June 9, 1931. W. McCLINTOCK ET AL 1,808,964

EXTRUSION MACHINE

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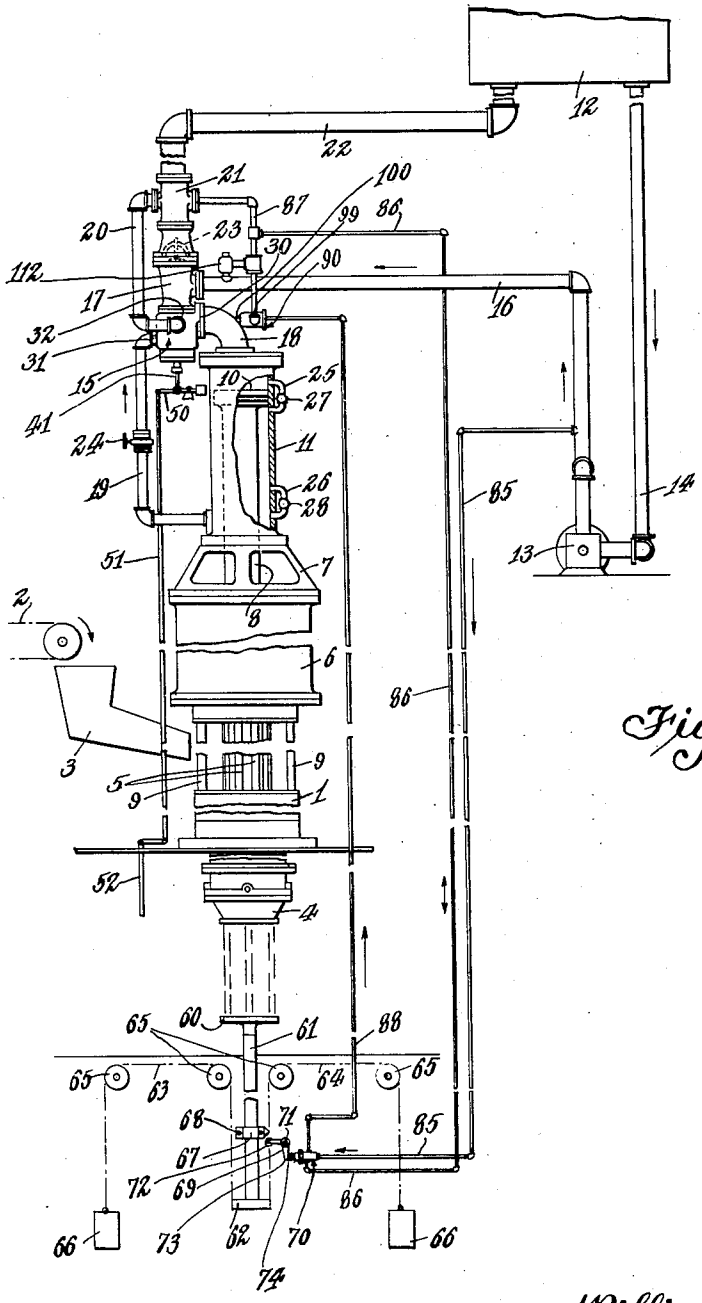


Fig. 1.

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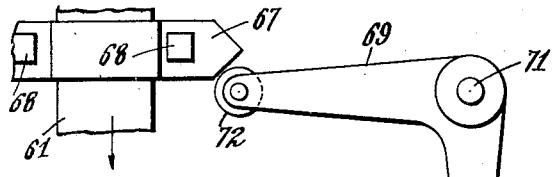
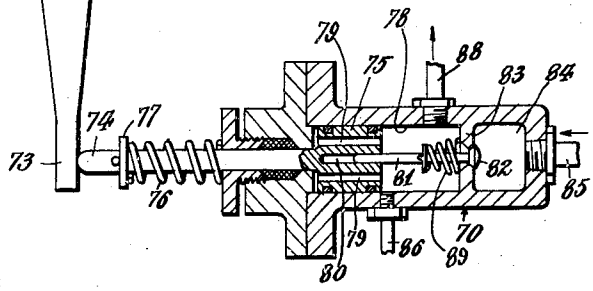


Fig. 2.



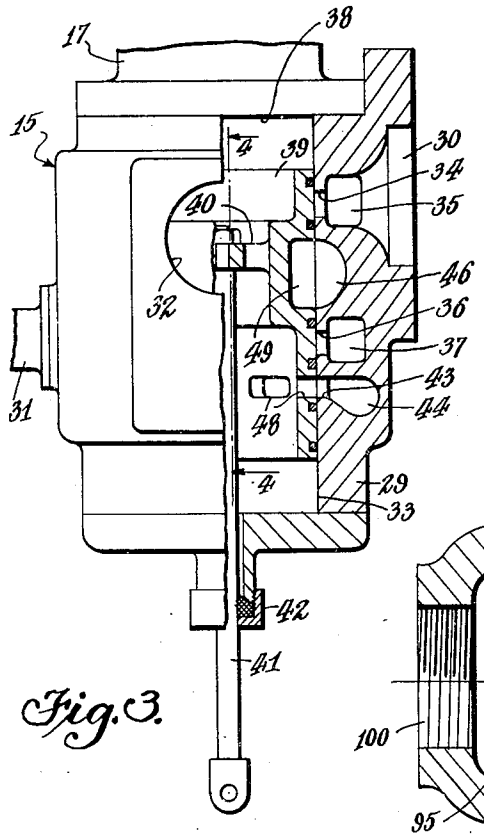


Fig. 3.

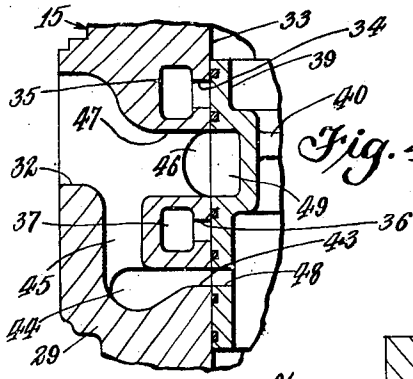


Fig. 4.

