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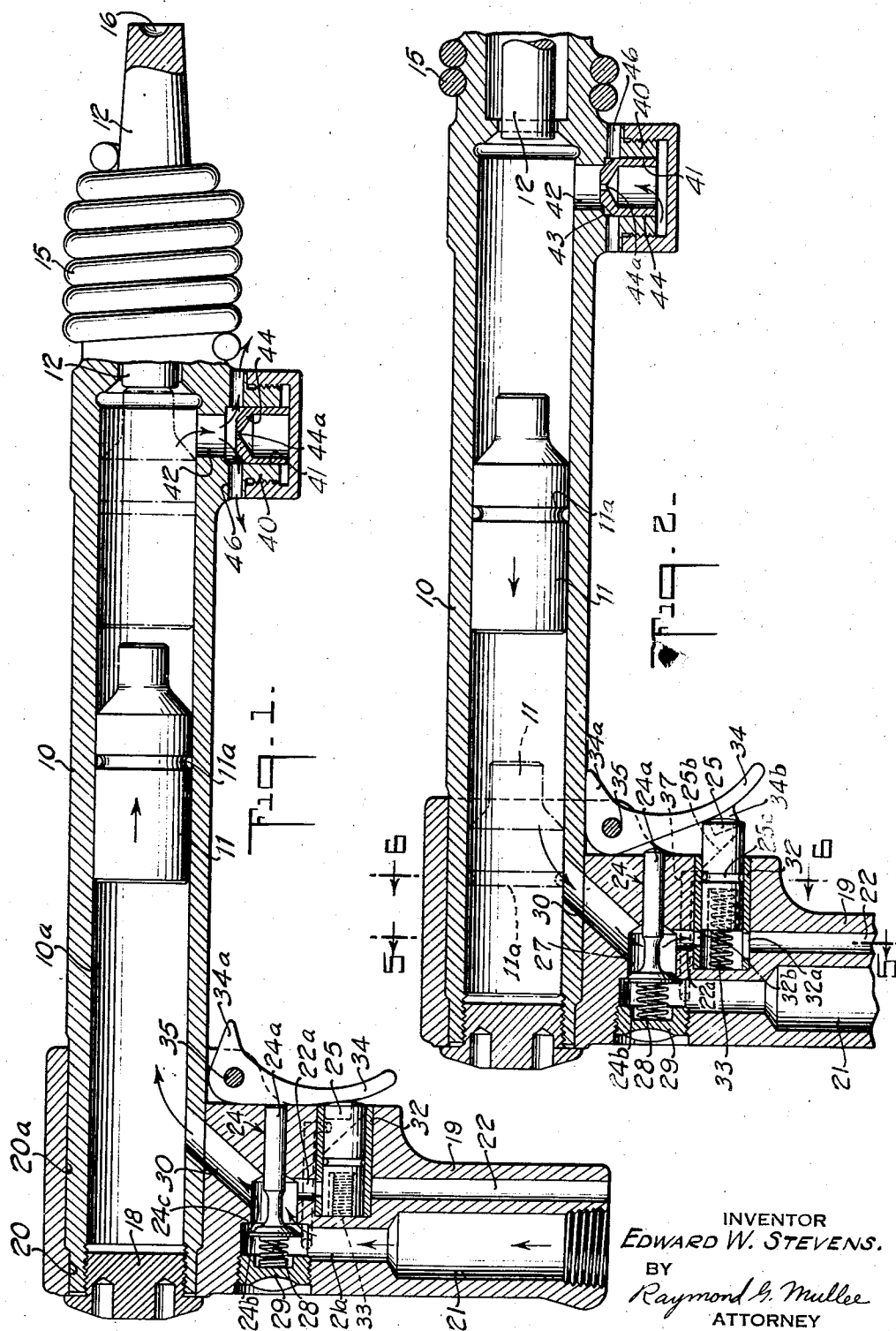
E. W. STEVENS

