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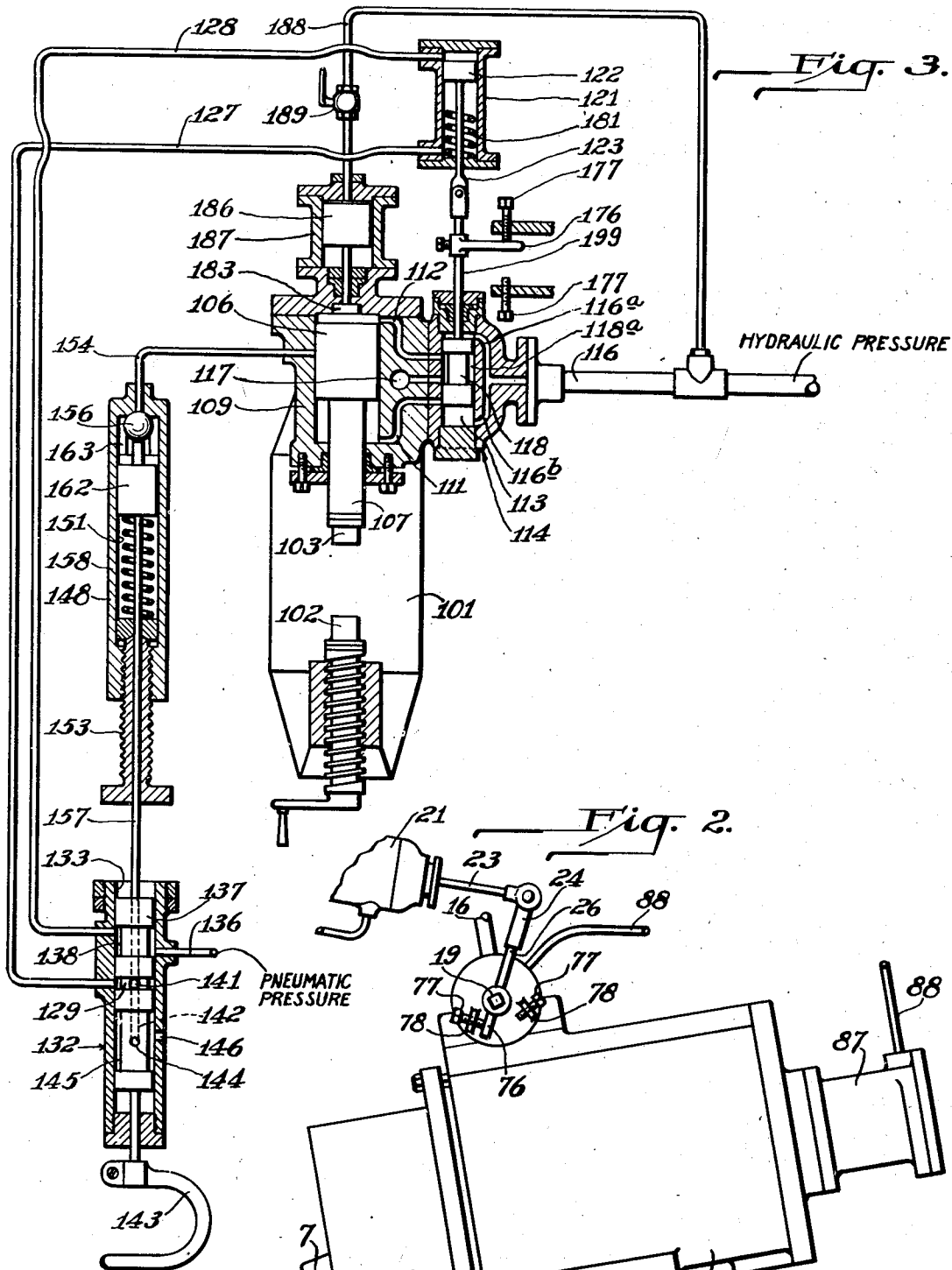
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RIVETING APPARATUS

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RIVETING APPARATUS

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This invention relates to compression riveters, and more particularly to riveters used for driving rivets cold.

