

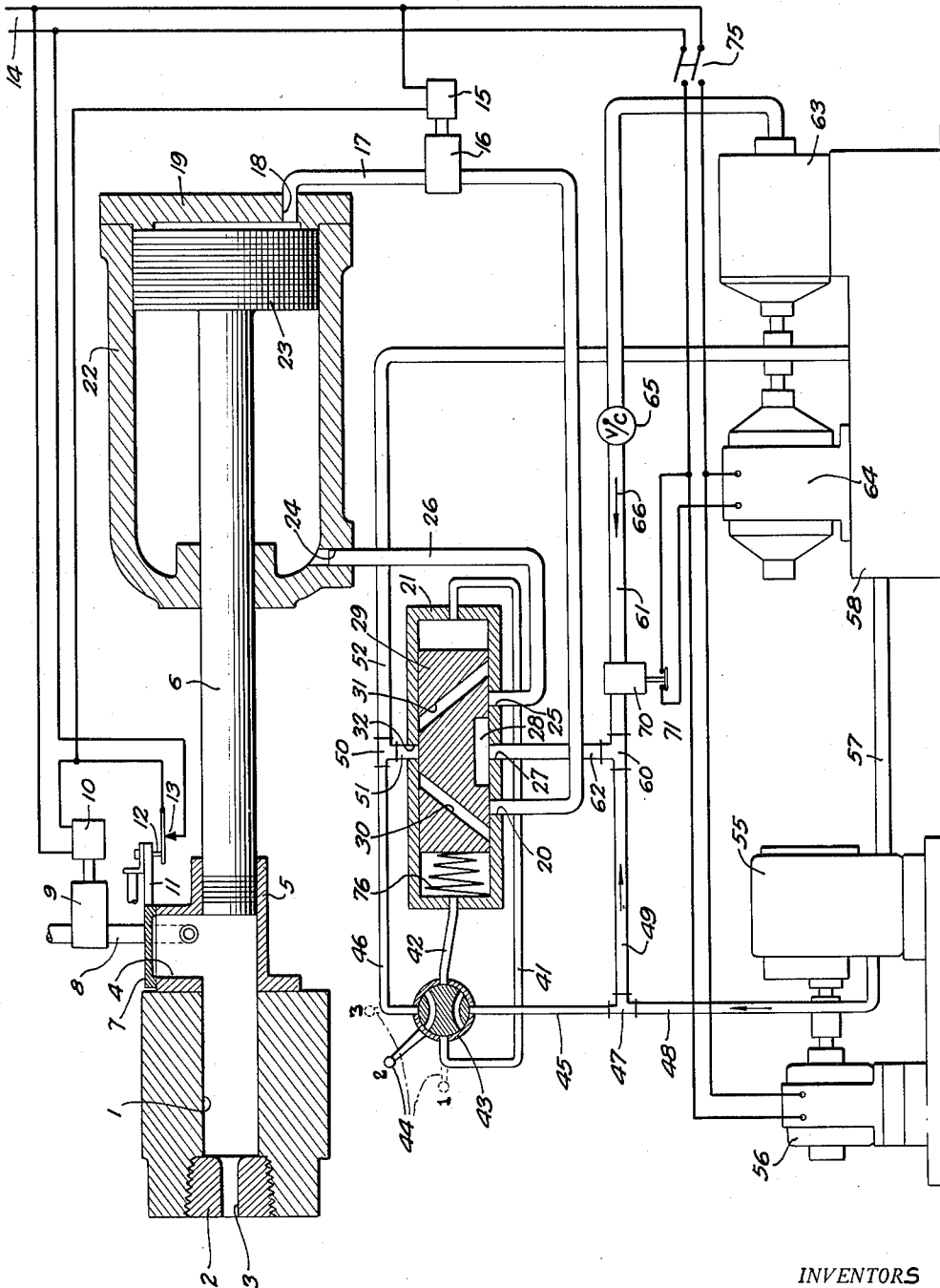
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EXTRUSION APPARATUS

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EXTRUSION APPARATUS

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This invention relates to an extrusion apparatus and more particularly to an extrusion apparatus having an automatic controlling mechanism.

It is an object of the present invention to provide a simple and efficient extrusion apparatus.

In accordance with one embodiment of the invention, an hydraulically operated extrusion press is provided for extruding ceramic rods wherein an extruding plunger is actuated by fluid under pressure by a high pressure, low volume pump and a low pressure, high volume pump until the piston encounters a predetermined amount of resistance to its movement and then the high volume, low pressure pump is automatically cut out of operation. In this apparatus, a manually controlled valve may be operated to direct fluid under pressure to opposite sides of a slidable control valve which, in turn, will direct fluid to one side or the other of a piston which actuates the extrusion plunger, and the apparatus may be loaded through an air-tight door which, when closed, closes a circuit to connect the extrusion chamber to a vacuum system and to render the extrusion plunger operable.