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PNEUMATIC HAMMER

Filed Sept. 11, 1935

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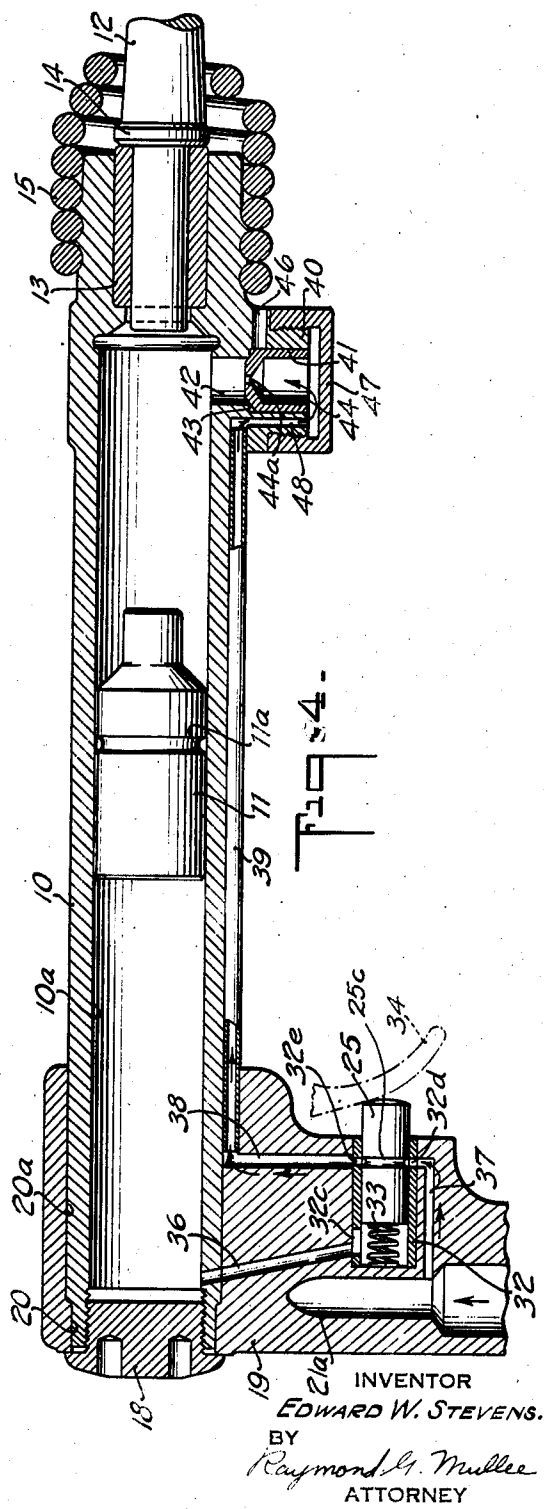
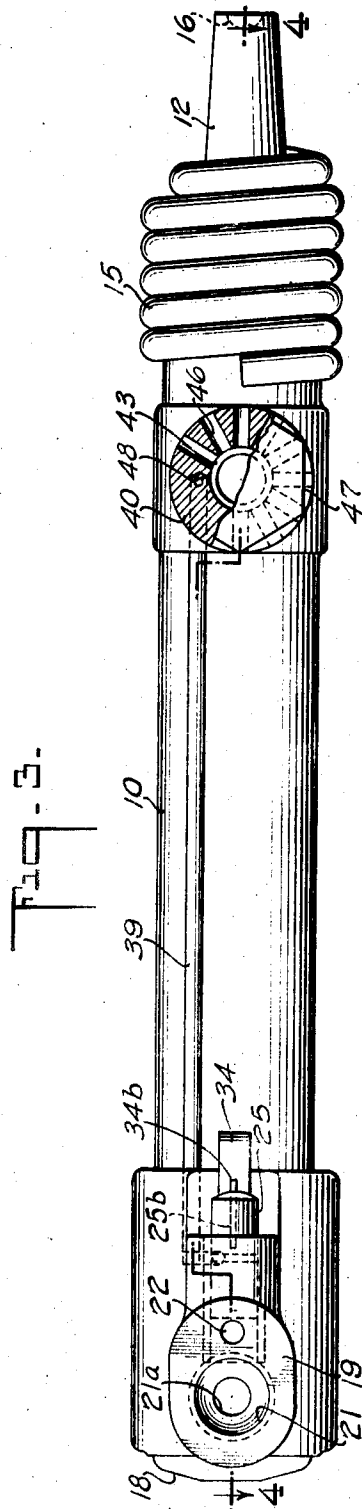
