

Sept 10, 1957

B. T. HENSGEN ET AL

2,805,444

CONTINUOUSLY OPERATING PISTON PUMP EXTRUDERS

Filed Feb. 17, 1955

3 Sheets-Sheet 1

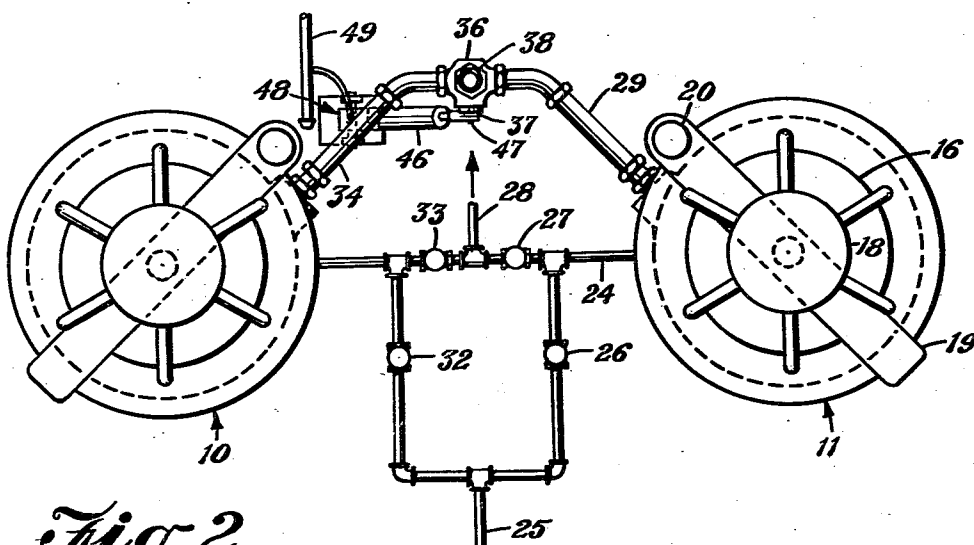


Fig. 2

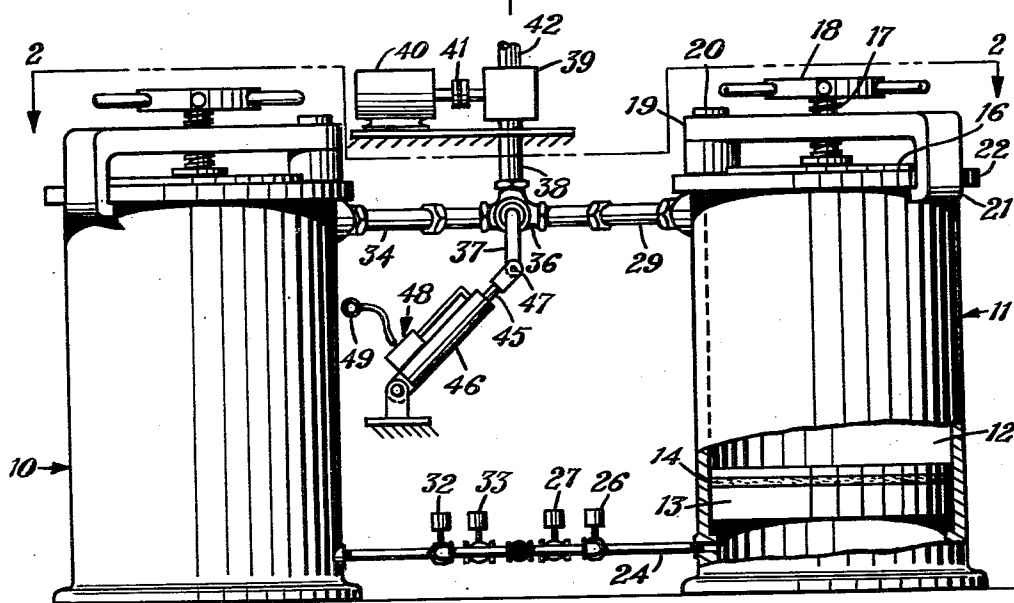


Fig. 1