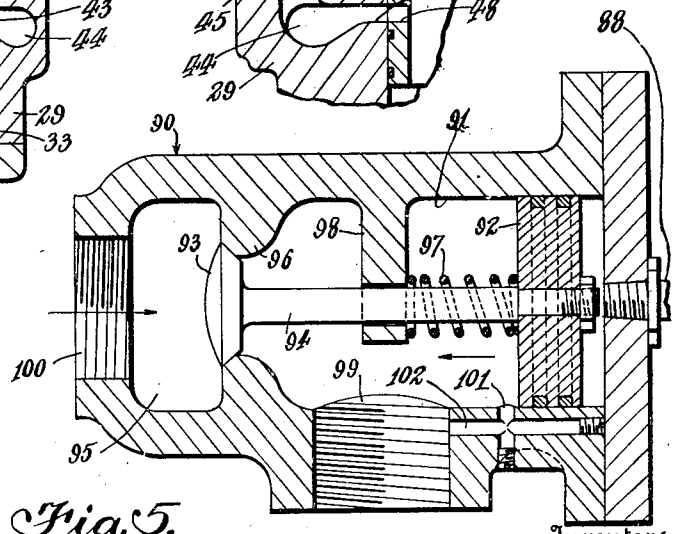


Fig. 5.

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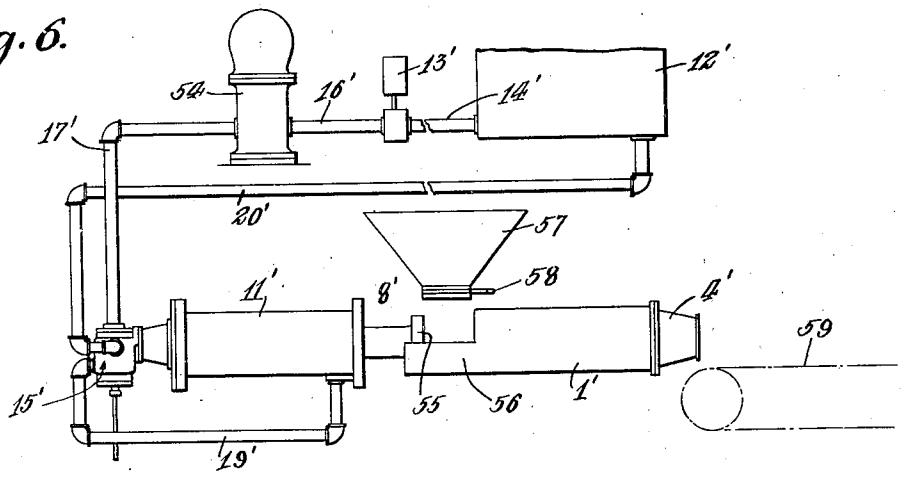
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EXTRUSION MACHINE

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Fig. 6.



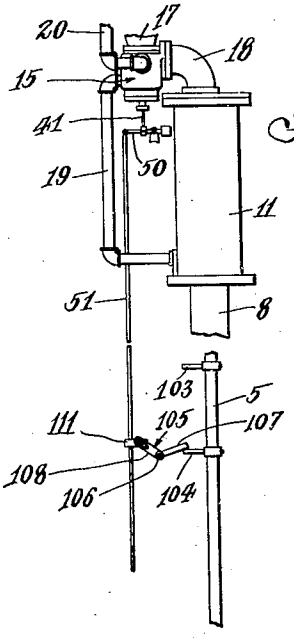
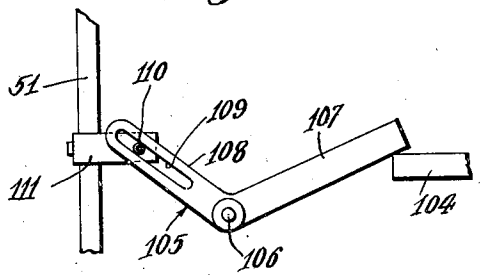


Fig. 7.

Fig. 8.



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UNITED STATES PATENT OFFICE

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EXTRUSION MACHINE

Application filed July 23, 1929. Serial No. 380,297.

This invention refers to a hydraulic extruding machine and particularly to an arrangement and combination of elements whereby articles may be formed from clay or other plastic material by extrusion. More particularly, the invention relates to means for operating and controlling the extrusion machine, and to a fluid pressure system by means of which the movements of a hydraulic ram operably connected to the extrusion means, or forming a part thereof, may be controlled.

An object of this invention is to disclose and provide means for hydraulically operating a ram of an extrusion machine.

A still further object is to disclose and provide a fluid pressure system whereby the movements of the ram may be quickly changed or easily controlled.

A still further object of this invention is to disclose and provide a novel means for operating a pressure cylinder.

Another object is to disclose and provide a new and useful means for controlling the application of pressure fluid to a pressure cylinder.

A still further object of this invention is to disclose and provide a means whereby a pressure ram operating in a pressure cylinder may be rapidly moved by fluid pressure.

Another object is to disclose and provide means whereby a gravity head of fluid may be used in facilitating the movements of a ram in a pressure cylinder.

A still further object is to disclose and provide automatic means for arresting the movement of a ram operated by hydraulic means.

Another object is to disclose and provide means for automatically interrupting the action of expressing means when an article of predetermined length has been formed.

Other objects, uses and advantages of this invention will become apparent to those skilled in the art from the following detailed description of a preferred form of the apparatus and its mode of operation. It is to be understood that the appended drawings (referred to hereinafter) are only illustrative of one particular arrangement of elements, and the invention is not limited to the particular construction and arrangement shown therein, but embraces all such changes and modifications as come within the scope of this invention and claims appended hereto.

In describing the invention, reference will be had to the appended drawings, in which:

Fig. 1 is an elevation, partly broken away and partly diagrammatic, of the general assembly of units included in one form of our invention.

Fig. 2 is an enlarged elevation and vertical section, taken through one form of pilot valve which may be employed, and illustrating its mode of operation.

Fig. 3 is an enlarged side elevation, partly in vertical section, of a four-port slide valve adapted to be used in regulating the movements of the hydraulic ram.

Fig. 4 is a section taken along line 4—4 of Fig. 3, through a portion of the valve end shown.

Fig. 5 is an enlarged vertical section taken through a release valve adapted to be used in regulating the movement of the expressing means.