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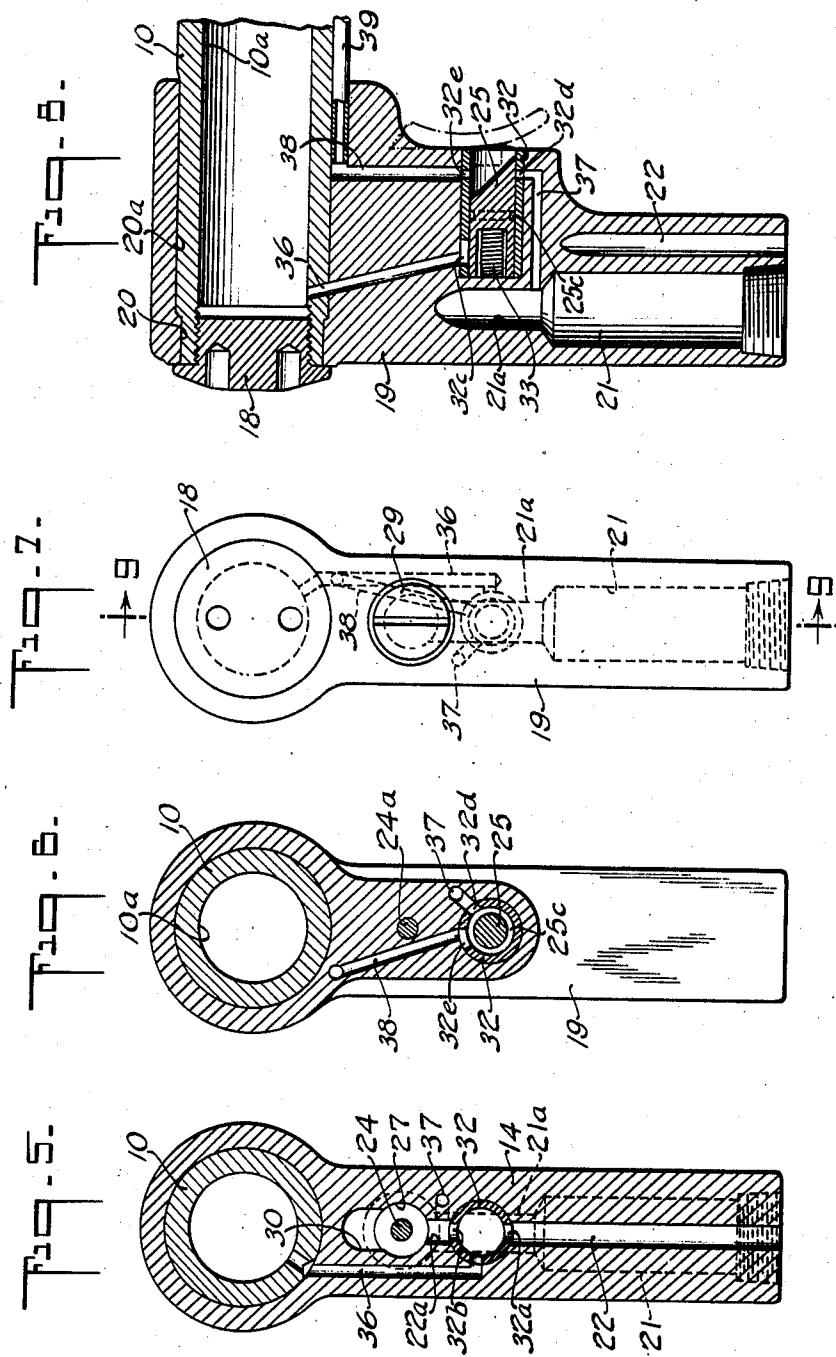
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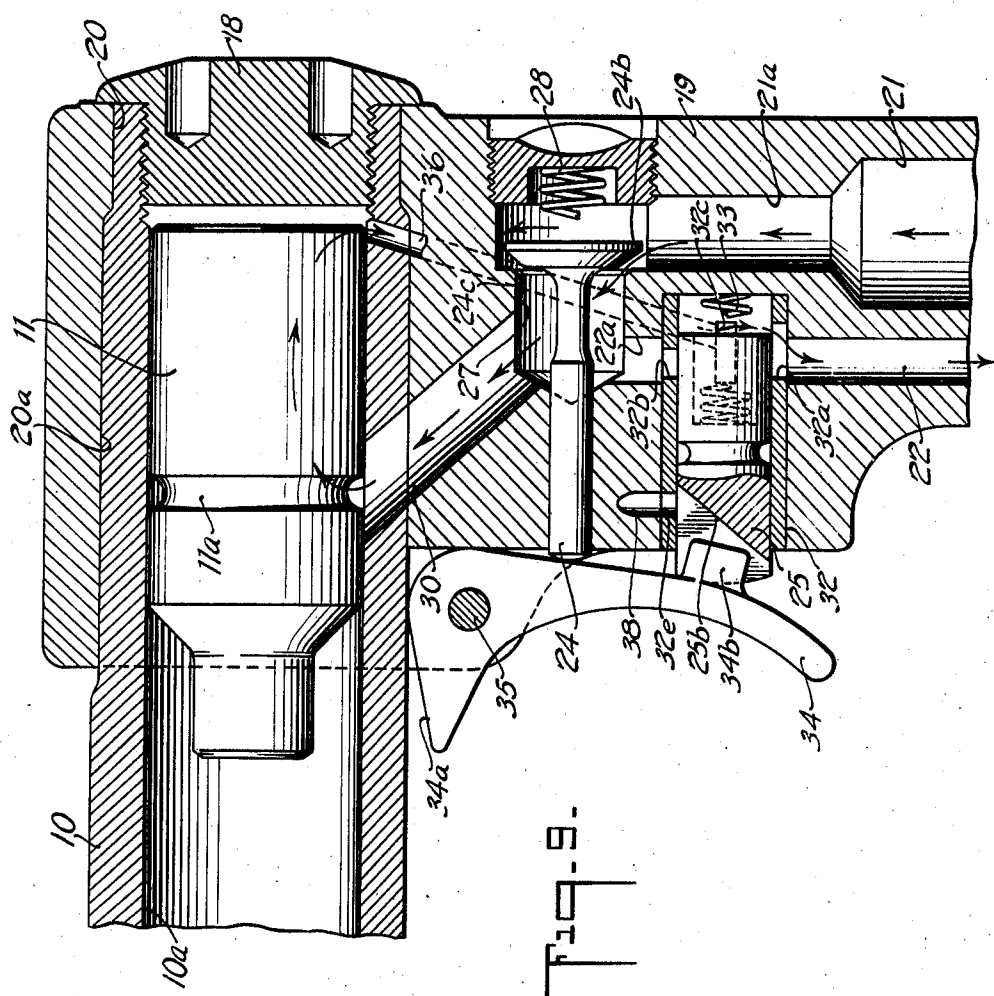
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4 Sheets-Sheet 4