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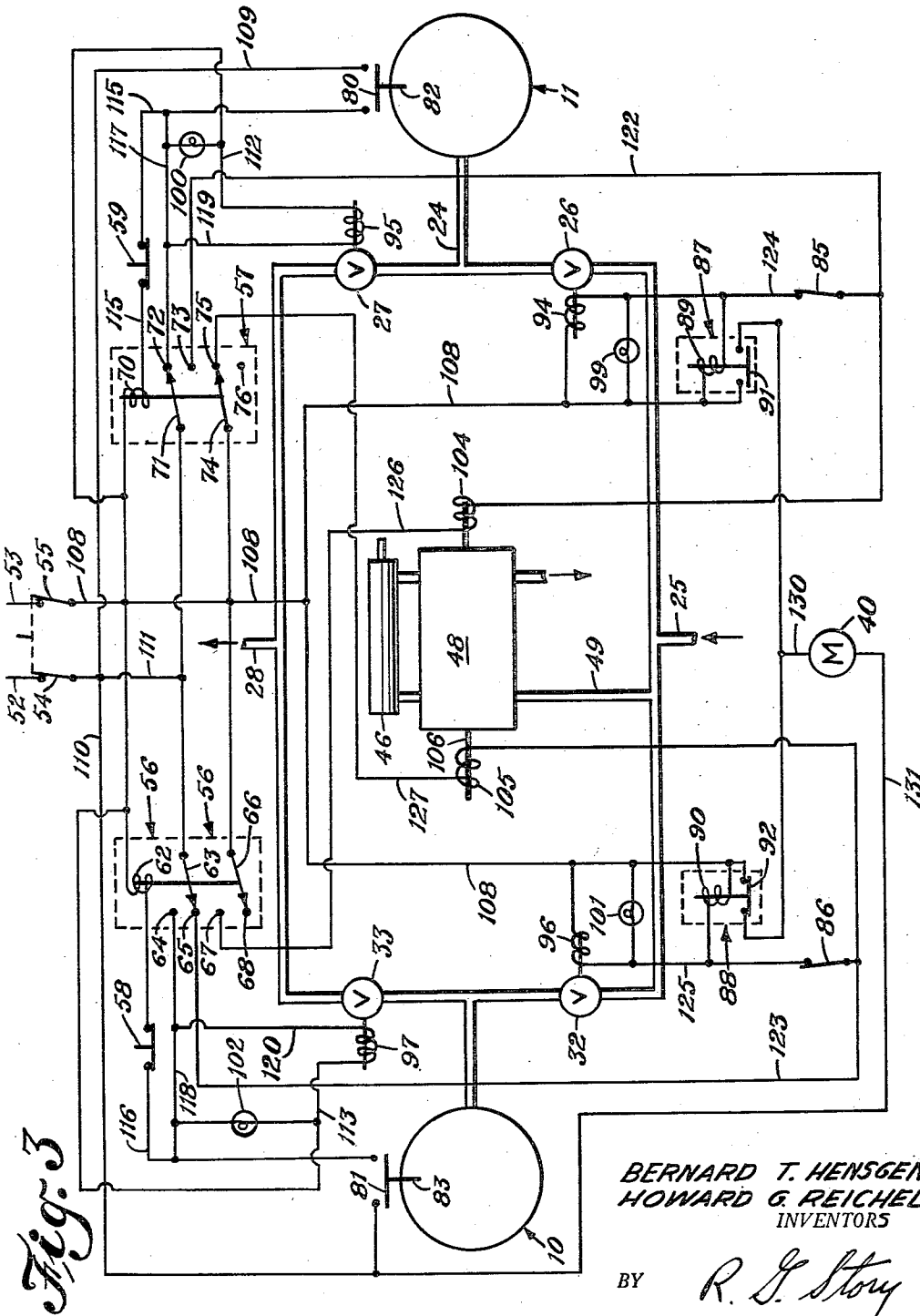
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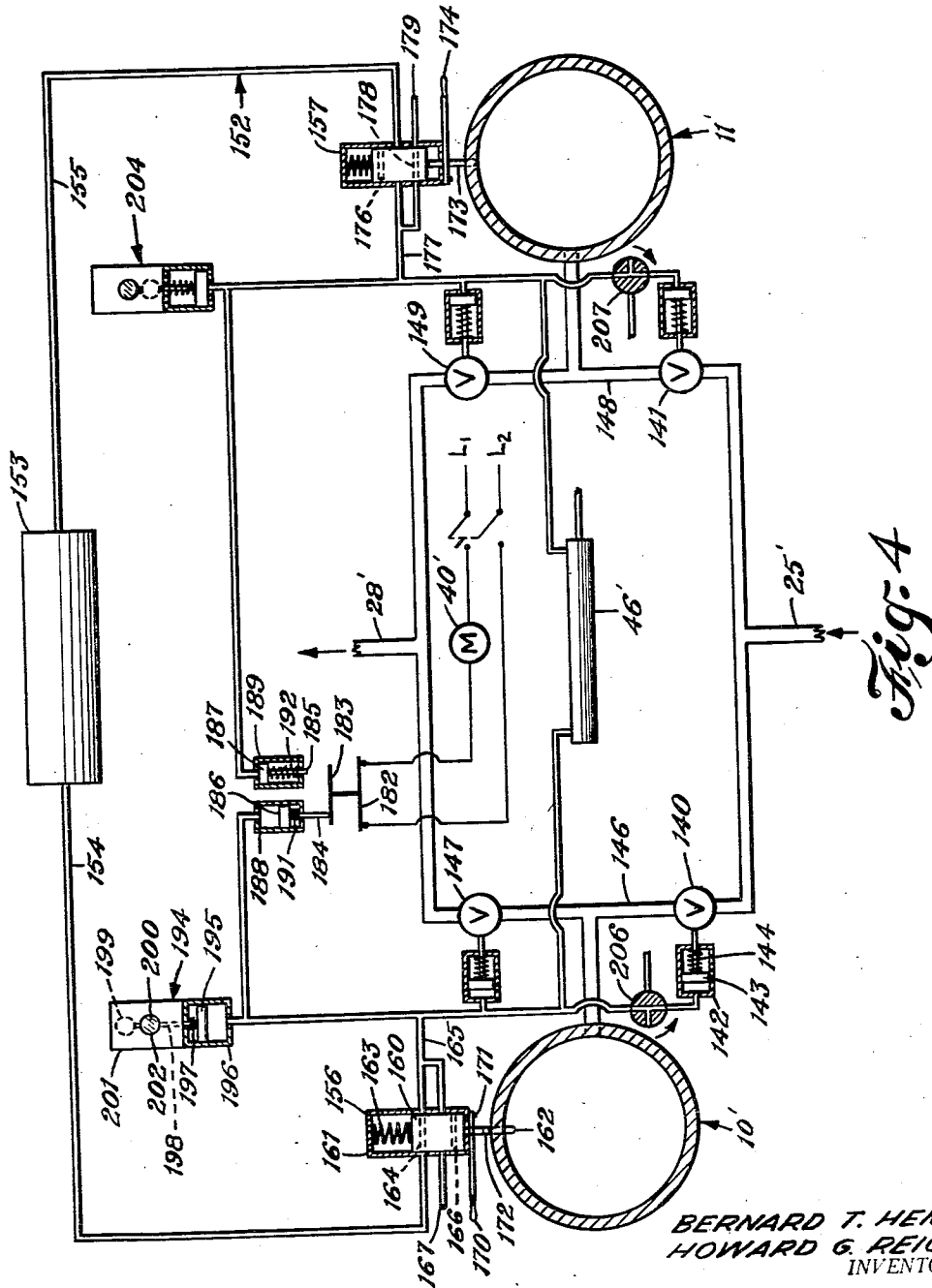
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CONTINUOUSLY OPERATING PISTON PUMP EXTRUDERS