Fig. 6 is a diagrammatic representation of a modified form of apparatus.

Fig. 7 is a diagrammatic representation of means for automatically stopping the motion of the expressing means.

Fig. 8 is an enlarged view of a portion of the stop means illustrated in Fig. 7.

The apparatus illustrated in Fig. 1 preferably includes a suitable cylinder 1 for plastic material, such as for example, clay. Means for supplying plastic material to such cylinder may include a continuous conveyor 2 and a trough or hopper 3. A forming head such as a die 4 is preferably attached to the lower end of the clay cylinder 1.

An expressing means comprising a pressure head, or what is known as a mud head in the art and being in fact a piston, operates in the cylinder 1 and is adapted to be raised up out of said cylinder to permit the introduction of clay or other plastic material thereinto. Said pressure head or mud head

is preferably connected by means of one or more piston rods 5 to a suitable cross head or guide.

Heretofore, extrusion machines of the character described herein have been operated by means of steam pressure from a steam chest or cylinder 6. In order to adapt this invention to present devices, the piston rods 5 are shown connected to a piston in the cylinder 6, the head of said cylinder having been removed, however, and an open support 7 substituted therefor. In this manner the cylinder 6 and the piston therein take the place of a cross head or guide. It is to be understood, however, that it is not necessary or essential that the piston rods 5 be connected to a hydraulic ram such as the ram 8 through the intervention of a piston in a cylinder 6, as the ram 8 may be directly connected to a mud head. The cylinder 6 is generally supported in spaced relation from the cylinder 1 by means of suitable supports 9.

The ram 8 preferably terminates in a piston 10 operating in a pressure cylinder 11. A fluid pressure system preferably connects the upper and lower ends of said pressure cylinder 11. Such fluid pressure system may include a tank for fluid 12, a source of fluid pressure such as for example a suitable pump 13, adapted to receive fluid from the tank 12 as by pipe means 14 and a suitable multiple port valve 15.

The valve 15 is preferably a sliding multiple port balanced valve, that is, a valve having its various faces subjected to substantially equal pressure heads so as to permit its rapid and quick operation. The valve 15 is preferably connected by suitable pipe means to the tank 12 or to a low pressure portion of the fluid system to the opposed ends of the pressure cylinder 11, and to the source of fluid pressure such as the pump 13. As shown in Fig. 1, the pump 13 discharges fluid under pressure through pipe means 16 into a T 17 which is connected to the valve 15. The valve 15 is also provided with a pipe means such as the L 18 connecting said valve with the upper end of pressure cylinder 11 and with pipe means 19 connecting said valve 15 with the lower end of pressure cylinder 11.

Pipe means 20 lead from a suitable port and valve 15 to a low pressure portion of the fluid system, such as for example, the cross 21 in line 22 leading to tank 12. A one-way check valve 23 is preferably positioned in the line 22 and between the cross 21 and the T 17, the operation of said check valve 23 being described later. A suitable valve 24 may be positioned in line 19 connecting the valve 15 with the lower end of pressure cylinder 11, said valve being normally open and being only closed when it is desired to discontinue the operation of the pump 13 and maintain the piston 10 and parts attached thereto at the upper portion of its stroke in pressure cylinder 11.

The pressure cylinder 11 may also be provided with means for stopping the piston 10 therein at the end of its stroke within said pressure cylinder 11. Such means may comprise by-pass lines 25 and 26, said by-pass lines 25 and 26 embracing a portion of the length of pressure cylinder 11 slightly greater than the thickness of the piston 10. Each of said by-pass lines 25 and 26 is preferably provided with a check valve such as the valves 27 and 28, respectively. The operation of said valves will be described later.

In Fig. 3 is shown one preferred form of the valve 15. Said valve 15 may comprise an outer body portion 29 provided with a port 30 adapted to be connected with the upper end of pressure cylinder 11 (as by means of the L 18) a port 31 adapted to be connected to the lower end of the pressure cylinder 11, and a port 32 adapted to be connected to a return line or low pressure portion of the fluid system.

The valve 15 preferably includes a cylindrical bore 33 containing a plurality of ports or openings leading into cavities formed in the body 29, said cavities in turn communicating with the various ports 30, 31 and 32. For example, the body portion 29 of the valve 15 may include a plurality of ports 34 in a plane transverse to the axis of the bore 33, said ports 34 leading to an annular cavity 35 communicating with the port 30.

The body portion 29 may also include a plurality of ports 36 in a plane transverse to the axis of the bore 33, said ports 36 communicating with an annular chamber 37 to which the port 31 is connected. The interior of valve 15 preferably communicates directly, as by means of port 38, with the source of fluid pressure and as shown in the drawings, through the T 17 with a line 16 which in turn leads to the pump 13. Slidably mounted within the body portion 29 of the valve 15 is a valve member 39. Said valve member is preferably adapted to slide upon the inner surface of the bore 33 and may be provided with a plurality of packing rings so as to form a substantially fluid tight seal. The valve member 39 is preferably provided with a spider 40 in its center, to which is connected an operating rod 41 extending through a suitable packing gland 42 exteriorly of the valve 15.

The body portion 29 of the valve 15 is preferably provided with a plurality of ports 43, extending in a plane transverse to the axis of the bore 33 and connected with an annular port 44, which in turn is connected, as by means of a passage-way 45 with the port 32 leading to a low pressure portion of the fluid system, or as is shown in Fig. 1, being connected by line 20 with the T 21,

and line 22 which in turn leads to the tank 12. The body portion 29 of the valve 15 also preferably includes a plurality of ports 46, said ports being connected together and also connected, as by means of a passage-way 47, with the port 32.

The movable valve 39 preferably includes a plurality of ports 48 adapted to coincide with the ports 43 and cause said ports 43 to communicate with the interior of the valve 15. The valve 39 also preferably includes an annular chamber 49.

