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HYDRAULIC CONTROL MECHANISM

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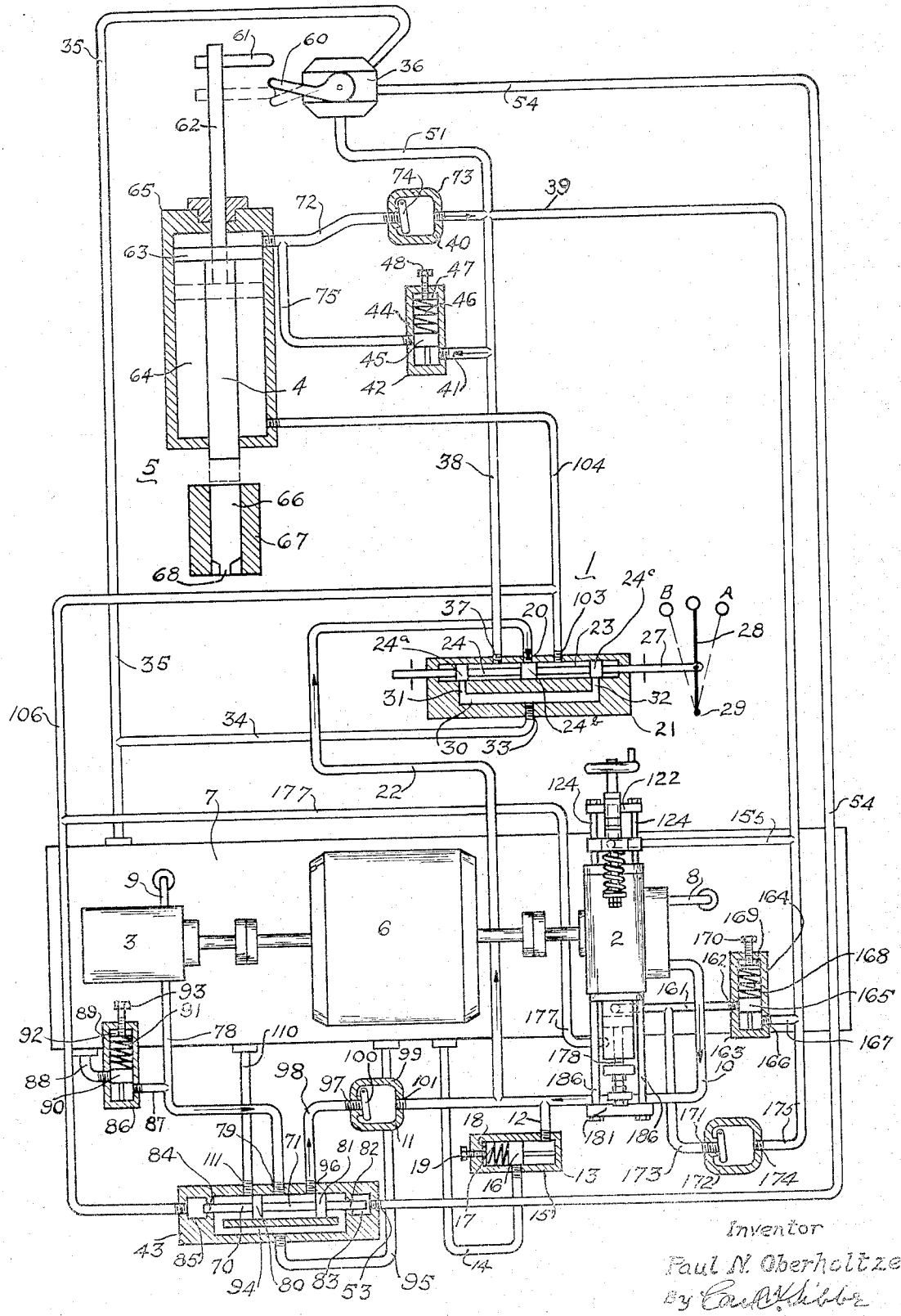


Fig. 1

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HYDRAULIC CONTROL MECHANISM

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2 Claims. (Cl. 60—52)

This invention relates to hydraulic control mechanisms having particular reference to hydraulic presses or extruding apparatus.

One object of the present invention is to provide in a device of the class described certain automatic connections which enable operation of a platen in a predetermined sequential order.