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Application February 17, 1955, Serial No. 488,961

14 Claims. (Cl. 17—39)

The present invention relates to an apparatus for supplying product in an extrusion device or the like. The specific embodiment hereinafter described was devised for use in the manufacture of sausage, although it will be apparent that the structure may be employed in the handling of various other products, as for example plastic materials.

The principal advantage is that it produces a continuous flow of the products from two or more sausage stuffers, a cylinder and piston pump device, without the necessity of continuous supervision to ascertain when one or more of the pumps have been emptied.

A second advantage of the device is that it is sufficiently simple so that it can be operated by unskilled labor. When any one of the pumps has been emptied, that fact is signaled. There is a substantial period of time during the operation of the other pumps for the signal to be observed and the pump refilled. When the pump has been refilled the pressing of a lever resets the machine for the subsequent operation of that pump upon the emptying of another pump. Highly skilled, expensive help is not required, nor is there any particular training period necessitated when starting a new employee on the job.

A further advantage is that any one pump, if necessary, may be operated independently. For example, if it were necessary to shut down one pump for repairs, operations may be kept going through the use of the remaining pumps whether it be only one or more.

A further advantage is that no special parts are required. The device may be built entirely from standard structures. This not only simplifies the construction and maintains the initial cost at a minimum, but facilitates servicing the apparatus should any trouble occur. The servicing may be performed by those skilled in the particular trades involved.

Additional objects and advantages will become apparent from the following description taken in conjunction with the drawings, in which:

Figure 1 is an elevation, partly broken away, of an embodiment of the invention;

Figure 2 is a plan view taken at line 2—2 of Figure 1;

Figure 3 is a schematic diagram of the control mechanism for the embodiment of Figure 1; and

Figure 4 is a diagrammatic illustration of an alternative embodiment of the invention.

Referring to Figures 1 and 2, a pair of sausage stuffers generally 10 and 11 of a type common to the sausage manufacturing industry are employed. Referring specifically to stuffer 11, it comprises a cylinder 12 within which is a piston 13 having a packing ring 14 to provide a seal about the piston. The top of the stuffer can be opened to load the area above the piston 13 with material. To accomplish this the cover 16 is attached to the end of a threaded rod 17 having a hand wheel 18 at the other end thereof. The threaded rod 17 is received in a matching set of threads in a dog 19 which is pivotally

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attached to the stuffer 11 by a bolt 20 adjacent one end of the dog, while the other end of the dog has a hook 21 which fits under flange 22 of the stuffer 11.

Adjacent the bottom of cylinder 12 a pipe 24 is threaded into the wall of the stuffer to communicate with the portion of the cylinder 12 below piston 13. It connects to a piping system 25 leading to a suitable source of fluid pressure, with an electrically operated valve 26 interposed to control the flow of the fluid to cylinder 12. A second valve 27 controls the exhaust from cylinder 12 to pipe 28. Adjacent the top of the stuffer is a threaded connection to receive pipe 29 that communicates with the upper end of cylinder 12 and serves as a passageway for the discharge of the product from the stuffer.

The structure of stuffer 10 corresponds to that just described for stuffer 11. An electrically operated valve 32 corresponds to valve 26 and controls the flow of the fluid from pipe 25 to the bottom of the cylinder. Similarly, a valve 33 corresponds to valve 27 and controls the discharge of the fluid from the bottom of the cylinder. The product from the stuffer is discharged through a pipe 34 corresponding to pipe 29 connected to stuffer 11.

Pipes 29 and 34 connect to a 3-way valve 36 having a valve handle 37 which may be turned to discharge products from either pipe 29 or pipe 34 into a pipe 38 which leads to an extrusion mechanism. In the illustrated embodiment it was desired to have the product discharged at a constant rate and as a result pipe 38 leads to a constant volume pump 39 driven by a motor 40. A coupling 41 connects the shaft of the pump 39 to the shaft of the motor 40. The discharge from pump 39 is through pipe 42.

The piston rod 45 of a fluid cylinder 46 is connected to valve handle 37 by a pin 47. An electrically operated 4-way valve generally 48 supplied with fluid under pressure from a pipe 49 is used to control the action of cylinder 46 in a manner well known to the art.

Referring to Figure 3, which schematically illustrates the control means for the stuffers, a pair of wires 52 and 53 lead from master switches 54 and 55, respectively, to a suitable source of electric power. Two double pole, double throw relays, generally 56 and 57, respectively, are used which form lockout means for the two stuffers 10 and 11. A control means in the form of switches 58 and 59 is used in conjunction with relays 56 and 57 to reset the lockout means for subsequent operation of the pumps, as hereinafter described. Relay 56 has an actuating coil 62, a switch arm 63 with two corresponding switch points 64 and 65, and a switch arm 66 with two corresponding switch points 67 and 68. Similarly, relay 57 has an actuating coil 70, switch arm 71, switch points 72 and 73, and a switch arm 74 with switch points 75 and 76.