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PNEUMATIC HAMMER

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6 Claims. (Cl. 121—21)

The present invention relates to fluid pressure percussive tools and more particularly to single acting riveting hammers adapted to head a rivet in one blow.

5 An object of the invention is to enable a percussive tool to deliver a powerful blow for its size and weight.

In the usual pneumatic hammer of the single acting type, the hammer piston is normally held 10 in its rearmost position and is started on its forward stroke by the opening of a manually operated throttle valve which admits line pressure to the cylinder in back of the piston. Full pressure behind the piston does not develop instantly 15 but builds up during the time interval between the initial movement of the throttle valve and its completely open position. In the operation of prior constructions of this type, the piston starts to move just as soon as the throttle valve begins 20 to open and travels rapidly toward the front end of the cylinder before the operator has an opportunity to complete the valve movement. Consequently, full pressure is not delivered to the cylinder until after the piston has drifted a considerable distance away from its starting point. 25

In accordance with the present invention the piston is actuated by full pressure during its entire stroke resulting in increased velocity and force of blow. This result is accomplished by a 30 novel throttle arrangement which retards movement of the piston away from its normal position until the opening movement of the throttle valve has been completed.

Another object is to enable the operator to control the force of blow in response to either a quick or slow throttle valve movement.

A further object is the provision of a one-shot riveting hammer which is light in weight, easy to manipulate, and in which the piston is quickly 40 restored to normal position after each forward stroke whereby the machine may deliver blows in rapid succession under the control of the operator.

In accordance with the invention, live air is 45 normally supplied to the front end of the cylinder to hold the piston at the opposite end. A manipulative trigger controls an inlet and an exhaust valve, so constructed and arranged that movement of the trigger first cuts off the holding 50 pressure in front of the piston, then admits live air to a cylinder port intermediate the ends of the piston. A feature of the invention resides in means for preventing the air admitted through said port from starting the piston forwardly until 55 the trigger has completed its movement. Such

means comprises an exhaust port at the extreme rear end of the cylinder which vents the air leaking around the peripheral surface of the piston.

