of return piston 18 constantly being under pressure, pistons 1 and 2 will be lifted through rods 15 into their upper extreme positions, whereby first the pressure fluid enclosed in cylinder space 12 of auxiliary piston 2 is displaced through conduit 19 by-passing the back-pressure valve 7, and then the pressure fluid of cylinder space 11 is displaced through the annular clearance 25 which exists between the prolongation 6 of piston 2 and the upper portion of cylinder 10, via space 22, conduit 21 and through valve 7 to discharge conduit 23.

According to the invention the advantage will be obtained that, by providing auxiliary piston 2 in the interior of working or main piston 1 and by arranging check valve 7 in a branch of the pressure fluid conduit, piston head 13 will perform its idle stroke with only a minimum force exerted by the high pressure fluid. Thus it will

be achieved that auxiliary piston 2 itself will, at a predetermined intermediate position of the stroke and quite independent from the pressure of the casting material, automatically transmit the pressure fluid to working or main piston 1. Said piston will now perform the working part of the stroke with high pressing power and at an adjustable speed which may be different from that of the idle stroke and can e. g. be adjusted by throttling supply branch 21. If in the supply branch 21 an adjustable throttle 27 is provided it will be possible to regulate the flowing speed of the fluid passing through supply branch 21 by adjusting the throttle 27. By this means, the working speed of the plunger can be increased or decreased respectively.

Independent from the example represented in the drawing, it also lies within the scope of the present invention to arrange the pressure cylinder of the main or working piston between the auxiliary piston and the main piston, thus causing auxiliary piston, during its idle stroke, to move the main piston together with the working cylinder, whilst the working movement proper of the stroke which forces the metal into the cavity of the die is performed by the continued movement of the working piston alone.

I claim:

1. In die-casting, injection molding and like hydraulically operated working machines comprising a hydraulic main cylinder, a main piston in the cylinder, an auxiliary piston in the main piston, a cylinder for the auxiliary piston formed by and in the main piston, a pressure fluid supply conduit common to both cylinders, a check valve having a movable valve member, an inlet valve in said conduit, said conduit having two branches, one of which connects by the check valve with the interior of the auxiliary cylinder and the other branch connects with the main cylinder, the movable valve member of said check valve closing automatically when the pressure on its backside in the direction of the flow is at least approximately equal to the pressure on its front side, an outlet valve arranged on the back pressure side of said check valve, said main and auxiliary cylinders being arranged with respect to their pistons that, under the influence of the pressure submitted from said common supply conduit, the pistons will perform the working stroke of said machine so that first the auxiliary piston begins moving and after being stopped by an abutment of the main piston, the working stroke is continued by both pistons, control means to interrupt and respectively fully open the connection between the second-mentioned branch and the main cylinder, the movement of said auxiliary piston immediately before contacting the abutment causing the opening movement of said control means so that the fluid through said second-mentioned branch may enter the main cylinder and initiate the stroke of the main piston which, by increasing the pressure in the auxiliary cylinder automatically closes the check valve, thereby locking the pressure fluid within said auxiliary cylinder for the further common travel of the working stroke.

2. In die-casting machines according to claim 1, in which said control means is provided with a piston-like member movable in a hole and movable out of the hole when the auxiliary piston contacts the abutment.

3. In die-casting machines according to claim 1, in which said control means is provided with a piston-like member movable in a hole and mov-

able out of the hole when the auxiliary piston contacts the abutment, the piston-like member being firmly connected to the auxiliary piston.

4. In die-casting machines according to claim 1, in which said control means is provided with a piston-like member movable in a hole and movable out of the hole when the auxiliary piston contacts the abutment, the piston-like member and its hole having a clearance to allow the return flow of the residual pressure fluid out of the main cylinder after the piston-like member has moved into the hole during the end portion of the return stroke.

5. In die-casting machines according to claim 1, in which a piston head and a compression chamber are provided, the auxiliary piston being connected with said piston head of the machine and with the abutment so that the auxiliary piston contacts the abutment.

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