Switches 80 and 81 have control members 82 and 83 extending through the wall of stuffers 11 and 10 respectively adjacent the top of the cylinders though in a position to be actuated by the pistons as the pistons reach the top of the cylinder, thus emptying the cylinder of product. A pair of temporary stop switches 85 and 86 are employed to permit temporary stop in the operation of the movement of the pistons in the stuffers. A pair of single pole, single throw relays generally 87 and 88 are employed having coils 89 and 90, respectively, and switches 91 and 92, respectively, operated by the armatures in the coils in the conventional manner. Numbers 94 through 97 indicate the solenoid coils of valves 26, 27, 32 and 33, respectively, while numbers 99 through 102 are used for the indicator lights connected in parallel with each of coils 94 through 97, respectively. The movement of 4-way valve 48 is controlled by a pair of solenoids 104 and 105 which move an armature 106 to control the position of the 4-way valve.

As will be seen, one side of switches 91 and 92, and

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each of solenoids 89 and 90 of relays 87 and 88, solenoids 94 and 96, lights 99 and 101, switch arms 66 and 74 and solenoids 62 and 70 of relays 56 and 57, respectively, are connected to switch 55 through wire 108. Switch 55 also connects to solenoid 95, light 100, solenoid 97 and light 102 through wire 108 and wires 112 and 113, respectively. Switch 54 is connected to switches 80 and 81 through wires 109 and 110, respectively, and to switch arms 63 and 71 of relays 56 and 57 by wire 111. The other sides of switches 80 and 81 are connected to solenoids 70 and 62 by wires 115 and 116, respectively, to contact 72 and light 100 and contact 64 and light 102 by wires 117 and 118 and to solenoids 95 and 97 by wires 119 and 120 respectively. Switches 58 and 59 are interposed in wires 116 and 115 respectively. Wires 122 and 123 are connected from switch points 73 and 65 of relays 57 and 56 to switches 85 and 86, respectively, and to solenoids 104 and 105, respectively, on valve 48. The other side of switches 85 and 86 are connected to solenoids 89 and 90, lights 99 and 101 and solenoids 94 and 96 by wires 124 and 125, respectively. The other side of solenoids 104 and 105 are connected to contacts 67 and 75 of relays 56 and 57, respectively, by wires 126 and 127, respectively. Switches 91 and 92 are in parallel and are connected to motor 40 by a wire 130. The other side of motor 40 is connected to wire 110 by wire 131.

The position of the circuits in Figure 3 is such as would occur if the machine were running with stuffer 10 feeding the product to pump 39 and with stuffer 11 having been emptied and the piston thereof returned to the bottom of the cylinder.

The coil 70 of relay 57 is energized through the following holding circuit: switch 54, wire 111, switch arm 71, contact 72, wire 117, wire 115, switch 59, coil 70, wire 108 and switch 55. Coil 62 of relay 56 is de-energized and the upper switch arm 63 of this relay maintains a circuit from switch 54 through wire 123, switch 86 to coil 90 of relay 88, signal light 101 and solenoid 96 of valve 32 to wire 108 which connects back to switch 55. The energizing of solenoid 96 holds valve 32 open to permit fluid pressure to be applied to the cylinder below the piston in stuffer 10. Light 101, being lighted, indicates that stuffer 10 is operating (or is ready to operate in case the other stuffer is then operating). Solenoid 97 of valve 33 is de-energized so that that valve is closed.

The energizing of solenoid 90 of relay 88 closes contacts 92 to complete a circuit from switch 55, wire 108, through wire 130, motor 40, wire 131 and wire 110 to switch 54. Cylinder 46 was actuated to position valve arm 37 for flow of the product from stuffer 10 to pump 39 by a circuit from switch 55 through wire 108, switch arm 74, and contact 75 of relay 57, wire 127, solenoid 105, wire 123, contact 65 and switch arm 63 of relay 56, and wire 111 to switch 54. Light 100 as well as energized to indicate that stuffer 11 is empty by a circuit from switch 54 through wire 111 to switch arm 71 and contact 72 of relay 57, wire 117, light 100, wire 112 and wire 108 to switch 55. Solenoid 95 is energized by the same circuit to open valve 27 and permit the piston of stuffer 11 to descend.

The lighting of light 100 will call to the attention of the operator the fact that stuffer 11 is empty. The operator opens the stuffer by turning hand wheel 18 to raise lid 16 which is then moved to one side by turning dog 21. In the meantime the opening of valve 27 exhausts the portion of the cylinder 12 below piston 13 to atmosphere through pipes 24 and 28, whereupon the piston 13 descends of its own weight. After filling the stuffer 11 and replacing the cover, the operator presses the actuating lever of reset switch 59 to open the holding circuit through relay 57, previously described. The changing of switch arm 74 breaks the circuit through solenoid 105 of four-way valve 48. The changing of the position of switch arm 71 breaks the circuits through

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light 100 and solenoid 95, turning off the light and permitting valve 27 to close. At the same time a circuit is established from switch 54 through wire 111, switch arm 71 and contact 73 of relay 57, wire 122, switch 85, wire 124, through coil 89 of relay 87, light 99 and solenoid 94 of valve 26, which are in parallel, wire 108 to switch 55.