It is desirable that riveters of the type referred to herein operate at maximum speed whenever possible so as to save time, and also that they operate more slowly as the difficulty of the work increases in order that the work may be properly done. As it is usually not practicable to slow up the return stroke of the driving die as well as its driving stroke, it is desirable that the speed of the driving stroke be easily adjusted to that desired independently of the speed of the return stroke. In some types of work it is likewise desirable that the driving die of the riveter approach the work slowly so as to allow proper alignment of the rivets with the dies, and then quickly drive the rivet and return to its original position. With compression riveters known heretofore such speed control has not been possible except to the extent made possible by careful manual operation of the control lever, commonly termed "inching up on the rivet", and with the attendant loss of time and uncertainty of operation.

In certain types of work, such as when there are no obstructions to pass between the dies of the riveting apparatus, it has been found feasible to economize on time by diminishing the distance which the driving die can be moved away from the stationary die; in other words, to shorten its stroke. Here again, prior to the present invention, the strokes of each riveter have been uniform in length.

Again, it is desirable that riveters of this type be adapted for use with hydraulic as well as with pneumatic power, and that their operation may be controlled entirely by a trigger valve independently of the usual automatic control.

It is among the objects of this invention to provide a compression riveter in which the speed of operation can be varied at the will of the operator, in which the speed of operation during a single cycle can be varied, and in which the distance the driving die moves away from the stationary die can be varied as desired, all by positive automatic controls.

Other objects are to provide a riveter in which the driving die is driven by hydraulic pressure, in which the pressure applied to the rivets can be automatically controlled, and in which both the driving and return stroke of the driving die can be initiated by a trigger valve.

A still further object is to provide such a riveter in which the control mechanism is simple, sturdy and easy to operate.

The invention is illustrated in the accompanying drawings, in which Fig. 1 is a view in section and somewhat diagrammatic of a compression riveter in which the riveting mechanism is operated by hydraulic pressure; Fig. 2 a side view of the main valve and its associated parts; and Fig. 3 a front view in section of a modified form of hydraulic riveter.

Referring to Fig. 1 of the drawings, there is shown a riveting mechanism comprising a riveter frame or yoke 1 supporting a stationary die 2 and carrying a vertically reciprocable and adjustable driving die 3 which is actuated through a toggle connection 4 by a driving piston 6 connected to the toggle by a piston rod 7. The piston is provided with a cylindrical skirt 8, and is reciprocable in a driving cylinder 9 the opposite ends of which communicate through passages 11 and 12 with the central bore 13 of a main valve 14 mounted on the cylinder. Bore 13 is connected by a conduit 16 to a source of fluid under pressure, preferably hydraulic pressure, and by an exhaust passage 17 to the atmosphere. Disposed in the valve bore is a valve member 18 which is turned by a shaft 19 projecting through the wall of the valve, and which is so formed that when it is turned to either end of its path of movement it connects either passage 11 or passage 12 to exhaust passage 17 and permits the pressure fluid from conduit 16 to enter the driving cylinder through the remaining passage. Thus, driving piston 6 is forced to one end or the other of the driving cylinder by hydraulic pressure, depending on which way valve member 18 is turned.

This valve member is actuated by pressure fluid operated means comprising a cylinder 21 in which is disposed a piston 22 having a piston rod 23 pivotally connected to a sleeve 24 which is slidable axially on a lever 26 rigidly mounted on the projecting end of shaft 19 at a right angle thereto (Fig. 2). The opposite ends of cylinder 21 are connected by conduits 27 and 28 to ports 29 and 31, respectively, which lead through the wall of a trigger valve 32 into an axial bore 33 therein. Equidistant from ports 29 and 31 the trigger valve is provided with an inlet port 34 which is connected by a conduit 36 to a source of fluid under pressure for moving piston 22 in cylinder 21 in order to operate the main valve. The fluid used for this purpose is preferably gaseous, such as compressed air, because liquids do not flow fast enough to obtain the almost instantaneous response of the control mechanism which is highly desirable.