A more specific object is to provide a generally improved hydraulic control mechanism which may be so adjusted as to cause the press platen to move toward the work at a relatively high speed, to materially reduce the speed of the platen and increase the system pressure as it engages the work, and to cause said platen to travel at an increased speed when a higher predetermined pressure is attained.

A further object is to provide a hydraulic control mechanism which is simple in construction and efficient in operation.

Other and further objects will become apparent as the description of the invention progresses.

Of the drawings:

Fig. 1 is a general assembly view, diagrammatic in part, of the entire control mechanism comprising the present invention.

Fig. 2 is an end view, partly in section, of one of the pumps included in the hydraulic system showing certain of the control elements associated therewith.

Fig. 3 is a sectional view of one of the control valves in the hydraulic circuit, and

Fig. 4 is a sectional view taken substantially along line 4, 4 of Fig. 2.

Referring to the drawings, the numeral 1 indicates the entire hydraulic control system which, in the present instance, includes a high pressure pump 2, and a low pressure pump 3 for actuating the plunger or platen 4 of an extruding apparatus 5. Pumps 2 and 3 are simultaneously actuated by any suitable electric motor 6. Pumps 2 and 3, and electric motor 6 are mounted upon a makeup tank 7 from which fluid is drawn into pump 2 through a pipe 8, and into pump 3 through a pipe 9. Pumps 2 and 3 may be of the variable stroke radial piston type on the order of that shown in the United States patent to Hele-Shaw No. 1,077,979. Pump 2 discharges its fluid through a pipe 10, one end of which being connected to a check valve 11. A pipe 12 connects pipe 10 to a relief valve 13 which in turn is connected to makeup tank 7 by a pipe 14.

Relief valve 13 is of the usual type comprising a casing 15 having a plunger 16 provided therein. A spring 17 extends between plunger 16 and a spring seat 18, the latter of which may be adjusted to vary the pressure of spring 17 by a thumb screw 19.

Pipe 10 is also connected to the central port 20 of an operating valve 21 by a pipe 22. Operating valve 21 comprises a central chamber 23 having a valve member 24 provided therein. As shown in Fig. 1, valve member 24 is provided with 3 spaced valve heads 24a, 24b and 24c. The stem 27 of valve member 24 is pivotally connected to an operating lever 28 pivoted at 29 and movable from its neutral position shown in full lines in Fig. 1 to positions A and B shown in broken lines. Valve 21 also has provided therein a passage 30 which is connected to central chamber 23 by communicating passages 31 and 32. When lever 28 is in its neutral position shown in full lines in Fig. 1, passages 31 and 32 are closed by valve heads 24a and 24c respectively, thereby preventing the passage of fluid into passage 30 from chamber 23. A port 33 communicating with passage 30 has connected thereto one end of the pipe 34, the other end being connected to a pipe 35 which connects the pilot valve 36 to makeup tank 7, as will appear more fully hereinafter. A third port 37 of valve 21 disposed between valve heads 24a and 24b has connected thereto one end of a pipe 38, the other end of which is connected to a pipe 39 leading from a check valve 40 to certain controls associated with pump 2, which will be fully described hereinafter. A branch pipe 41 connects pipe 38 with a bypass valve 42 provided to produce a predetermined pressure in the system to ensure operation of a 4-way valve 43.

Valve 42 comprises a casing 44 having a plunger 45 mounted therein. A spring 46 extends between plunger 45 and a spring seat 47, the latter being adjustable by a thumb screw 48, to vary the pressure of said spring 46.

Pipe 39 is also connected to the port 50 of pilot valve 36 by a pipe 51. A second port 52 of valve 36 is connected to a port 53 of 4-way valve 43 by a pipe 54. A third port 55 of valve 36 is connected to makeup tank 7 by the pipe 35.

Valve 36 comprises a central chamber 56 having a rotatable valve element 57 mounted therein. A lever 60 is secured to valve element 57 exteriorly of the valve casing, and is adapted to be engaged by an arm 61 provided at the outer end of the piston rod 62 secured to and extending outwardly from piston 63. Piston 63 operates in the cylinder 64 of a motor 65 of the extruding apparatus 5. The plunger of platen 4 secured to the opposite face of piston 63 extends through the lower end of cylinder 64 and is adapted to

152, the former engaging crosshead 134 while the latter is positioned near the left hand end of rod 135 and held in position by nuts 153 making threaded engagement with the left hand end of said rod. Movement of crosshead 134 to the right is limited by the collar 141 as is clearly apparent in Fig. 4. The pressure of spring 151 may be adjusted by simply adjusting nuts 153. To place pump 2 on stroke, the pressure of spring 151 is adjusted the required amount. Spring 151 now urges crosshead 134 to the right and moves levers 128, 128 in a clockwise direction (Fig. 2) causing guide rods 124 to move to the left, thereby placing the pump on stroke. The pressure at which the pump is to be maintained on stroke may be predetermined by adjustment of spring 150.