The energizing of solenoid 94 opens valve 26 to apply fluid pressure below piston 13 to cause the product in the cylinder 12 to be placed under pressure. However, since valve 36 has not been repositioned, no extrusion of the product from stuffer 11 will occur. In some instances it may be desirable to remove any trapped air above piston 13 in stuffer 11. This is done by leaving cover 16 slightly loose at the time the reset switch 59 is pressed to de-energize relay 57. This starts the piston 13 upwardly as just described and as soon as all the trapped air is removed, stop button 85 is pressed to break the circuit through solenoid 94 of valve 26 and close valve 26, thus stopping the movement of the piston. The cover 16 is then secured in place and switch 85 closed to establish the operating condition for stuffer 11.

When the piston of stuffer 10 which has been operating reaches the top, at which position all of the product has been extruded therefrom, the piston strikes actuating lever 83 of switch 81 to close the switch and establish a circuit through coil 62 of relay 56 as follows: switch 55, wire 108, coil 62, switch 58, wire 116, switch 81 and wire 110 to switch 54. The energizing of coil 62 picks up relay 56 to establish a holding circuit through switch arm 63 and contact 64 in the same manner as the holding circuit previously described for relay 57.

Solenoid 104 of the four-way valve 48 is energized by a circuit from switch 55 through wire 108, switch arm 66 and contact 67 of relay 56, wire 126, solenoid 104, wire 122, contact 73 and switch arm 71 of relay 57, wire 111 to switch 54. The position of four-way valve 48 is changed to move piston rod 45 of fluid cylinder 46 and reposition valve 36 to close the line 34 from stuffer 10 to pump 39 and open the line 29 from stuffer 11 to pump 39. At the same time, upon the actuation of relay 56, the circuit previously described through coil 90 of relay 88, light 101 and solenoid 96 of valve 32 was broken to open contacts 92 of relay 88 and to close valve 32. Motor 40, however, remains energized through relay 87 which, as previously described, was energized upon the pressing of reset switch 59. Further, a circuit was established through solenoid 97 of valve 33 and light 102 which are in parallel through switch arm 63 and contact 64 of relay 56 to open the exhaust valve 33 and light light 102 to indicate that stuffer 10 was empty and in need of refilling. The descending of the piston of stuffer 10 which opens switch 81 does not change the established circuits because of the holding circuit through relay 56.

If stuffer 10 has not been refilled and thus reset by the time stuffer 11 empties, both relays 56 and 57 will be picked up and relays 87 and 88 will both be de-energized so that there will be no circuit through motor 40 and the motor will be stopped. This prevents any further operation of pump 39 which might be damaging to the pump. It will be apparent that if the extruders are used in conjunction with other apparatus, as for example a plastic molding machine, the molding machine motor which is wired as is motor 40 will be stopped to stop the molding machine when no product is being presented to it. Both of valves 27 and 33 will be opened by the energizing of solenoids 95 and 97, respectively, and lights 100 and 102 will both be lit.

If one stuffer is then refilled, say for example stuffer 11, the pressing of reset switch 59 associated with that stuffer will allow relay 57 to drop out which will place stuffer 11 back into operation. The fact that relay 56 remained picked up kept coil 104 of four-way valve 48 energized to properly position valve 36 for the handling

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of product from stuffer 11. If for example stuffer 10 had to be shut down for repairs, stuffer 11 could be operated alone in this manner thus avoiding complete shut down of the apparatus because of the failure of one stuffer.

Figure 4 is an illustration of an alternative embodiment of the invention wherein the electrical controls of the embodiment illustrated in Figure 3 have been replaced with a fluid actuated control. In this embodiment the two stuffers 10' and 11' correspond to the two stuffers in the previously described embodiment, while the fluid cylinder 46' is used to operate 3-way valve 36 in the same manner as previously described cylinder 46. Pipe 25' leads to a suitable source of fluid pressure for the operation of the stuffers 10' and 11' and connects to two valves 140 and 141. Valve 140 is a normally closed valve and is operated by fluid pressure in cylinder 142 working against piston 143. Springs 144 close valve 140 upon the fluid pressure in cylinder 142 being relieved. The structure of valve 141 is identical with that of 140.

A pipe 146 connects valve 140 to stuffer 10' and to a normally open valve 147. Similarly, a pipe 148 connects valve 141 to stuffer 11' and to a normally open valve 149. The structure and operation of valves 147 and 149 correspond to that of valve 140, as previously described, except that each of valves 147 and 149 are normally open valves and are closed by the application of fluid pressure to the cylinders and opened upon the removal of the fluid pressure. Exhaust pipe 28' connects to each of valves 147 and 149.

It will be appreciated that the structure described so far is substantially identical with that previously described for the embodiment of Figure 3 except that fluid operated valves have been substituted for the electrical operated valves. A second fluid system generally 152 replaces the electrical system of Figure 3. Fluid under pressure is supplied to system 152 from a source of fluid pressure 153 and pipes 154 and 155 connect to valves 156 and 157 respectively. Valve 156 is a slide valve, with the valve body 160 moving longitudinally within a casing 161. A control member 162 is attached to body 160 and projects through the wall of stuffer 10' to be moved to the piston thereof in the same manner that the piston of stuffer 10 moved control member 83.

A spring 163 between casing 161 and body 160 urges the body into a first position whereat a passageway 164 in body 160 is in communication with pipe 154 and with pipe 165, and control member 162 is in the extended position to intercept the piston of stuffer 10'. Body 160 has a second passageway 166 that at this position of the valve body 160 is inactive but upon control member 162 being pushed inwardly by the piston of stuffer 10' passageway 166 will come into communication with the branch of pipe 165 and with an exhaust pipe 167.

A lockout and reset means is provided by arm 170 which is pivotally attached to body 160 by a pin 171 and rests on the top of control member 162. Control member 162 has a slot 172 across the top thereof into which the arm 170 will fall and engage the control member when the control member is pushed back by the piston of stuffer 10'.