To restrict the flow of the pressure fluid to only

one end of cylinder 21 at a time, trigger valve bore 33 is provided with a snugly fitting axially movable plunger 37 having an annular recess 38 therein which is long enough to connect inlet port 34 to either one of ports 29 and 31, depending on the position of the plunger. When this annular recess places port 34 in communication with port 31, an annular groove 39, with which the plunger is also provided, registers with port 29 and vents it through a radial bore 41 and an axial plunger bore 42 to the atmosphere, whereby movement of piston 22 is not restricted by compression in the piston rod end of cylinder 21. Also, for the same reason, the portion of the plunger between the outer end of annular recess 38 and the adjacent end of the plunger is short enough to leave port 31 uncovered when the recess connects inlet port 34 to port 29.

One end of the plunger has a trigger 43 connected thereto for moving the plunger back and forth in the trigger valve. When this trigger is pressed into contact with the valve casing, fluid under pressure flows from conduit 36 into the head end of cylinder 21 and forces piston 22 to the opposite end of the cylinder. This movement of the piston turns valve member 18 to permit hydraulic pressure to force driving piston 6 from the head end of the driving cylinder to the opposite end thereof, thereby causing driving die 3 to drive a rivet 44. If trigger 43 is then pulled its full distance away from the trigger valve casing, the movements of all parts are reversed and the driving die is again raised to its upper position. However, as it is highly desirable that just the proper amount of pressure be applied to a rivet to avoid either incomplete driving or damage to the work, outward movement of plunger 37 is not generally left to the variable human element, but is ordinarily accomplished automatically at the moment a predetermined pressure is applied to the rivet.

Accordingly, the portion of trigger valve bore 33 adjacent trigger 43 is enlarged, and a piston 45 is rigidly mounted on plunger 37 therein. The wall of the valve is provided with a port 46 which connects the inner end of the enlarged bore to a conduit 47 leading through a pressure control valve 48 to a conduit 49 preferably connected to the same source of compressed air or the like to which conduit 36 is connected. Consequently, when pressure is applied to the inner face of piston 45, plunger 37 is moved to connect conduit 36 with the piston rod end of cylinder 21, and driving die 3 is withdrawn from the work. Piston 45 also acts as a stop for limiting the movement of plunger 37 in either direction. It is the purpose of pressure control valve 48 to admit pressure fluid to conduit 47 at the proper time as determined by the driving pressure in the head or driving end of cylinder 9.

In accordance with this invention, valve 48 is provided with an axial bore 51 enlarged near its upper end, as at 52, and closed at its lower end by an adjusting screw 53. The upper end of the bore is connected by a conduit 54 to the driving end of cylinder 9, but pressure fluid is normally prevented from entering enlarged bore 52 from the driving cylinder by a ball 56 disposed in the enlarged bore and seated across the opening in the upper wall thereof by a plunger 57 and a coil spring 58 resting on the screw 53. Near the lower end of this plunger the valve casing is provided with a pair of unaligned ports 59 and 61 to which conduits 47 and 49 are connected, respectively, and which open into axial bore 51 but

are normally kept out of communication with each other by plunger 57. Within enlarged bore 52 is a piston 62 which is mounted on plunger 57, and the portion of the wall of that bore which ball 56 engages is provided with a plurality of longitudinal grooves 63 which permit fluid to freely pass the ball when it is unseated.

When the fluid pressure in the driving end of cylinder 9 reaches a point where it is great enough to overcome the resistance of spring 58, it forces ball 56 away from its seat 55 which permits the pressure fluid to enter enlarged bore 52 where it passes the ball through grooves 63 and strikes piston 62, thereby quickly depressing plunger 57 and compressing the coil spring since the area of bore 52 is greater than that of ball seat 55. An outlet 64 in the lower end of valve 48 and an outlet 66 below piston 62 exhaust the spaces below the plunger and piston, respectively, when the latter are depressed. It will be understood that adjusting screw 53 is adjusted so as to hold ball 56 against its seat until the driving pressure in cylinder 9 produces the maximum pressure that is to be applied to rivet 44, at which instant the ball is unseated.