The operation of this valve is as follows. Fluid under pressure is admitted into the interior of the valve through the inlet port 38, and after the moving valve body 39 is in the position shown in Fig. 3, the fluid under pressure will pass through the spider 40 and through the ports 48 and 43 into the annular ring 44 which communicates by port 45 with the port 32 leading back to line 22 through the pipe line 20. If it is desired to move the piston 10 in pressure cylinder 11 downwardly, then the valve stem 41 which may be attached by means of suitable levers, such as the counterweight lever 50, rod 51 and bell crank lever 52, to an operating handle, is so moved as to move the valve 39 downwardly. Port 43 will thus be closed, while port 34 is simultaneously opened and placed into communication with the interior of the valve 15. Concurrently with such movement, the annular chamber 49 will cause the port 36 to communicate with the annular chamber 49, said chamber 49 leading into the port 46. Fluid under pressure will thus be allowed to pass from the interior of the valve into port 34 and through the port 30 into the upper end of pressure cylinder 11, whereas the lower end of the cylinder 11 will, by means of pipe 19, communicate with port 31 which is in communication with port 36.

Port 36 in turn will be in communication with port 46 through the annular chamber 49, thereby permitting fluid from the lower portion of the pressure cylinder 11 to flow into port 46 and through passage-way 47 into port 32, the port 32 communicating by line 20 with a low pressure portion of the system, namely, line 22 leading to the tank 12.

If it is desired to reverse the operation and to raise the piston 10 within pressure cylinder 11, the handle attached to bell crank lever 52 is moved so as to move the valve stem 41 upwardly from the position shown in Fig. 3. When ports 48 in valve 39 come into alinement with ports 36 of the valve body 29, then port 43 is closed and ports 34 and 46 are in communication with each other through the annular chamber 49. Pressure fluid inside the valve will then be passed through ports 48 and 36 into the annular chamber 37, which is in communication with port 31 and with line 19 leading to the bottom of pressure cylinder 11. The upper end of cylinder 11 will now be in communication with port 30 and through port 34, annular chamber 49, chamber 46, passage-way 47 and port 32 with the return line 20 leading to a low pressure portion of the system, such as line 22.

The throttle valve, therefore, is capable of selectively connecting either end of the pressure cylinder 11 with the power fluid supplied thereto, and simultaneously connect the opposed end of said cylinder with a low pressure section of the fluid system, such as the tank 12.

The valve 15 in its neutral position, shown in Fig. 3, is also adapted to connect the source of fluid pressure directly with the tank 12 or other section of low pressure area in the fluid system, when in said neutral position.

In order to facilitate the downward movement of the piston 10 within the pressure cylinder 11, the tank 12 may be positioned above the pump 13 and above the valve 15 and the cylinder 11, so as to create a gravity head of fluid from the tank 12 to the valve 15 and cylinder 11. When a substantially incompressible fluid, such as oil, is used in the system and the valve 15 is so adjusted as to move the piston 10 downwardly, then the weight of the piston 10, the ram 8 and the various cross heads, pistons and mud heads connected thereto assists in the downward movement and momentarily the fluid pressure in the line 16, T 17, valve 15, L 18 and the upper end of pressure cylinder 11 drops. In order to permit this pressure to quickly build up again so as to positively move the piston 10 downwardly, the check valve 23 described hereinabove has been provided.

When the fluid pressure from the pump 13 acting upon the upper end of piston 10 momentarily drops at the beginning of a downward stroke, and falls below the gravity head of fluid from the tank 12 to the check valve 23, then said check valve will open automatically, thus permitting the gravity head of fluid from the tank 12 to act upon the upper end of piston 10 and thereby facilitate moving said piston 10 downwardly.

As soon as the pump 13 develops a pressure in the line 16 and T 17 exceeding the gravity head in line 22 from the tank 12, then the check valve 23 will automatically close.

It is to be understood that although it is preferred to have the tank 12 positioned above the rest of the apparatus, as shown in Fig. 1, still substantially the same effect can be obtained by positioning the tank 12 at a lower level and placing a stand pipe or other reservoir above the check valve 23, said stand pipe being refilled with oil or other fluid by a return line such as the return line 20. The stand pipe may be made of any

required size and height so as to produce a desirable gravity head.

Under certain circumstances it may not be advisable to employ a gravity head such as is described hereinabove in assisting the downward movement of the piston 10 within the pressure cylinder 11. The fluctuation and pressure may be substantially obviated by the introduction of an accumulator or pressure cylinder in the line 16 leading to the throttle valve 15. Such an arrangement is diagrammatically illustrated in Fig. 6, in which the pump 13′ receives oil from a tank 12′ by line 14′ and discharges the fluid through line 16′ into an accumulator or pressure cylinder 54, provided with a suitable air cushion so that when fluid is withdrawn from the pressure tank 54 through line 17′ into the valve 15′ and into the upper or lower end of pressure cylinder 11′, the expansion of the air cushion in the pressure cylinder substantially prevents a momentary but rapid drop in working pressure.

The valve 15′ may be provided with a return line 20′ leading to the tank 12′.

It is to be noticed that when an accumulator such as the pressure chamber 54 is employed, it is not necessary to employ a check valve such as the valve 23 shown in Fig. 1, as there is no gravity head to be used in facilitating and cooperating with the fluid pressure from a pump.

Fig. 6 also shows the application of the machine to a horizontal apparatus, as for the extrusion of certain types of articles it may be desirable to have the machine operate in a horizontal plane instead of a vertical plane. The mud head 55, here shown directly connected to the ram 8′ works in and out of a cylinder 1′ adapted to receive plastic material. The lower portion of the cylinder 1′ may have connected thereto a substantially semi-circular guide 56 adapted to act as a guide for the mud head 55 and retain clay or other plastic material periodically discharged into the hopper formed by the member 56 from a suitable feeding means, such as the hopper 57 provided with a valved outlet 58. Plastic material from the cylinder 1′ may be extruded from a suitable die 4′ upon a moving conveyor 59 adapted to receive and carry away the formed products.

Means may be provided whereby the expressing means such as the mud head operating in the cylinder 1, may be automatically stopped whenever an article of predetermined length has been extruded through the die 4.

A former plate 60 mounted upon a movable scale rod 61, said scale rod being movable along an axis passing through the axis of the cylinder 1 and die 4 may be provided in operative relation with the die 4. The scale rod 61 may be provided with a suitable cross arm 62 to which may be connected flexible members such as cables 63 and 64 passing over suitable sheaths and pulleys 65, and having counter-weights 66 attached thereto. In such manner the former 60 may be readily moved along its longitudinal axis, the counter-weights being sufficient to balance the device.