The structure of valve 157 corresponds to that described for valve 156. In Figure 4 the control member 173 has been pushed in by the piston of stuffer 11' and is locked in that position by the arm 174 being engaged in the slot (not visible) in the top of control member 173. In this position the passageway 176 corresponding to passageway 164 is out of communication with pipe 155 and with pipe 177, and passageway 178 which corresponds to passageway 166 of valve 156 is in communication with pipe 177 and exhaust pipe 179.

Pipe 165 connects to the operating cylinders of valves 147 and 140 and also to one end of fluid piston 46'. Similarly pipe 177 connects to the actuating cylinders of

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valves 149 and 141 and to the other end of fluid piston 46'.

An electrical switch 182 is connected in series with motor 40' and with a suitable source of electrical power. Switch 182 has an operating member 183 positioned to be contacted by both of actuating members 184 and 185 of pistons 186 and 187 in cylinders 188 and 189 respectively. Springs 191 and 192 urge pistons 186 and 187 upwardly in the cylinders. Pipes 165 and 177 connect to cylinders 188 and 189 respectively.

An indicator generally 194 for stuffer 10' is provided by a fluid piston 195 operating in cylinder 196. Pipe 165 communicates with cylinder 196. A spring 197 urges the piston 195 downwardly in the cylinder. Piston rod 198 carries a pair of targets 199 and 200, respectively, with the target 199 being green and target 200 being red. A shield 201 mounted on cylinder 196 has a window 202 behind which one or the other of the targets appear depending upon whether or not fluid pressure is applied to cylinder 196. The indicator generally 204 for stuffer 11' corresponds in structure to that just described with respect to indicator 294.

A three-way valve 206 is interposed in pipe 165 just ahead of the actuating mechanism of valve 140 and a similar three-way valve 207 is interposed in pipe 177 just ahead of the actuating mechanism for valve 141. The structure of these valves is such that the valve may be rotated between the position illustrated in Figure 4 whereat the pipes are in communication with the actuating mechanism of the valves and an alternate position at which the actuating mechanism of the valves is exhausted to atmosphere and the remainder of pipe 165 is shut off.

The position of the parts illustrated in Figure 4 is such as exists when stuffer 10' is operating and stuffer 11' is empty. Fluid pressure from source 153 is applied through valve 156 to pipe 165. This fluid pressure is holding valve 140 open and holding valve 147 closed. The position of valves 140 and 147 is such as to apply fluid pressure from line 25' to stuffer 10' and drive the stuffer piston upwardly. Valve 157 has shut off the fluid pressure from pipe 155 to pipe 177 and has exhausted pipe 177 to atmosphere through pipe 179. Pipe 177 being exhausted, valve 141 is closed and valve 149 is opened, thus exhausting the space under the piston of stuffer 11' to atmosphere through pipe 28 and allowing the piston to descend. Control member 173 is locked out by arm 174 as previously described. The application of pressure to pipe 165 has urged piston 195 upwardly thus displaying target 200 through window 202 and advising that stuffer 10' is in operation (or ready for operation). Similarly, the application of pressure has driven piston 186 down to close switch 182 and energize motor 40'. The exhausting of line 177 has positioned indicator 204 to indicate that the stuffer 11' is out of operation.

After stuffer 11' is refilled the operator lifts arm 174 to release control member 173 and apply pressure to pipe 177. This repositions valves 141 and 149 so as to start the piston of stuffer 11' upwardly. If the operator wishes to exhaust the air above the product in the stuffer 11' before tightly closing the lid, this is done by allowing the stuffer piston to rise and when the air is all exhausted from stuffer 11' valve 207 is turned to shut off pipe 177 and exhaust the operating mechanism of valve 141 to atmosphere thus closing valve 141 and stopping the application of pressure through pipe 148 to stuffer 11'. The lid can then be fastened on the stuffer 11' and valve 207 again turned to change the position of valve 141 and apply pressure to the stuffer through pipe 148. At this time pressure has been applied to the right-hand end of fluid cylinder 46' through pipe 177, but since the same pressure is still applied to the other end of cylinder 46' through pipe 165, no movement of the piston of fluid cylinder 46' will occur and valve 36 will remain positioned so as to feed product from stuffer 10'.

When stuffer 10' empties, the piston of the stuffer pushes

back control member 162 and permits arm 170 to drop into slot 172 of the control member. With the valve body 160 being moved, pipe 165 is shut off from supply pipe 154 and exhausted to atmosphere through pipe 167. Exhausting of line 165 closes valve 140, opens valve 147 (which allows the piston of stuffer 10' to start downwardly), changes the position of indicator 194 (moving target 199 in front of window 202 to indicate the stuffer 10' is empty), and permits piston 186 to raise by the action of spring 191. If fluid pressure had not previously been applied to pipe 177, thus driving down piston 187, switch 182 would open. However, piston rod 185 holds switch 182 closed. The release of pressure from the left-hand end of fluid cylinder 46' creates a pressure differential therein and permits the movement of the piston in response to the fluid pressure being applied to the other end of the cylinder through pipe 177. This repositions valve 36 and allows stuffer 11' to commence operating.

The foregoing description of specific embodiments is for the purpose of compliance with 35 U. S. C. 112, and we do not desire to be limited to the exact details shown and described, for obvious modifications will occur to a person skilled in the art.