A better understanding of the invention may be had by reference to the following detailed description when considered in conjunction with the accompanying drawing, wherein the single figure illustrates diagrammatically a preferred form of the invention.

In the drawing, there is shown an extrusion chamber 1, having an extruding die 2 suitably attached in its left end whereby ceramic material which has been placed within the chamber 1 may be extruded through an orifice 3 in the die 2 to form ceramic rods which may be later fused. Attached to the right end of the extrusion chamber is a loading chamber 4 having formed integrally with it a guide portion 5 for guiding an extruding plunger 6 into the chamber 1 for forcing a mass of ceramic material (not shown) through the die orifice 3.

The loading chamber 4 is provided with a suitable air-tight door 7, which may be raised to permit the loading of material in the loading chamber. The door 7 may be hinged in any suitable manner so that when closed, it will seal the loading chamber. In communication with the chamber 4 is an exhaust pipe 8, having a shut-off valve 9 connected in it. The valve 9 is adapted to be actuated by a solenoid 10 of any suitable type when the door 7 is closed so that a vacuum pump (not shown) connected to the exhaust pipe 8 may create a vacuum in the chamber 4 to pre-

vent the entrapment of air in the rod extruded by the plunger 6, forcing the material through the die orifice 3. The door 7 has mounted on it a lever 11, carrying a contact actuating element 12 in position to close a pair of contacts 13 when the door is closed. One side of the winding (not shown) of the solenoid 10 is connected to one side of a current source 14 and the other side of the winding of the solenoid may be connected through the pair of contacts 13 to the other side of the current source 14 when the door 7 is closed.

In addition to controlling the supply of current to the solenoid 10, the pair of contacts 13 also control the supply of current to a second solenoid 15, which is connected to a shut-off valve 16. The shut-off valve 16 is normally closed and will normally prevent fluid from passing through a pipe 17 in which the shut-off valve 16 is inserted. The pipe 17 extends from a port 18 in a cylinder head 19 to a port 20 in a slide valve 21 and thus the shut-off valve 16 controls the flow of fluid in either direction between a cylinder 22, in which the cylinder head 19 is mounted, and the slide valve 21. The cylinder 22 has a piston 23 mounted for reciprocation on it and the piston 23 is connected to the end of the extruding plunger 6 so that when the piston 23 is actuated, the plunger 6 will move with it. In addition to the port 18 communicating with the interior of the cylinder 22 through the cylinder head 19, the left end of the cylinder has a port 24 formed in it. The port 24 is interconnected with a port 25 in the slide valve 21 by a pipe 26 and either the port 20 or the port 25 may be connected in communication with a port 27 by a passageway 28 formed in a slidable valve member 29, depending upon the position of the valve member 29 in the slide valve 21. Also formed in the valve member 29 are a pair of passages 30 and 31 and when port 27 is connected with port 25, the passageway 31 will be inoperative, but passage 30 will then connect the port 20 to a port 32 in the slide valve 21. Conversely, the passageway 30 will be inoperative and the passageway 31 will interconnect the port 25 with the port 32 when the valve member 29 is shifted to a position where the passageway 28 will interconnect ports 20 and 27.

The valve member 29, in effect, constitutes a piston which may be shifted from the right end of the slide valve 21 upon the admission of fluid under pressure to the right end of the slide valve. The right end of the slide valve 21 is in communication with a pipe 41 and the left end of the slide valve is in communication with a pipe 42.

The pipes 41 and 42 interconnect the slide valve 21 with diametrically opposed sides of a manually operable valve 43, which, when in the position shown, will block the flow of fluid in any direction through it. The valve 43 has three different positions in which it may be set, as indicated by the solid and dot and dash line positions of a handle 44. In addition to the pipes 41 and 42 extending to the manually operable valve 43, there are a pair of pipes 45 and 46 connected thereto. The pipe 45 is connected by a T-connection 47 to a pair of pipes 48 and 49, whereas the pipe 46 is connected through a T-connection 50 to a pair of pipes 51 and 52. The pipe 48 serves to connect both the pipes 45 and 49 to a high pressure, low volume pump 55 connected to be driven by a motor 56 and adapted to draw fluid through a pipe 57 from a supply tank 58. The pipe 51 serves to connect the pipes 49 and 52 to the tank 58.

A T-connection 60 connected to pipe 49 interconnects the pipe 49 and a pipe 61 through a pipe 62 to the port 27. The pipe 61 serves to supply fluid under pressure from a high volume, low pressure pump 63 adapted to be driven by a motor 64 and drawing fluid from the supply tank 58. The pipe 61 has in it a check valve 65, which will prevent fluid from travelling in the direction opposite to the arrow 66 through the pipe 61 and the pipe 61 also has mounted in it a pressure responsive switch 70, which, when the pressure in the pipe 61 reaches a predetermined value, will actuate a contact 71 to disconnect the motor 64 from the power source 14, although the pair of contacts 13 may be closed. Power for driving the motors 56 and 64 may be supplied from the current source 14 by closing a switch 75. However, the handle 44 must be operated to effect a shift of the valve member 29 which is normally urged to a mid position in the slide valve 21 by a spring 76, which normally holds the member 29 in mid position to block ports 20, 25, 27 and 32.