With the plunger in its lowest position, ports 59 and 61 are connected by an annular recess 67 in the plunger, and fluid under pressure flows from conduit 49 through the pressure control valve and conduit 47 into the trigger valve where it strikes piston 45 and moves plunger 37 outwardly. This causes main valve 14 to be reversed and the driving piston to be returned to the head end of the driving cylinder. When the main valve is reversed in this manner the head end of the driving cylinder is vented to the atmosphere through passages 12 and 17, and the pressure that depressed plunger 57 of the pressure control valve escapes. Thereupon, coil spring 58 again raises plunger 57 and forces ball 56 to its seat, whereby the flow of pressure fluid through valve 48 is shut off.

In the upper position of the plunger, conduit 47 is vented to the atmosphere through port 59 and outlet 64. This removes the pressure from piston 45 and permits plunger 37 to again be actuated manually for putting the riveting mechanism in operation. Also, when plunger 57 is in its upper position conduit 49 is connected by annular recess 67 to a port 72 in the wall of the valve. This port is closed by a plug 73 which can be removed in case it is desired to connect a conduit to the port for automatic repetition of the cycle of driving.

If it is desired to operate the apparatus entirely manually by means of the trigger valve, valve 74 in conduit 54 is closed to prevent the pressure in cylinder 9 from operating pressure control valve 48.

As set forth at the outset, it is desirable to be able to operate riveting apparatus at different speeds. Therefore, as shown in Fig. 2, lever 26 of main valve 14 is provided with an extension 76 the movement of which is limited by adjustable set screw stops 77 threaded in lugs 78 projecting from the valve. By turning these stops, singly or together, toward or away from lever extension 76, the amount that the valve member 18 is turned, and, consequently, the amount that the upper ends of passages 11 and 12 are uncovered by valve member 18, can be varied. If the stops are set so that both passages can be only partially uncovered regardless of the direction in which valve member 18 is moved, the entrance of fluid under pressure into either end of cylinder 9 will

be retarded and the rate of movement of piston 6 correspondingly diminished. On the other hand, if one stop is moved away from lever extension 76 and the other stop toward it, movement of valve member 18 in one direction will fully uncover the passages, while its movement in the opposite direction will only partly uncover them, thereby giving either a fast driving stroke and a slow return, or vice versa.

Where the work is difficult but it is necessary for the dies to be spread apart as far as possible to pass over obstructions, the driving die can be made to approach the work slowly while the rivet is being properly aligned with the dies, and then moved rapidly during the rest of its driving stroke and return. This is made possible by the presence of a coil spring 81 in cylinder 21 where one end of it encircles an inwardly projecting stop 82. By moving trigger 43 of the trigger valve quickly toward the valve casing and back to a neutral position where annular recess 38 does not register with either port 29 or port 31, sufficient pressure fluid is permitted to enter cylinder 21 to force piston 22 against coil spring 81 the resistance of which stops further movement of the piston. This initial movement of the piston turns valve member 18 only far enough to partially open passages 11 and 12, whereupon piston 6 moves the driving die slowly toward the work. When the work and rivet have been properly adjusted, the trigger 43 is again pressed against the valve casing and allowed to remain there, and the pressure fluid then forces piston 22 the rest of the distance of its stroke until it strikes against stop 82, coil spring 81 being compressed during this second movement of the piston as shown in Fig. 1. The result is that passages 11 and 12 are fully opened at this time, whereupon the driving die quickly drives a rivet and returns to its starting point.