It is also seen that upon manipulation of hand wheel 144, rotary movement is imparted to sleeve 138 which in turn imparts a translational movement to rod 135. By this action collar 141 is brought toward or away from crosshead 134, depending upon the direction of movement of wheel 144. When the collar 141 lies in abutting relation with flange 139, as shown in Fig. 4, crosshead 134 may be urged the greatest distance by spring 150, and consequently in that position the pump may be adjusted to maximum stroke. As collar 141 is caused to move toward crosshead 144 the stroke of the pump is correspondingly decreased.

As shown in Figs. 1 and 2, the left hand end of cylinder 118 is connected to pipe 39 by branch pipe 155. Accordingly, when valve member 24 has been adjusted to the position A the left hand end of piston 119 will be subjected to the system pressure. When the pressure impressed against piston 119 exceeds that of spring 150, piston 119 will move to the right (Fig. 2), thereby rocking levers 128 in a counter-clockwise direction against the pressure of spring 150 to bring the sliding blocks 125 of pump 2 toward neutral position. The pump controls are so adjusted, as will appear more fully hereinafter, that the pump will always discharge a certain amount of fluid at the pressure to which spring 150 was originally adjusted, even when piston 119 has actuated levers 128 to their limiting position.

As shown in Fig. 2, the opposite end of pump 2 has secured thereto by bolts 156 a motor 157. Motor 157 comprises a cylinder 158 having a piston 159 operating therein. A port 160 connects the right hand end (Fig. 2) of cylinder 158 with the exterior of the casing, and has connected thereto one end of a pipe 161. The other end of pipe 161 is connected to the port 162 of a pressure valve 163. Pressure valve 163 comprises a casing 164 having a plunger 165 operating therein. A second port 166 provided near the lower end of casing 164 is connected to pipe 39 by a branch pipe 167. A spring 168 extends between plunger 165 and a spring seat 169. Spring seat 169 may be adjusted to vary the pressure of spring 168 by thumb screw 170. Pipe 161 is also connected to the port 171 of a check valve 172 by pipe 173. The port 174 provided at the opposite side of the check valve 172 is connected to pipe 39 by a pipe 175. Check valve 172 prevents fluid from pipe 39 from flowing to pipe 161 and thence to motor 157.

A port 176 provided at the other end of cylinder 158 is connected to pipe 106 by a pipe 177. The piston rod 178 of piston 159 extends through a packing gland 179, secured to cylinder 158 in any suitable manner, such as by bolts 180, 180. Rod 178 also extends through a guide block 181 spaced from gland 179 by the extensions 182, 182 of bolts 180, 180. Nuts 183 engaging the outer side of gland 179 may urge the latter inwardly and thereby prevent leakage of oil past the piston rod. Member 181 is held in spaced position by nuts 184. The outer end of piston rod 178 engages the inner surface of a crosshead 185 midway between the ends of the latter. Secured to and extending through the opposite ends of crosshead 185 are a pair of guide rods 186, the inner ends of the latter of which are secured to the sliding blocks 125 of pump 2 in any suitable manner. Nuts 187, secured to rods 186 at the opposite sides of crosshead 185, hold the said crosshead in proper position.

The distance that crosshead 185 may move toward pump 2 may be varied by adjusting crosshead 185 and guide member 181 toward or away from each other. This may be done by adjusting, respectively, the nuts 187 and 184 on rods 186 and the extensions 182 of bolts 180. Thus the stroke controls 125 of pump 2 may be adjusted from neutral position to full stroke position, thereby permitting the pump 2 to discharge amounts of fluid in proportion to the adjustments of the members just described when said stroke controls are moved to their limit of adjustment in one direction.

From the foregoing description of the structure of my improved device, the operation thereof is thought to be obvious. However, in order to correlate the various elements thereof a brief résumé of the operation of the apparatus as a whole will now be given.