Other objects and features of the invention will appear more clearly from the following description taken in connection with the accompanying drawings and appended claims. 5

Referring to the drawings, Fig. 1 is a longitudinal view, partly in section and partly in elevation of a riveting hammer embodying the invention, 10 showing the position of the parts during the time the piston is driven forwardly;

Fig. 2 is a longitudinal section showing the piston on its rearward stroke;

Fig. 3 is an elevational view, looking upwardly, 15 of the riveting hammer shown in Fig. 1;

Fig. 4 is a longitudinal section showing the exhaust valve in normal position and taken through an irregular plane to show passages under control of said valve; 20

Figs. 5 and 6 are cross sections, as indicated by the arrows 5—5 and 6—6 respectively in Fig. 2;

Fig. 7 is an end view in elevation looking from left to right in Fig. 1;

Fig. 8 is a fragmentary longitudinal section corresponding to Fig. 4 but showing the exhaust valve in operated position; and 25

Fig. 9 is a fragmentary longitudinal section looking in the direction of arrows 9—9 in Fig. 7, the valves and operating trigger being shown in an intermediate position of movement. 30

The illustrative riveting hammer comprises a cylinder 10 providing a piston chamber 10a in which reciprocates a hammer piston 11 adapted 35 to strike the end of a riveting tool 12 which is mounted in a chuck bushing 13 in the front end of the cylinder. A collar 14 (see Fig. 4) on the working tool abuts against the bushing on its inner face and is adapted to engage a retainer 15 on its outer face. The tool 12 has a concave 40 outer end 16 which engages the head of a rivet (not shown).

The tool 12 and bushing 13 serve as a closure for the front end of the piston chamber while the rear end thereof is closed by a threaded block 18. 45

The block retains the cylinder 10 in assembled relationship with a grip handle 19 having a bore 20 and counterbore 20a to fit the outside surface of the cylinder. The grip handle has an inlet 50 duct 21, 21a adapted to be connected to a fluid pressure supply line (not shown) and has an exhaust duct 22 leading to atmosphere.

Connections are provided between ducts 21 and 22 and the respective ends of the piston chamber 55

under control of an inlet valve 24 and an exhaust valve 25, both mounted in the handle.

Valve 24 has a stem 24a slidable in a bore in the grip handle 19 and has a head 24b engageable with a seat 24c to control communication between supply duct 21a and a counterbore 27 in the handle. A spring 28 is interposed between the valve head 24b and a plug 29 to hold the valve head yieldingly against its seat. Counterbore 27 is connected by a large port 30 to the cylinder. Port 30 delivers live motive fluid to the cylinder during the forward or working stroke and serves as an exhaust port on the return stroke. To enable the cylinder to exhaust through port 30 the counterbore 27 at the lower end of this port is adapted to be connected to exhaust passage 22 by means under control of the exhaust valve 25.

Exhaust valve 25 is in the form of a plunger mounted to reciprocate in a sleeve 32 fixed to the handle 19. Near its rear extremity, the sleeve has a port 32a registering with exhaust passage 22, and a port 32b registering with port 22a leading to the counterbore 27. Plunger 25 is adapted selectively to cover and uncover ports 32a and 32b to control the flow of exhaust air from cylinder port 30 through counterbore 27 and said ports to the exhaust passage 22. Inward movement of the plunger 25 is resisted by compression spring 33 extending within a recess in the plunger.

The forward or outer end of the exhaust valve 25 abuts against a trigger 34 mounted on a pin 35 and having a stop 34a which limits outward rocking movement of the trigger and consequently forward movement of the plunger 25. The trigger and valve are guided by a tongue 34b on the trigger which fits in a slot 25b in the plunger valve 25.

Normally piston 11 is held at the rear end of the piston chamber by means, under control of exhaust valve 25, for simultaneously exhausting the rear end and supplying pressure fluid to the front end of the cylinder. Referring to Figs. 4, 5, 8, and 9, the rear end of the cylinder is adapted to be exhausted through passage 36, sleeve port 32c, the interior of sleeve 32 and port 32a to the exhaust passage 22. The means for supplying pressure fluid to the front end of the cylinder comprises passage 37 (see Fig. 4), leading from live air duct 21a to a port 32d which is in the same radial plane as port 32e, both ports being adapted to register with the annular groove 25c when the plunger 25 is in its normal position. Port 32e registers with passage 38 communicating with tube 39 extending toward the front end of the cylinder. Near the front end of the piston chamber 10a, the cylinder has a boss 40 provided with a recess 41 communicating through a port 42 with the interior of the cylinder. At the outer end of the cylinder port 42 is a seat 43 for a hollow valve 44 guided within recess 41. Valve 44 controls communication between cylinder port 42 and radial ports 46 in the boss 40 which lead to atmosphere. The outer end of recess 41 is closed by a threaded cap 47. Pressure fluid supplied by tube 39 passes through passage 48, then under cap 47 to the interior of the hollow valve 44 to hold the valve against its seat and thereby cut-off port 42 from atmosphere. At the same time, a limited supply of pressure fluid passes through a small orifice 44a in the valve and through port 42 to the front end of the piston chamber 10a to return the piston and hold it at the rear end of the piston chamber. Due to the larger diameter of recess 41 as compared with port 42, and the drop in pressure of air passing

through the small orifice 44a, the valve 44 is held firmly on its seat.