A more complete understanding of the invention may be had by reference to the following brief description of the mode of operation thereof. In order to place the apparatus in condition for operation, switch 75 may be closed to supply current to motors 56 and 64 and the manually operable valve 43 may be shifted to position "3," where pipes 45 and 41 will be interconnected and pipes 46 and 42 will be interconnected through the passageways shown in the valve 43. After the apparatus has thus been placed in condition for operation, a supply of ceramic material to be extruded may be placed in the loading chamber 4 and as soon as the door 7 is closed, the pair of contacts 13 will complete a circuit to supply current from the source 14 to the solenoids 10 and 15. Since the valve 43 has been shifted to position to interconnect pipes 41 and 45 and pipes 42 and 46, fluid under pressure will be directed from both of the pumps through pipes 45 and 41 to shift the slidable valve member 29 to the left. As soon as the slidable valve member 29 is shifted to its lefthand position, the passageway 28 will interconnect ports 20 and 27 and the passageways 30 and 31 will interconnect ports 25 and 32. With the slide valve in this position, both of the pumps will supply fluid under pressure through the port 27 to passageway 28 and through passageway 28 and port 20 to pipe 17, thereby to direct the fluid under pressure to the right hand side of the piston 23. The piston 23 will force the ceramic material placed in the loading chamber 4 over to a point where the ceramic material engages the extruding die 2 since the

closure of the pair of contacts 13 opened the shutoff valve 16. The travel of the plunger 6 will be relatively rapid since both the pump 56 and the pump 63 will be supplying fluid under pressure to drive the piston 23. As soon as the plunger 6 encounters an appreciable amount of resistance, due to the engagement of the ceramic material with the extruding die 2, back pressure will be built up in the pipe 61 and since the fluid cannot travel opposite to the direction of the arrows 66 in pipe 61, check valve 65 will automatically close and the pressure responsive valve 70 will open its contact 71. When the contacts 71 open, the motor 64 will be cut out of operation and the continued travel of the plunger 6 to the left will be at an appreciably slower rate, but at a higher pressure. Thus, the plunger 6, when the resistance to its movement is relatively low, will travel at a high rate of speed and as soon as the resistance to the movement of the plunger 6 increases to a predetermined amount, the travel of the plunger will be slowed down and will continue under the operation of the pump 55.

As soon as a charge placed in the apparatus has been extruded through the die orifice 3, the handle 44 may be moved to position 1, where the pipes 41 and 46 will be interconnected and pipes 42 and 45 will also be interconnected, thus to supply fluid under pressure to the left side of the slide valve member 29 and restore the slide valve 21 to its right hand position. When the slide valve 21 returns to the right hand position in the drawing, the pressure at T-connection 60 will drop and the pressure responsive switch 70 will close its contact 71, thereby to cut the motor 64 back into operation and the return of the piston 23 to the position shown will be effected by fluid forced through the pipe 62 by the combined operation of the pumps 55 and 63. When the piston 23 returns to normal position, as shown, the valve 43 may be restored to the position shown, thus cutting off the supply of fluid under pressure to operate the slide valve 21 and the air tight door 7 may be opened to permit another charge of ceramic material to be placed in the loading chamber 4. When the door 7 is opened, the pair of contacts 13 will be opened to close the shutoff valve 9 through deenergization of the solenoid 10 and to close the valve 16 through the deenergization of the solenoid 15. When this condition prevails, the spring 76 will move the slidable member 29 to normal position, as shown.

What is claimed is:

1. In an extrusion apparatus, an extrusion chamber having a charging opening in a wall thereof, a closure member for said charging opening, a piston for actuating an extrusion plunger, a cylinder for said piston, a high pressure low volume pump and a low pressure high volume pump for supplying fluid pressure to said cylinder, a motor drive for each of said pumps, means responsive to the position of said closure member for controlling the admission of fluid to said cylinder from said pumps, and an electric switch responsive to fluid pressure in said cylinder for controlling the actuation of the motor drive for said high volume pump.

2. In an extrusion apparatus, an extrusion chamber having a charging opening in a wall thereof, a closure member for said opening, a piston for actuating an extrusion plunger, a cylinder for said piston, a high pressure low volume pump and a low pressure high volume

pump for supplying fluid pressure to said cylinder, a motor drive for each of said pumps, means responsive to the position of said closure member for controlling the admission of fluid to said cylinder from said pumps, and electric switch 5 responsive to fluid pressure in said cylinder for controlling the actuation of the motor drive for

said high volume pump, means for exhausting air from said chamber, and means also under control of said closure member for controlling the operation of the exhausting means.

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