Handwheel 144 is first adjusted the proper amount to insure proper stroking of pump 2. Spring 46 of valve 42 is also adjusted to the proper pressure, say 150 pounds per square inch, depending upon what pressure in the system is necessary to insure proper operation of valve 70. Spring 168 of valve 163 is also adjusted to the desired pressure which, in certain extruding operations, is in the neighborhood of 800 pounds per square inch, before piston 159 of motor 157 may operate to urge the stroke controls 125 of pump 2 to full stroke position, as will appear more fully hereinafter. Relief valves 13 and 86 are also adjusted to permit discharge of fluid from pumps 2 and 3 respectively to exhaust, to prevent abnormal pressures in the system. Crosshead 185 and guide member 181 are also so adjusted as to cause the pump 2 to discharge the proper amount of fluid when piston 119 of motor 117 has fully actuated the stroke controls 125 to the right (Fig. 2).

Valve element 24 of operating valve 21 is now shifted to the right (Fig. 1) to the A position. Fluid from pump 2 will now enter port 20 of valve 21 through pipes 10 and 22. Fluid from pump 3 also will now flow to port 20 of valve 21 through pipe 78, port 79 of valve 43, chamber 71, port 96, pipe 98, valve 11 and pipes 10 and 22. The fluid entering port 20 will now flow through central chamber 23 of valve 21, port 37, and into pipe 38. The fluid in pipe 38 will now enter the lower end of valve 42 through branch pipe 41, and when the pressure of the fluid acting on the lower end of plunger 45 is sufficient to overcome the pressure of spring 46 the said plunger will move upwardly to permit fluid to flow from said valve to the upper end of cylinder 64 of extruding apparatus 5 through pipes 75 and 72. Fluid from pipe 38 will now also flow through pipe 39 and enter cylinder 118 of motor 117 through pipe 155.

Fluid from pipe 39 will also enter the lower end of valve 163 through branch pipe 167. Fluid from pipe 38 will also enter port 50 of pilot valve 36 through pipe 51. The fluid so entering valve 36 will be trapped therein since at this time valve element 57 is in the position shown in full lines in Fig. 3.

Piston 63 and platen 4 of extruding apparatus will now move downwardly at a relatively high rate of speed since the combined discharges of pumps 2 and 3 now enter the upper end of cylinder 64. When arm 61 on piston rod 62 engages arm 60, valve element 57 will be shifted to the broken line position shown in Fig. 3, whereupon the fluid entering valve 36 through pipe 51 will now be discharged therefrom through port 52 and into pipe 54, from which it enters port 53 at the right hand end of 4-way valve 43. When this occurs valve element 70 of valve 43 will be urged to the left (Fig. 1) causing valve head 81 to disconnect port 96 from chamber 71, and thus permitting the discharge of pump 3 to pass to makeup tank through pipes 78, chamber 71, port 111, and pipe 110. Pump 2 will now continue to operate alone to supply fluid pressure to the upper end of cylinder 64.

When platen 4 engages the work in mold 66 this resistance to its movement causes the pressure in the system developed by pump 2 to increase. This pressure, it will be remembered, is communicated to the left hand end (Fig. 2) of piston 119, and tends to move the latter to the right against the pressure of spring 150. As the platen descends, the materials in the mold 66 are compressed, causing the air bubbles and some moisture to be eliminated therefrom. The resistance also increases causing the pressure in the system to build up thereby urging piston 119, and consequently the stroke controls 125 of pump 2 to move to the right until crosshead 185 engages member 181. The discharge of pump 2 is thus materially reduced and platen 4 continues to descend at a correspondingly reduced speed. The pressure in the system continues to increase, and when the pressure at the lower end of plunger 165 of valve 163 is sufficient to overcome the pressure of spring 168 said plunger will move upwardly to uncover port 162, and thereby permit fluid from pipe 39 to enter the right hand end of cylinder 158 of motor 157. Piston 159 of motor 157 will now move to the left and assist spring 150 to place pump 2 on full stroke. It will be noted that the diameter of piston 159 is greater than that of 119 and consequently there will be a much greater pressure tending to maintain the pump on full stroke than that tending to urge it toward neutral position. As a result a greater quantity of fluid will now be discharged by pump 2, thereby causing piston 63 and platen 4 to move downwardly at a greater rate of speed. This speed will now cause extrusion of the material through the die 68. The rate of extrusion may be controlled by manipulation of handwheel 144. Should the rate of extrusion be too great handwheel 144 may be so manipulated as to cause a reduction in the stroke of pump 2 and thereby decrease the discharge of said pump. On the other hand, if the extrusion is at a slower than the desired rate of speed the hand wheel may be so manipulated as to increase the stroke of pump 2, and thereby cause a greater discharge of the latter, and a consequent movement of platen 4 at a greater rate of speed.