When the work is easy to do and there are but few or minor obstructions to pass between the dies, the distance which the driving die moves away from lower die 2 can be decreased to save power and time. This is accomplished by limiting the return stroke of the driving piston by a piston stop 83 mounted on the inner end of a piston rod 84 reciprocable through the head of cylinder 9 and provided at its outer end with a piston 86 disposed in an auxiliary cylinder 87 mounted on cylinder 9. The length of piston rod 84 will depend on the amount the driving piston stroke is to be limited, or either piston stop 83 or piston 86 can be adjustably mounted on rod 84. The outer end of the auxiliary cylinder is connected by a conduit 88 to the central bore of main valve 14 whereby fluid under pressure is admitted to the outer end of the auxiliary cylinder where it forces piston 86 and stop 83 toward piston 6 which is incapable of moving them back against the pressure because the area of the face of piston 86 is greater than the area of the face of piston 6 around skirt 8. While stop 83 is projecting into the driving cylinder, piston 6 can not move backward the full length of the cylinder and, therefore, the driving die is not withdrawn as far as otherwise possible from the stationary lower die. To make the use of the piston stop optional, conduit 88 is provided with a three-way valve 89 which, when turned to shut off the flow of fluid to the auxiliary cylinder, opens the latter to an exhaust line. Piston 6 can then push stop 83 back into the recess 91 provided for it in the cylinder head where it remains until valve 89 is again operated.

In Fig. 3 there is illustrated a modified form of hydraulic riveter in which a driving piston 106 acts directly on the driving die 103 instead of through the medium of a toggle. A yoke or frame 101 carries the driving die and a cooperating vertically adjustable lower die 102, and supports substantially all of the control mechanism. The driving die is mounted on the lower end of a piston rod 107 to the upper end of which piston 106 is rigidly connected, the piston being reciprocable vertically in a cylinder 109 securely mounted on the front of the riveter frame. The opposite ends of this cylinder are connected by passages 111 and 112 to a cylindrical bore 113 in a main valve 114 attached to one side of the cylinder, the valve also being provided midway between these passages with an exhaust passage 117. Fluid pressure, preferably hydraulic, is admitted to opposite ends of the cylindrical bore of the valve through a conduit 116 and branch conduits 116a and 116b.

The end of driving cylinder 109 to which pressure fluid is admitted is governed by a piston valve member 118 reciprocable in bore 113, the central portion of the valve member being provided with an annular recess 118a which connects either passage 111 or passage 112 to exhaust passage 117, depending on whether the valve member is raised or lowered, and thereby permits fluid under pressure to enter the remaining passage from conduit 116 and the adjacent branch conduit. The vertical position of piston valve member 118 in the main valve is controlled by a piston 122 disposed in a cylinder 121 and connected to the valve member by piston rods 123 and 119. The head end of this cylinder is connected by a conduit 128 to the axial bore 133 of a trigger valve 132 located in a position convenient for the operator of the riveting apparatus, and the opposite end of the cylinder is connected by a conduit 127 to trigger valve bore 133 at a point below conduit 128. The trigger valve is also connected to a source of fluid pressure, preferably pneumatic to insure quick response of the control mechanism, by a conduit 136 which opens into axial bore 133 midway between conduits 127 and 128.

For selecting to which of these latter conduits the pressure fluid shall be admitted, a plunger 137 is disposed in the trigger bore and is provided at its lower end with a trigger 143 for manipulating it. This plunger is also provided with an annular recess 138 which connects conduit 136 with conduit 128 when the plunger is in its upper position, and with conduit 127 when the plunger is in its lower position. In the first case conduit 127 is exhausted through an annular groove 129, a radial bore 141, an axial bore 142, a radial bore 144, and an annular recess 145, all in the plunger, and a port 146 in the wall of the trigger valve. When the plunger is lowered, conduit 128 is exhausted through the upper end of valve bore 133.

For automatically reversing main valve 114 to withdraw the driving die from a rivet when a predetermined pressure has been applied thereto, the trigger valve plunger is actuated by a pressure control valve 148 which is operated by the pressure in the driving end of cylinder 109. The pressure control valve is provided with an axial bore 151 that is connected at its upper end by a conduit 154 to the head end of cylinder 109. The opening between conduit 154 and bore 151 is normally closed by a ball 156 seated by a piston 162 which is constantly forced upwardly by a coil spring 158 resting on a hollow adjusting screw 75

153 threaded through the bottom of the pressure control valve. Downward movement of piston 162 is transmitted directly to trigger valve plunger 137 by means of a piston rod 157 rigidly connected to piston 162, passing through hollow adjusting screw 153, and resting on the upper end of plunger 137.