The scale rod 61 may carry one or more adjustable stops 67 of any desired form and size, said stops 67 being adjustably positioned on the scale rod 61 as by means of bolts 68. The stop members 67 are preferably of such size as to come into operative engagement with a bell crank lever 69 or other means adapted to translate the motion of the stop 67 into a suitable motion adapted to actuate a pilot valve 70. For example, the bell crank lever 69 pivoted at 71 may be provided with a roller 72 or other smooth surface at its extremity adapted to engage with the stop 67, and with a flat plate or end 73 adapted to contact a piston rod 74 connected to a piston 75 in the pilot valve 70. A compression spring 76 may be positioned between a stop 77 mounted on the piston rod 74 and the housing of the pilot valve 70, so as to normally maintain the piston 75 against one end of a cylinder 78 of the pilot valve 70.

The piston 75 is preferably provided with suitable packing rings and with a plurality of ports 79 extending through the piston so as to permit a fluid connection between opposed ends thereof. The piston 75 is also preferably provided with an axial bore 80 adapted to slidably receive a valve stem 81 of a poppet valve 82 which seats upon an aperture in a bulkhead 83 dividing the cylinder 78 from a chamber 84 in the pilot valve 70. Fluid under pressure may be supplied to the pilot valve 70 and particularly to chamber 84 thereof through a line 85 connected to a source of fluid under pressure, such as for example, the pump 13 and line 16 (or to an accumulator or pressure cylinder when that modification of the system is employed).

The cylinder 78 of the pilot valve 70 may be connected by means of a line 86 to a low pressure portion of the fluid system, and as shown in Fig. 1, the line 86 leads to a line 87 which in turn discharges into the low pressure line 22 leading to tank 12. Preferably, the connection made by line 86 in the cylinder 78 is closely adjacent to the edge of piston 75 when said piston is in its normal position within said cylinder 78 and adjoining one end thereof. The cylinder 78 may also be provided with a line 88 leading to a release valve 90. The valve 82 is normally maintained in seated position by means of a compression spring 89 or other suitable means.

The release valve 90, one form of which is shown in detail in Fig. 5, may include a cylinder 91 adapted to slidably receive a piston 92 connected to a valve 93 by means of a stem

94. The valve 90 may be divided into two major portions, namely, the cylinder 91 and a chamber 95 separated by means of the valve 93 seating upon an annular lip 96 extending from the walls of the release valve 90. Normally the valve 93 is maintained in seated position by means of compression spring 97 acting between a lug 98 extending from the wall of the release valve 90 (provided with an aperture through which the valve stem 94 is slidably held) and the piston 92.

The line 88 from the pilot valve 70 is preferably connected to the release valve 90 at the end of cylinder 91 away from the bulkhead formed by the valve 93, so as to permit fluid admitted into the release valve through the line 88 to act directly upon the piston 92. An outlet port 99 may be provided from cylinder 91 of the release valve 90, said port 99 being connected to line 87 leading to a low pressure portion of the fluid system. The chamber 95 may be provided with a port 100 leading directly to the upper portion of the pressure cylinder 11, or as shown in Fig. 1, leading to the L 18 which in turn communicates with the upper portion of the cylinder 11.

The operation of this automatic mechanism is as follows. If it is desired to extrude an article of predetermined length from the die 4, the operating handle attached to bell crank lever 52 is so moved as to permit the valve 15 to allow pressure fluid to pass through the valve and into the upper end of pressure cylinder 11. This will cause the piston 10 in said cylinder to move downwardly, thereby causing the mud head connected thereto through the ram 8 and pistons 5 to exert considerable pressure upon the plastic material in the cylinder 1 and cause the same to be extruded through the die 4 upon the former 60. As the article is extruded the former 60 and scale rod 61 will move downwardly and the stop 67 mounted upon the scale rod 61 will also move downwardly.

When the stop 67 contacts with the bell crank lever 69, said bell crank lever will pivot upon point 71, causing arm 73 thereof to move the piston rod 74 and piston 75 so as to close the port 86. The cylinder 78 is, of course, filled with oil or other fluid admitted thereto through the line 86. Valve stem 81 is not moved until the end of said valve stem comes in contact with the end of the bore 80 in the piston 75. Up to this point, fluid in the cylinder 78 is under a very low pressure, said fluid being allowed to pass through aperture 79 in the piston 75 to the end of the cylinder 78.

When the valve stem 81 contacts with the bottom of bore 80 and the piston 75 continues its forward travel under the urge of arm 73 of bell crank lever 69, valve 82 will become unseated, thereby permitting fluid under pressure admitted into chamber 84 through line 85 from a high pressure source to pass into the cylinder 78 and out through the line 88.

Fluid under pressure thus admitted into line 88 passes into the release valve 90 and pressure is thus imparted to the piston 92 in the release valve 90, causing said piston to move in the direction of the arrow indicated in Fig. 5. Inasmuch as the area of piston 92 is much greater than the area of valve 93, the piston will move in the direction of the arrow even though fluid in chamber 95 is under substantially the same pressure as the fluid admitted to the release valve 90 through line 88. When the piston 92 moves in the direction of the arrow indicated in Fig. 5, fluid under pressure present in chamber 95 and admitted thereto through port 100 which is in direct communication with the upper end of pressure cylinder 11, is by-passed through the valve thus open and into cylinder 91 and out of said cylinder 91 through port 99 into line 87 which leads to a low pressure portion of the system.

It will be thus seen that the pressure being exerted upon the upper portion of piston 10 in the pressure cylinder 11 is released by the release valve 90 when the valve 93 thereof is open, thereby substantially arresting the downward movement of the piston 10 and thus arresting the movement of the expressing means or mud head in the cylinder 1.

The operating fluid or fluid under pressure from the pump 13 is thus by-passed through the valve 15 and through the release valve 90 back into a low pressure portion of the fluid system. This condition will remain as long as the stop arm 67 on the scale rod 61 is in operative contact with the bell crank lever 69 and as long as the pilot valve 70 is open. This gives the operator of the machine an opportunity to reverse the direction of the throttle valve 15 by operation of the handle attached to bell crank lever 52, or to place said valve 15 in neutral position so that the extruded article may be severed or removed.