When the materials have been fully extruded from mold 66 the operator moves lever 28 to position B. Fluid from pump 2 will now enter the lower end of cylinder 64 through pipes 10 and 22, port 20 of valve 21, chamber 23, port 103 and pipe 104. The fluid pressure in pipe 104 will now enter the cylinder 85 at the left hand end of valve 43 through pipe 106 thereby causing the valve element 70 to be shifted to the right. When this occurs fluid from pump 3 will also flow into pipe 22 through pipe 78, port 79, chamber 71 of valve 43, port 96, pipe 98, and valve 11. The combined discharges of pumps 2 and 3 will cause piston 63 and platen 4 to move upwardly at a relatively rapid rate of speed. The fluid at the upper end of cylinder 64 will now discharge to exhaust through pipe 72, valve 40, pipe 38, port 37 of valve 21, the left hand end of chamber 23, passages 31 and 30, port 33, and pipes 34 and 35.

Fluid pressure will also now be conducted to the left hand end of cylinder 158 of motor 157, through pipes 106 and 177, and port 176. When this occurs piston 159 will be moved to the right (Fig. 2) to bring piston 159 back to its normal position. Fluid at the right hand end of cylinder 158 will now discharge to makeup tank 7 through port 160, pipe 161, valve 172, pipe 39, pipe 38, port 37 of valve 21, passages 31 and 30, port 33 and pipes 34 and 35. When piston 63 approaches its upper limit of adjustment arm 61 will engage arm 60, secured to valve element 57, and upon further upward movement the parts will be restored to the position shown in full lines in Fig. 1. The device is now ready for another cycle of operation.

It is also seen that when piston 63 moves downwardly the fluid at the lower end of cylinder 64 will discharge to makeup tank through pipes 104, the right hand end of chamber 23 of valve 21, passages 32 and 30, port 33 and pipes 34 and 35.

From the foregoing description it is seen that a highly efficient device has been provided which permits operation of the apparatus through a predetermined cycle. The device functions to compress the materials in the mold until ready for extrusion and thereafter to effect extruding at the proper pressure. The device is also so constructed as to enable the operator to control the rate of extrusion manually, and thereby insure a product of the proper consistency.

While the embodiment herein shown and described is admirably adapted to fulfill the objects primarily stated, it is to be understood that the invention is not to be limited thereto, since it may be embodied in other forms, all coming within the scope of the claims which follow.

What is claimed is:

1. In a fluid system of the class described, the combination of a pair of pumps, a fluid motor adapted to be actuated by said pumps, a reversing valve for controlling the operation of said fluid motor, piping connecting said pumps to said reversing valve, a shiftable valve adapted to connect one of said pumps to, or disconnect it from, the system, a control valve for controlling the operation of said shiftable valve in one direction, means actuated by said fluid motor for actuating said control valve to different positions, control means for the other of said pumps for controlling the stroke and pressure characteristics thereof including resilient means for placing said pump on stroke, a servo motor adapted to operate from its normal position in unison with said resilient means to actuate said pump toward full stroke position, a pressure actuated valve for controlling the operation of said servo motor, means controlled by the operation of said reversing valve

for actuating said shiftable valve in the opposite direction, and means controlled by said reversing valve for actuating said servo motor to normal position.