When the pressure in the driving end of cylinder 109 reaches the amount for which the adjusting screw has been adjusted it unseats the ball 156, and the pressure fluid passes the ball through grooves 163 formed in the wall of the valve and strikes piston 162 which is thereby quickly forced down against the resistance of the coil spring. This movement is transmitted to the trigger valve plunger by piston rod 157, and conduits 136 and 128 are connected to conduit 127 and the exhaust, respectively, whereupon the main valve is reversed and the driving die withdrawn from the work.

The distance which piston valve member 118 moves in bore 113 can be regulated by adjustable stops 177 against which abuts an arm 176 projecting laterally from piston rod 119. If the path of movement is shortened by the use of these stops, passages 111 and 112 will be only partly uncovered and the speed of operation of the riveting apparatus will be correspondingly reduced, the lower stop governing the forward movement and the upper stop the return movement of piston 106. In short, stops 177 function in the same manner as stops 77 shown in Fig. 2.

To facilitate varying the speed of die 103 during its driving stroke, a coil spring 181 is disposed in cylinder 121 where it encircles piston rod 123. This spring functions in the same manner as spring 81 in Fig. 1.

In order to shorten the stroke of the driving die, a back stop 183 is disposed in a recess in the head of cylinder 109. This stop is projected into the cylinder by a piston 186 disposed in a superposed auxiliary cylinder 187, the piston being depressed by fluid pressure preferably obtained from hydraulic pressure line 116 by a conduit 188 provided with a three-way valve 189.

Riveting apparatus constructed in accordance with this invention is adapted particularly for the use of hydraulic pressure in driving rivets, although it is also possible to use pneumatic pressure throughout. The apparatus is also adapted to do highly satisfactory work under all conditions because the speed at which it operates can be easily and quickly set so as to be automatically controlled to that proper and safe for the work in hand, while the pressure applied to the rivets can be automatically controlled to that proper for the work and size of rivets. By using a short driving stroke where feasible, the dies and rivet can be more easily and exactly aligned, and time can be saved. The simplicity and ruggedness of the apparatus insure lack of trouble, and the certainty of operation insures the high quality of the work.

According to the provisions of the patent statutes, I have explained the principle and mode of operation of my invention, and have illustrated and described what I now consider to represent its best embodiment. However, I desire to have it understood that, within the scope of the appended claims, the invention may be practiced otherwise than as specifically illustrated and described.

I claim:

1. Fluid actuating mechanism for a riveting die, comprising a cylinder, a piston therein con-

nected to the die, a conduit connecting a source of hydraulic pressure to the cylinder for reciprocating the piston to actuate the die, a main valve in said conduit for controlling the application of said hydraulic pressure to said piston, means for operating said main valve, a conduit connecting a source of pneumatic pressure to said valve-operating means for actuation thereof, a trigger valve in said pneumatic pressure conduit for controlling the application of said pneumatic pressure to said valve-operating means, and a pressure control valve for reversing said trigger valve, said control valve being actuated by predetermined hydraulic driving pressure in the driving end of said cylinder and being formed to keep said hydraulic pressure fluid from passing there-through.

2. Fluid actuating mechanism for a riveting die, comprising a cylinder, a piston therein connected to the die, a conduit connecting a source of hydraulic pressure to the cylinder for reciprocating the piston to actuate the die, a main valve in said conduit for controlling the application of said hydraulic pressure to said piston, means for operating said main valve, a conduit connecting a source of pneumatic pressure to said valve-operating means for actuation thereof, a trigger valve in said pneumatic pressure conduit for controlling the application of said pneumatic pressure to said valve-operating means, and a pressure control valve for reversing said trigger valve, said pressure control valve being actuated by predetermined hydraulic driving pressure in the driving end of said cylinder, actuation of said pressure control valve placing said source of pneumatic pressure in communication with said trigger valve to reverse it, whereby the main valve is reversed.