In order to prevent the fluid under pressure admitted through line 88 from injuring the release valve 90 a by-pass port 101 may be provided in the cylinder 91, said by-pass port 101 communicating with a port 102 leading to the outlet port 99. When the piston 92 traverses and uncovers port 101 thereby placing said port into communication with the fluid admitted to the release valve 90 through line 88, then said piston 92 will remain in substantially the same position, allowing said pressure fluid from line 88 to be discharged through ports 101 and 102 into the outlet 99 until the supply of pressure fluid from line 88 is discontinued.

Means may also be provided for stopping the piston 10 at the end of its stroke within the pressure cylinder 11. Such means may include the by-pass lines 25 and 26 described hereinabove and the check valves 27 and 28.

When it is desired to move the piston 10 downwardly for example, and the upper edge of the piston 10 passes the upper port of by-pass line 26 so that the piston is positioned between the ports connecting by-pass line with the interior of cylinder 11, then the fluid under pressure being supplied into the upper end of cylinder 11 will actuate the check valve 28 in the by-pass line 26, opening said valve and permitting said fluid under pressure to be by-passed around the piston 10 into the lower portion of the cylinder 11. In this manner the working pressure upon the upper portion of piston 10 is eliminated and the piston remains substantially stationary. When, on the other hand, it is desired to raise the piston 10 from such position, then when the multiple port throttle valve 15 is operated and fluid under pressure admitted through line 19 into the lower portion of pressure cylinder 11, the check valve 28 will close in the by-pass line 26, thereby permitting said pressure to act upon the lower face of piston 10 and raise said piston. When said piston comes into position between the ports connecting by-pass line 25 with the pressure cylinder 11, then the fluid under pressure will act upon the valve 27 in said by-pass and open said valve, permitting said pressure fluid to by-pass around said piston.

A modified form of means for automatically stopping the piston 10 at any predetermined point in its stroke or at the end of its stroke within the pressure cylinder 11 is shown rather diagrammatically in Figs. 7–8. As shown therein, the ram 8 or one of the piston rods 5 rigidly connecting the piston 10 and the mud head may be provided with adjustably mounted stop arms 103 and 104 adapted to directly manipulate the multiple port throttle valve 15. If, for example, it is desired to stop the piston 10 at the end of its stroke automatically, the stops 103 and 104 may be mounted on the piston rod 5, a distance apart substantially equivalent to the length of the desired stroke of the piston 10. A bell crank lever 105 pivoted at 106 may be provided, one of said arms, such as 107, being adapted to come into operative engagement with the stops 103 and 104.

The opposed arm 108 may be provided with a slot 109 adapted to slidably receive a pin 110 in a collar or stop 111 positioned on the operating rod 51 connected to the lever 50 which operates the valve stem 41 of the throttle valve 15. If, for example, the piston 10 in the cylinder 11 is moving upwardly, then the stop arm 104 on the piston rod 5 is moving upwardly, and when said stop arm 104 contacts with the leg 107 of bell crank lever 105 it will pivot said bell crank lever, causing the arm 108 (in engagement with the pin 110 of stop 111) to move downwardly, thereby causing the operating rod 51 to move downwardly and thereby minipulating the multiple port valve 15 either into neutral position, or into such position as to reverse the stroke of the piston.

Whether the stop arms 103 and 104 merely cause the valve 15 to be placed into neutral position, thereby stopping the travel of the piston 10, or whether said stop arms actuate the valve 15 so as to reverse the direction of travel of the piston 10 is discretionary with the desires of the operator and the operations to be performed by the apparatus.

In order to prevent fluid pressure in line 16 to be built up to a dangerous extent, a pressure relief valve 112 may be provided, as shown in Fig. 1. The pressure relief valve 112, which may be of any desired construction is preferably connected to the high pressure line 16, so that when the pressure in said line exceeds a certain predetermined quantity, the fluid is by-passed through said valve into line 87, leading to a low pressure portion of the system.

It will be understood that, while we have shown and described a particular method and apparatus herein, the same is not to be limited to the details described, but may be changed or modified within the scope of the claims appended hereto without departing from the spirit of the invention. Certain modifications have been described herein, and it is to be understood that said modifications may be utilized in various combinations, depending upon the character of the work which it is desired to produce by the apparatus and the control required for the production of the desired articles by said apparatus. Furthermore, the means described in detail herein may be modified and changed in accordance with the skill of those in the art without departing from the invention disclosed herein.

What we claim is:

1. In a machine for the formation of articles by extrusion, a cylinder for plastic material, means for expressing said material from said cylinder, a pressure cylinder, a piston in said pressure cylinder operably connected to said expressing means, a tank for fluid, a source of fluid under pressure, a multiple port slide valve, and pipe means connecting said valve with opposed ends of said cylinder, the tank and said source of fluid pressure, said valve being adapted to selectively connect either end of said pressure cylinder with said source and simultaneously connect the opposed end of said cylinder with said tank.

2. In a machine for the formation of articles by extrusion, a cylinder for plastic material, means for expressing said material from said cylinder, a pressure cylinder, a piston in said pressure cylinder operably connected to said expressing means, a tank for fluid, a source of fluid under pressure, a multiple port slide valve, and pipe means con-

necting said valve with opposed ends of said cylinder, the tank and said source of fluid pressure, said valve being adapted to selectively connect either end of said pressure cylinder with said source and simultaneously connect the opposed end of said cylinder with said tank, and including means for connecting said source with said tank when said valve is in neutral position.

3. In a machine for the formation of articles by extrusion, a cylinder for plastic material, means for expressing said material from said cylinder, a pressure cylinder, a piston in said pressure cylinder operably connected to said expressing means, a tank for fluid a source of fluid under pressure, a four-port slide valve, pipe means connecting said valve with opposed ends of said cylinder, the tank and said source of fluid pressure, said valve being adapted to selectively connect either end of said pressure cylinder with said source and simultaneously connect the opposed end of said cylinder with said tank, and means for operating said valve.