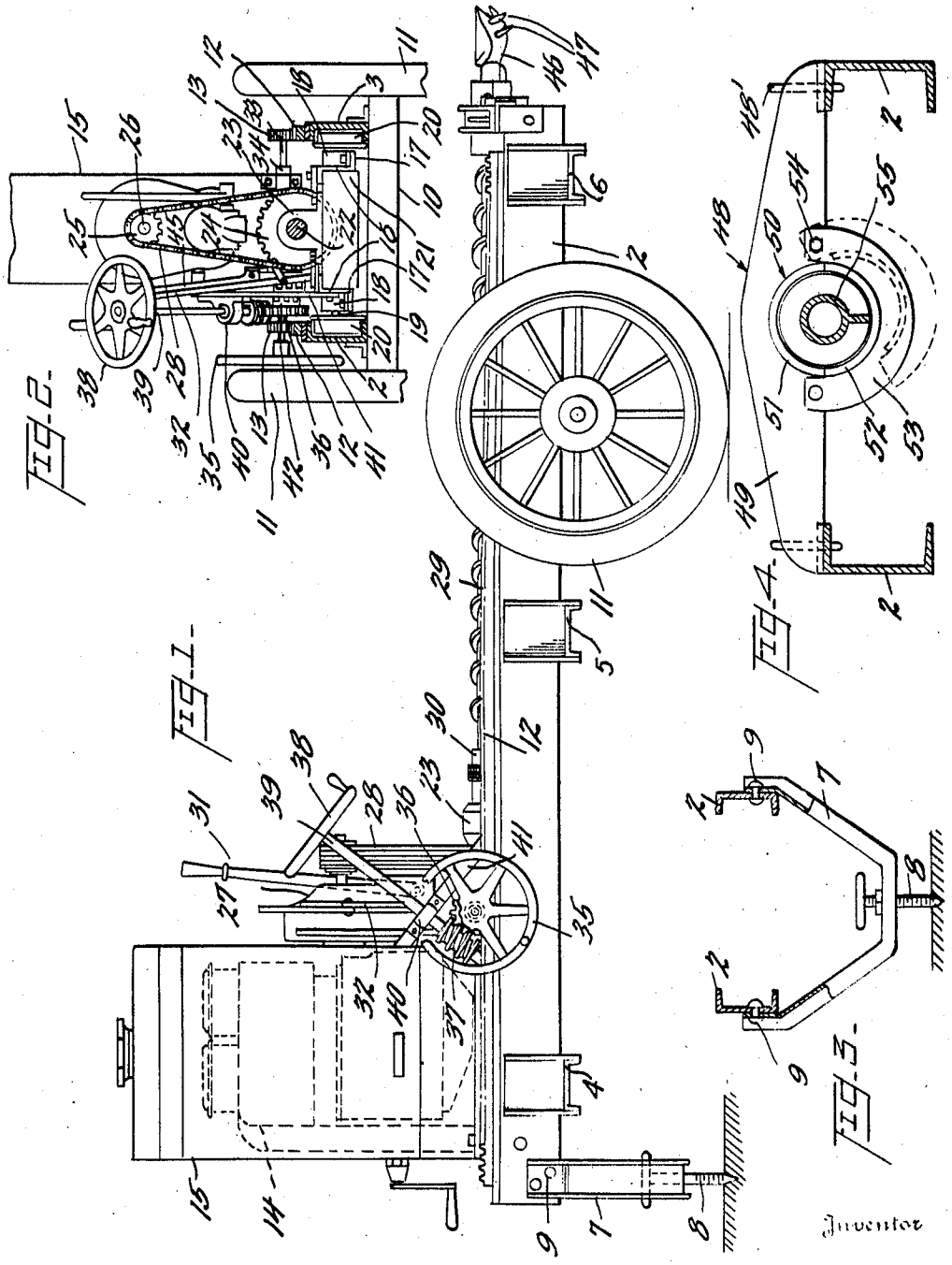
2. In a fluid system of the class described, the combination of a pair of pumps, a fluid motor adapted to be actuated by said pumps, a reversing valve for controlling the operation of said fluid motor, piping connecting said pumps to said reversing valve, a shiftable valve adapted to connect one of said pumps to, or disconnect it from, the system, a control valve for controlling the operation of said shiftable valve in one direction, means actuated by said fluid motor for actuating said control valve to different positions, control means for the other of said pumps for controlling the stroke and pressure characteristics thereof including resilient means for placing said pump on stroke, a servo motor operable by the pressure in the system adapted to operate from its normal position in unison with said resilient means to actuate said pump toward full stroke position, a valve actuated by the pressure in the system for controlling the operation of said servo motor, means controlled by the operation of said reversing valve for actuating said shiftable valve in the opposite direction, and means controlled by said reversing valve and operable by the pressure in the system for actuating said servo motor to normal position.

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BORING MACHINE

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