We claim:

1. An extrusion apparatus including a plurality of pumps, each of said pumps comprising a cylinder and a piston in said cylinder movable between an empty and a full position, an equal number of control members, each control member being operatively connected to a respective one of the pumps to be actuated by the pump when the piston is in the empty position, power means connected to each of said pumps to move the pistons of the pumps, and control means connected to said members and to said power means to move the piston of a filled pump in the direction from the full to the empty position in response to the actuation of the control member of another pump upon the piston of that other pump arriving at the empty position, said control means including a lockout means to inactivate each pump upon the actuation of the respective control member until after said pump has been refilled.

2. An extrusion apparatus including a plurality of pumps, each of said pumps comprising a cylinder and a piston in said cylinder movable between an empty and a full position, a discharge conduit for each of said pumps connecting to a common extrusion conduit, means in at least one of said conduits to cause the flow from each of the pumps to proceed only through said extrusion conduit, an equal number of control members, each control member being operatively connected to a respective one of the pumps to be actuated by the pump when the piston is in the empty position, power means connected to each of said pumps to move the pistons of the pumps, and control means connected to said members and to said power means to move the piston of a filled pump in the direction from the full to the empty position in response to the actuation of the control member of another pump upon the piston of that other pump arriving at the empty position, said control means including a lockout means to inactivate each pump upon the actuation of the respective control member until after said pump has been refilled.

3. An extrusion apparatus including a plurality of pumps, each of said pumps comprising a cylinder and a piston in said cylinder movable between an empty and a full position, a discharge conduit for each of said pumps connecting to a common extrusion conduit, means in at least one of said conduits to cause the flow from each of the pumps to proceed only through said extrusion conduit, motor driven means connected to said extrusion conduit, an equal number of control members, each control member being operatively connected to a respective one of the pumps to be actuated by the pump when the piston is in the empty position, power means connected to each of said pumps to move the pistons of the pumps, and control means connected to said members and to said

power means to move the piston of a filled pump from the full to the empty position in response to the actuation of the control member of another pump upon the piston of that other pump arriving at the empty position and to stop said motor driven means when all of the pumps are empty, said control means including a lockout means to inactivate each pump upon the actuation of the respective control member until after said pump has been refilled.

4. An extrusion apparatus including a plurality of pumps, each of said pumps comprising a cylinder and a piston in said cylinder movable between an empty and a full position, an equal number of control members, each control member being operatively connected to a respective one of the pumps to be actuated by the pump when the piston is in the empty position, power means connected to each of said pumps to move the pistons of the pumps, and control means connected to said members and to said power means to move the piston of a reset pump from the full to the empty position in response to the actuation of the control member of another pump upon the piston of that other pump arriving at the empty position, said control means including a lockout means and a manually operable member therefor for each of the pumps to reset the respective pump for operation after filling, said lockout means being effective to inactivate a pump in response to the actuation of a control member of another pump until said manually operable member has reset that pump for operation.

5. A material extrusion apparatus including a first and a second pump, each of said pumps comprising a cylinder and a piston, fluid supply means connected to each of said cylinders to actuate the pistons therein from a first position at which the cylinder is filled with material to a second position at which the cylinder is empty of material, a first and a second electrically controlled valve connected between the supply means and the first and second pumps respectively, a first and a second switch mounted on said first and second pumps, respectively, to be actuated by the pistons thereof when the pistons reach said second position, electrical means connected to each of said valves and said switches to position said valves to apply the fluid supply to the cylinder of one of said pumps upon the piston of the other cylinder reaching said second position and to cut off the fluid supply to the cylinder of said other pump.

6. A material extrusion apparatus including a first and a second pump, each of said pumps comprising a cylinder and a piston, fluid supply means connected to each of said cylinders to actuate the pistons therein from a first position at which the cylinder is filled with material to a second position at which the cylinder is empty of material, a first and a second electrically controlled valve means connected between the supply means and the first and second pumps respectively, a first and a second switch mounted on said first and second pumps, respectively, to be actuated by the pistons thereof when the pistons reach said second position, electrical means connected to each of said valve means and said switches to position said valve means to apply the fluid supply to the cylinder of one of said pumps upon the piston of the other cylinder reaching said second position and to cut off the fluid supply to the cylinder of said other pump to return the piston of said other cylinder to said first position.

7. A material extrusion apparatus including a first and a second pump, each of said pumps comprising a cylinder and a piston, fluid supply means connected to each of said cylinders to actuate the pistons therein from a first position at which the cylinder is filled with material to a second position at which the cylinder is empty of material, a first and a second electrically controlled valve connected between the supply means and the first and second pumps respectively, a first and a second switch mounted on said first and second pumps, respectively, to

be actuated by the pistons thereof when the pistons reach said second position, a first and a second lockout means for said first and second pump respectively, said lockout means each having a manual reset member, electrical means connected to each of said valves, said lockout means and said switches to position said valves to cut off the fluid supply to the cylinder of said other pump upon the piston of the other pump reaching said second position and to apply the fluid supply to the cylinder of said one of said pumps only if said manual reset member is actuated.

8. A material extrusion apparatus including a first and a second pump, each of said pumps comprising a cylinder and a piston, fluid supply means connected to each of said cylinders to actuate the pistons therein from a first position at which the cylinder is filled with material to a second position at which the cylinder is empty of material, a discharge conduit for each of said pumps connecting to a common extrusion conduit, means in at least one of said conduits to cause the flow from each of the pumps to proceed only through said extrusion conduit, a first and a second electrically controlled valve connected between the supply means and the first and second pumps respectively, a first and a second switch mounted on said first and second pumps, respectively, to be actuated by the pistons thereof when the pistons reach said second position, electrical means connected to each of said valves and said switches to position said valves to apply the fluid supply to the cylinder of one of said pumps upon the piston of the other cylinder reaching said second position and to cut off the fluid supply to the cylinder of said other pump.