4. In a machine for the formation of articles by extrusion, a cylinder for plastic material, means for expressing said material from said cylinder, a pressure cylinder, a piston in said pressure cylinder operably connected to said expressing means, a tank for fluid, a source of fluid under pressure, a four-port slide valve, pipe means connecting said valve with opposed ends of said cylinder, the tank and said source of fluid pressure, said valve being adapted to selectively connect either end of said pressure cylinder with said source and simultaneously connect the opposed end of said cylinder with said tank, and including means for connecting said source with said tank when said valve is in neutral position, and means for operating said valve.

5. In a machine for the formation of articles by extrusion, a cylinder for plastic material, means for expressing said material from said cylinder, a pressure cylinder, a piston in said pressure cylinder operably connected to said expressing means, a tank for fluid, a source of fluid under pressure, a four-port slide valve, pipe means connecting said valve with opposed ends of said cylinder, the tank and said source of fluid pressure, said valve being adapted to selectively connect either end of said pressure cylinder with said source and simultaneously connect the opposed end of said cylinder with said tank, and including means for connecting said source with said tank when said valve is in neutral position, means for operating said valve, and means for stopping said piston at the end of its stroke in said pressure cylinder.

6. In a machine for the formation of articles by extrusion, a cylinder for plastic material, means for expressing said material from said cylinder, a pressure cylinder, a piston in said pressure cylinder operably connected to said expressing means, a fluid pressure system connecting upper and lower ends of said pressure cylinder and including a tank for fluid, and a source of fluid under pressure, and means for selectively connecting either end of said pressure cylinder with said source and simultaneously connect the opposed ends of said cylinder with said tank.

7. In a machine for the formation of articles by extrusion, a cylinder for plastic material, means for expressing said material from said cylinder, a pressure cylinder, a piston in said pressure cylinder operably connected to said expressing means, a fluid pressure system connecting upper and lower ends of said pressure cylinder and including a tank for fluid and a source of fluid under pressure, means for selectively connecting either end of said pressure cylinder with said source and simultaneously connect the opposed ends of said cylinder with said tank, movable means for receiving a formed product, and means automatically actuated upon the advance of said movable means through a predetermined distance for releasing the pressure in the upper end of said pressure cylinder.

8. In a machine for the formation of articles by extrusion, a cylinder for plastic material, means for expressing said material from said cylinder, a pressure cylinder, a piston in said pressure cylinder operably connected to said expressing means, a fluid pressure system connecting upper and lower ends of said pressure cylinder and including a tank for fluid, a source of fluid under pressure, a four-port slide valve, said slide valve being adapted to selectively connect either end of said pressure cylinder with said source and simultaneously connect the opposed end of said cylinder with said tank; movable means for receiving a formed product, and means automatically actuated upon the advance of said movable means through a predetermined distance for releasing the pressure in the upper end of said pressure cylinder.

9. In a machine for the formation of articles by extrusion, a cylinder for plastic material, means for expressing said material from said cylinder, a pressure cylinder, a piston in said pressure cylinder operably connected to said expressing means, a tank for fluid, a source of fluid under pressure, a multiple port slide valve positioned beneath said tank, pipe means connecting said valve with opposed ends of said pressure cylinder, the tank and said source of fluid under pressure, said valve being adapted to selectively connect either end of said pressure cylinder with said source and simultaneously connect the opposed end of said cylinder with said

tank, and including means for connecting said source with said tank when said valve is in neutral position, and means adapted to permit fluid to flow from said tank to said valve when the fluid pressure within said valve drops below the gravity head from said tank.

10. In a machine for the formation of articles by extrusion, a cylinder for plastic material, means for expressing said material from said cylinder, a pressure cylinder, a piston in said pressure cylinder operably connected to said expressing means, a tank for fluid, a source of fluid under pressure, a four-port slide valve positioned beneath said tank, pipe means connecting said valve with opposed ends of said pressure cylinder, the tank and said source of fluid under pressure, said valve being adapted to selectively connect either end of said pressure cylinder with said source and simultaneously connect the opposed end of said cylinder with said tank and including means for connecting said source with said tank when said valve is in neutral position, and means positioned in pipe means connecting said valve and tank adapted to permit fluid to flow from said tank to said valve when the fluid pressure within said valve drops below the gravity head from said tank.

11. In a machine for the formation of articles by extrusion, a cylinder for plastic material, means for expressing said material from said cylinder, a pressure cylinder, a piston in said pressure cylinder operably connected to said expressing means, a tank for fluid, a source of fluid under pressure, a four-port slide valve positioned beneath said tank, pipe means connecting said valve with opposed ends of said pressure cylinder, the tank and said source of fluid under pressure, said valve being adapted to selectively connect either end of said pressure cylinder with said source and simultaneously connect the opposed end of said cylinder with said tank, and including means for connecting said source with said tank when said valve is in neutral position, and means adapted to permit fluid to flow from said tank to said valve when the fluid pressure within said valve drops below the gravity head from said tank, said means comprising a check valve.

12. In a machine for the formation of articles by extrusion, a cylinder for plastic material, means for expressing said material from said cylinder, a pressure cylinder, a piston in said pressure cylinder operably connected to said expressing means, a tank for fluid, a source of fluid under pressure, a multiple port slide valve positioned beneath said tank, pipe means connecting said valve with said opposed ends of said pressure cylinder, the tank and said source of fluid under pressure, said valve being adapted to selectively connect either end of said pressure cylinder with said source and simultaneously connect the opposed end of said cylinder with said tank, and including means for connecting said source with said tank when said valve is in neutral position, means adapted to permit fluid to flow from said tank to said valve when the fluid pressure within said valve drops below the gravity head from said tank, said means comprising a check valve, and means for operating said slide valve.

13. In a machine for the formation of articles by extrusion, a cylinder for plastic material, means for expressing said material from said cylinder, a pressure cylinder, a piston in said pressure cylinder operably connected to said expressing means, a tank for fluid, a source of fluid under pressure, a four-port slide valve positioned beneath said tank, pipe means connecting said valve with opposed ends of said pressure cylinder, the tank and said source of fluid under pressure, said valve being adapted to selectively connect either end of said pressure cylinder with said source and simultaneously connect the opposed end of said cylinder with said tank, and including means for connecting said source with said tank when said valve is in neutral position, and means positioned in pipe means connecting said valve and tank adapted to permit fluid to flow from said tank to said valve when the fluid pressure within said valve drops below the gravity head from said tank, said means comprising a check valve, and means for operating said valve.