3. Fluid actuating mechanism for a riveting die, comprising a cylinder, a piston therein connected to the die, a conduit connecting a source of hydraulic pressure to the cylinder for reciprocating the piston to actuate the die, a main valve in said conduit for controlling the application of said hydraulic pressure to said piston, means for operating said main valve, a conduit connecting a source of pneumatic pressure to said valve-operating means for actuation thereof, a trigger valve in said pneumatic pressure conduit for controlling the application of said pneumatic pressure to said valve-operating means, and a pressure control valve for reversing said trigger valve, said pressure control valve being actuated by predetermined hydraulic driving pressure in the driving end of said cylinder, and a mechanical connection between the pressure control valve and the trigger valve for transmittal of movement from the former to the latter when the pressure control valve is actuated, whereby the trigger valve is reversed.

4. Fluid actuating mechanism for a riveting die, comprising a cylinder, a piston therein connected to the die, a conduit connecting a source of fluid under pressure to the cylinder for reciprocating the piston to actuate the die, a main valve in said conduit for controlling the flow of said fluid to the cylinder, means for operating said main valve, and adjustable stops associated with said valve-operating means for selectively limiting the movement thereof, whereby the size of the passage through the valve is varied to vary the rate at which said fluid is admitted to the cylinder.

5. Fluid actuating mechanism for a riveting die, comprising a cylinder, a piston therein con-

5 nected to the die, a conduit connecting a source
of fluid under pressure to the cylinder for reciprocating the piston to actuate the die, a main valve
10 in said conduit for controlling the flow of said
fluid to the cylinder, pressure fluid operated
means for operating said main valve, a trigger
valve for admitting fluid under pressure to said
15 means, means for selectively varying the size of
the passage through the main valve to thereby
vary the rate at which said fluid is admitted to
the cylinder, and a pressure control valve operated
20 by predetermined driving pressure in the
driving end of said cylinder for automatically
reversing the trigger valve, whereby the main
valve is reversed.

25 6. Fluid actuating mechanism for a riveting
die, comprising a cylinder, a piston therein connected
to said driving die, a conduit connecting
a source of fluid under pressure to the cylinder
for reciprocating the piston to reciprocate the
30 driving die, a main valve in said conduit for controlling
the flow of said fluid to the cylinder,
means for operating said main valve, and means
for restricting the forward speed of the driving
35 die at will, said restricting means being adapted
to be displaced at will to permit a subsequent
fast driving speed of the driving die.

40 7. Fluid actuating mechanism for a riveting
die, comprising a cylinder, a piston therein connected
to the die, a conduit connecting a source
of fluid under pressure to the cylinder for reciprocating
the piston to actuate the die, a main valve
45 in said conduit for controlling the flow of said
fluid to the cylinder, means for operating said

main valve, and means for restricting movement
of the valve in one direction to thereby restrict
the flow of fluid to the driving end of the cylinder,
said restricting means being adapted to be displaced
5 by the application of additional pressure
thereto.

8. Fluid actuating mechanism for a riveting
die, comprising a cylinder, a piston therein connected
to the die, a conduit connecting a source
10 of fluid under pressure to the cylinder for reciprocating
the piston to actuate the die, a main valve
in said conduit for controlling the flow of said
fluid to the cylinder, a pressure fluid operated
piston connected to said valve for operation
15 thereof, resilient means for restricting the movement
of said piston in one direction to thereby
restrict the flow of fluid to the driving end of
said cylinder, said resilient means being adapted
to be stressed by the application of additional
20 pressure to said piston, whereby the main valve
is opened wide.

9. Fluid actuating mechanism for a riveting
die, comprising a cylinder, a piston therein connected
to the die, a conduit connecting a source
25 of fluid under pressure to the cylinder for reciprocating
the piston to actuate the die, a main
valve in said conduit for controlling the flow of
said fluid to the cylinder, means for operating
said main valve, a back stop disposed in the driving
30 end of said cylinder, and pressure operated
means for moving said back stop into operative
position.

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