9. A material extrusion apparatus including a first and a second pump, each of said pumps comprising a cylinder and a piston, fluid supply means connected to each of said cylinders to actuate the pistons therein from a first position at which the cylinder is filled with material to a second position at which the cylinder is empty of material, a discharge conduit for each of said pumps, an extrusion conduit, a three way valve connecting said discharge conduits to said extrusion conduit, power means to position said valve to place either of said discharge conduits into communication with said extrusion conduit, a first and a second electrically controlled valve connected between the supply means and the first and second pumps respectively, a first and a second switch mounted on said first and second pumps, respectively, to be actuated by the pistons thereof when the pistons reach said second position, electrical means connected to each of said valves, said power means and said switches to position said valves to apply the fluid supply to the cylinder of one of said pumps upon the piston of the other cylinder reaching said second position, to cut off the fluid supply to the cylinder of said other pump, and to actuate said power means to position said three way valve to place the conduit of said one pump into communication with said extrusion conduit.

10. An extrusion apparatus including a plurality of pumps, each of said pumps comprising a cylinder and a piston in said cylinder movable between an empty and a full position, an equal number of control members, each control member being operatively connected to a respective one of the pumps to be actuated by the pump when the piston is in the empty position, power means connected to each of said pumps to move the pistons of the pumps, and control means connected to said members and to said power means to move the piston of a reset pump from the full to the empty position in response to the actuation of the control member of another pump upon the piston of that other pump arriving at the empty position, said control means including a lockout means and a manually operable member therefor for each of the pumps to reset the respective pump for operation after filling, said lockout means being effective to in-

activate a pump in response to the actuation of a control member of another pump until said manually operable member has reset that pump for operation, said control means being constructed and arranged so that when all pumps are empty any one pump may be started by operating said manually operable member to reset said pump.

11. An extrusion apparatus including a plurality of pumps, each of said pumps comprising a cylinder and a piston in said cylinder movable between an empty and a full position, fluid means connected to each of said pumps to control the application of fluid pressure thereto to control the movement of the pistons, said fluid means including a fluid supply line and a fluid exhaust line each connected to each of said pumps, a valve in each fluid supply line leading to each pump and a valve in each fluid exhaust line leading from said pumps; a control member for each pump, each control member being operatively connected to a respective one of the pumps to be actuated by the pump when the piston of the pump is in the empty position, and control means connected to said members and to said valves to close the fluid supply valve for a pump and to open the fluid exhaust valve for that pump upon the control member of the respective pump being actuated by the piston thereof, said control means including a manually operated member to reset the positions of said valves independently of the operation of the other pump.

12. An extrusion apparatus including a plurality of pumps, each of said pumps comprising a cylinder and a piston in said cylinder movable between an empty and a full position, each of said pumps connected to a common discharge line, discharge valve means movable to connect either one or the other of said pumps with said discharge line, fluid means connected to each of said pumps to control the application of fluid pressure thereto to control the movement of the pistons, said fluid means including a fluid supply line and a fluid exhaust line each connected to each of said pumps, a valve in each fluid supply line leading to each pump and a valve in each fluid exhaust line leading from said pumps, a control member for each pump, each control member being operatively connected to a respective one of the pumps to be actuated by the pump when the piston of the pump is in the empty position, and control means connected to said members and to said valves to close the fluid supply valve for a pump and to open the fluid exhaust valve for that pump upon the control member of the respective pump being actuated by the piston thereof, said control means including a manually operated member to reset the positions of said valves independently of the operation of the other pump, said control means being connected to said discharge valve to position the valve to place one pump in communication with the discharge line when the manually operated member of that one pump has been actuated and the control member of the other pump has been actuated by the piston of said other pump.

13. Control means for an extrusion apparatus which includes a plurality of pumps, each of said pumps comprising a cylinder and a piston in said cylinder movable between an empty and a full position, fluid means connected to each of said pumps to control the application of fluid pressure thereto to control the movement of the pistons, said fluid means including a fluid supply line and a fluid exhaust line each connected to each of said pumps, a valve in each fluid supply line leading to each pump and a valve in each fluid exhaust line leading from said pumps, and a control member for each pump, each control member being operatively connected to a respective one of the pumps to be actuated by the pump when the piston of the pump is in the empty position, said control means connected to said members and to said valves to close the fluid supply valve for a pump and to open the fluid exhaust valve for that pump upon the control member of

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the respective pump being actuated by the piston thereof, said control means including a manually operated member to reset the positions of said valves independently of the operation of the other pump.

14. Control means for an extrusion apparatus which includes a plurality of pumps, each of said pumps comprising a cylinder and a piston in said cylinder movable between an empty and a full position, each of said pumps connected to a common discharge line, discharge valve means movable to connect either one or the other of said pumps with said discharge line, fluid means connected to each of said pumps to control the application of fluid pressure thereto to control the movement of the pistons, said fluid means including a fluid supply line and a fluid exhaust line each connected to each of said pumps, a valve in each fluid supply line leading to each pump and a valve in each fluid exhaust line leading from said pumps, and a control member for each pump, each control member being operatively connected to a respective one of the pumps to be actuated by the pump when the piston of the pump is in the empty position, said control means

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being connected to said members and to said valves to close the fluid supply valve for a pump and to open the fluid exhaust valve for that pump upon the control member of the respective pump being actuated by the piston thereof, said control means including a manually operated member to reset the positions of said valves independently of the operation of the other pump, said control means being connected to said discharge valve to position the valve to place one pump in communication with the discharge line when the manually operated member of that one pump has been actuated and the control member of the other pump has been actuated by the piston of said other pump.

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