14. In a machine for the formation of articles by extrusion, a cylinder for plastic material, means for expressing said material from said cylinder, a pressure cylinder, a piston in said pressure cylinder operably connected to said expressing means, a tank for fluid, a source of fluid under pressure, a four-port slide valve positioned beneath said tank, pipe means connecting said valve with opposed ends of said pressure cylinder, the tank and said source of fluid under pressure, said valve being adapted to selectively connect either end of said pressure cylinder with said source and simultaneously connect the opposed end of said cylinder with said tank, and including means for connecting said source with said tank when said valve is in neutral position, and means positioned in pipe means connecting said valve and tank adapted to permit fluid to flow from said tank to said valve when the fluid pressure within said valve drops below the gravity head from said tank, said means comprising a check valve, means for operating said valve, and means for stopping said piston at the end of its stroke within said pressure cylinder.

15. In a machine for the formation of articles by extrusion, a cylinder for plastic

material, means for expressing said material from said cylinder, said expressing means being hydraulically operated by a power fluid, movable means for receiving a formed product, and means automatically actuated upon the advance of said movable means through a predetermined distance for by-passing said power fluid and interrupting the action of said expressing means.

16. In a machine for the formation of articles by extrusion, a cylinder for plastic material, means for expressing said material from said cylinder, said expressing means being hydraulically operated by a power fluid and including a pressure cylinder, a piston in said pressure cylinder operably connected to said expressing means, a tank for fluid, a source of fluid under pressure, a four-port slide valve, pipe means connecting said valve with opposed ends of said cylinder, the tank and said power fluid, said valve being adapted to selectively connect either end of said pressure cylinder with said power fluid and simultaneously connect the opposed end of said cylinder with said tank, movable means for receiving a formed product and means automatically actuated upon the advance of said movable means through a predetermined distance for by-passing said power fluid, and interrupting the action of said expressing means.

17. In a machine for the formation of articles by extrusion, a cylinder for plastic material, means for expressing said material from said cylinder, said expressing means being hydraulically operated by a power fluid, and including a pressure cylinder, a piston in said pressure cylinder operably connected to said expressing means, a tank for fluid, a source of fluid under pressure, a four-port slide valve, pipe means connecting said valve with opposed ends of said cylinder, the tank and said power fluid, said valve being adapted to selectively connect either end of said pressure cylinder with said power fluid and simultaneously connect the opposed end of said cylinder with said tank; movable means for receiving a formed product, and means automatically actuated upon the advance of said movable means through a predetermined distance for by-passing said power fluid intermediate said valve and pressure cylinder, and interrupting the action of said expressing means.

18. In a machine for the formation of articles by extrusion, a cylinder for plastic material, means for expressing said material from said cylinder, said expressing means being hydraulically operated by a power fluid, and including a pressure cylinder, a piston in said pressure cylinder operably connected to said expressing means, a tank for fluid, a source of fluid under pressure, a four-port slide valve, pipe means connecting said valve with opposed ends of said cylinder, the tank and said power fluid, said valve being adapted to selectively connect either end of said pressure cylinder with said power fluid and simultaneously connect the opposed end of said cylinder with said tank; movable means for receiving a formed product and means automatically actuated upon the advance of said movable means through a predetermined distance for by-passing said power fluid into said tank, and interrupting the action of said expressing means.

19. In a machine for the formation of articles by extrusion, a cylinder for plastic material, means for expressing said material from said cylinder, said expressing means being hydraulically operated by a power fluid, and including a pressure cylinder, a piston in said pressure cylinder operably connected to said expressing means, a tank for fluid, a source of fluid under pressure, a four-port slide valve, pipe means connecting said valve with opposed ends of said cylinder, the tank and said power fluid, said valve being adapted to selectively connect either end of said pressure cylinder with said power fluid and simultaneously connect the opposed end of said cylinder with said tank; movable means for receiving a formed product, and a release valve automatically actuated upon the advance of said movable means through a predetermined distance for by-passing said power fluid into said tank and interrupting the action of said expressing means.

20. In a machine for the formation of articles by extrusion, a cylinder for plastic material, means for expressing said material from said cylinder, said expressing means being hydraulically operated by a power fluid, and including a pressure cylinder, a piston in said pressure cylinder operably connected to said expressing means, a tank for fluid, a source of fluid under pressure, a four-port slide valve, pipe means connecting said valve with opposed ends of said cylinder, the tank and said power fluid, said valve being adapted to selectively connect either end of said pressure cylinder with said power fluid and simultaneously connect the opposed end of said cylinder with said tank; movable means for receiving a formed product, and a release valve automatically actuated by a pilot valve upon the advance of said movable means through a predetermined distance for by-passing said power fluid into said tank, and interrupting the action of said expressing means.

21. In a machine for the formation of articles by extrusion, a cylinder for plastic material, means for expressing said material from said cylinder, said expressing means being hydraulically operated by a power fluid, and including a pressure cylinder, a piston in said pressure cylinder operably connected to

said expressing means, a tank for fluid, a source of fluid under pressure, a four-port slide valve, pipe means connecting said valve with opposed ends of said cylinder, the tank and said power fluid, said valve being adapted to selectively connect either end of said pressure cylinder with said power fluid and simultaneously connect the opposed end of said cylinder with said tank; movable means for receiving a formed product, and a release valve automatically actuated by a pilot valve upon the advance of said movable means through a predetermined distance for bypassing said power fluid intermediate said valve and pressure cylinder into said tank, and interrupting the action of said expressing means.

22. In a machine for the formation of articles by extrusion, a cylinder for plastic material, means for expressing said material from said cylinder, said expressing means being hydraulically operated by a power fluid and including a pressure cylinder, a piston in said pressure cylinder and means operably connecting said piston with said expressing means, a multiple port slide valve adapted to selectively connect either end of said pressure cylinder with a power fluid, and simultaneously connect the opposed ends of said cylinder with a discharge line, stop means attached to means connecting said piston and expressing means, means for operating said valve, and means actuated by said stop means for automatically moving said valve.

Signed at Los Angeles, Calif., at 8:30 A. M. this 8th day of July 1929.

WILLIAM McCLINTOCK.
FRANK Y. PEARNE.