In explaining the operation of the illustrative embodiment of the invention, let it be assumed that the trigger 34, inlet valve 24 and exhaust valve 25 are in the inoperative position shown in Fig. 2 and that the piston occupies its normal position indicated by broken lines in said figure. At this time holding pressure is transmitted from live air duct 21a to grip handle passage 37 (see Fig. 4) around exhaust valve groove 25c, through passage 38, tube 39, passage 48, valve orifice 44a and cylinder port 42 to the front end of the piston chamber 10a, thereby holding the piston 11 at the rear end of the cylinder. Holding pressure fluid escaping between the piston and cylinder toward the back of the piston 11 is intercepted by an annular groove 11a in the piston and is exhausted through ports 30, 22a, 32b, 32a and 22. As seen in Figs. 4, 5 and 9, the extreme rear end of the piston chamber 10a at this time is open to exhaust through passage 36, sleeve ports 32c and 32a and passage 22 which supplement the action of groove 11a and port 30 in preventing the building up of pressure behind the piston at this time.

As the operator pulls the trigger 34, he first actuates the exhaust valve 25 to move the valve groove 25c (Fig. 4) out of register with fluid pressure supply port 32d thereby cutting off the supply of holding pressure through tube 39 to the front end of the piston chamber 10a and releasing the valve 44 at the front end of the cylinder.

About the same time that the holding pressure is cut off from the front end of the piston chamber 10a, the exhaust valve 25 closes ports 22a and 32b (see Figs. 2 and 9) from exhaust.

Having discontinued the supply of holding pressure fluid from the front end of the piston chamber 10a and disconnected the counterbore 27 from exhaust (through port 32b), the device is in condition to admit live pressure fluid to the cylinder for driving the piston forwardly. Further movement of the trigger is transmitted through stem 24a to open the inlet valve 24, which admits live pressure fluid from inlet duct 21a around the valve head 24b and through counterbore 27 to cylinder port 30 which registers with piston groove 11a. In this intermediate stage of operation, and before the trigger has been moved to its extreme rearward position in which the throttle valve is wide open, the parts of the device occupy the positions shown in Fig. 9.

It will be noted from Fig. 9 that during the time the throttle valve 24 is only partly open, the extreme rear end of the piston chamber 10a is open to exhaust through passage 36, sleeve ports 32c and 32a and exhaust passage 22. The purpose of keeping these exhaust passages open after the throttle valve has started to unseat, is to prevent premature movement of the piston by venting the air that seeps from piston groove 11a over the circumference of the piston to the rear face of the latter. Movement of the piston is also retarded by the friction between the piston and cylinder, since the unbalanced area of the piston exposed to port 30 tends to force the piston against the opposite or upper wall of the cylinder.

Movement of the trigger 34 to its final position opens the throttle valve 24 wide and cuts off the rear end of the cylinder from exhaust at the ports 32c and 32a, which permits pressure to build up behind the piston and shift the piston until it uncovers inlet port 30, which by that time is

supplied with full pressure adapted to actuate the piston during substantially its entire stroke to deliver a heavy blow against the working tool 12. During the forward stroke, air is exhausted from the cylinder through ports 42 and 46, as shown in Fig. 1. The valve 44 is held in the Fig. 1 position by the predominance of pressure on its upper end, inasmuch as the lower end is connected to exhaust through passage 48, tube 39, passage 38, sleeve port 32 and valve slot 25b (see Figs. 8 and 9).

When the trigger is released, spring 33 restores it to the position shown in Fig. 2 and the piston is automatically returned to the rear end of the cylinder, and held there until the next operation, by pressure fluid through passage 37, valve groove 25c, passage 38, tube 39, passage 48 and restricted orifice 44a.

From the above description, it will be seen that the invention results in the delivery of a powerful blow by delaying actuation of the piston until the throttle valve has been opened wide. In prior devices of the single blow type, the piston usually started moving at the same time as the throttle valve and, even though the valve was actuated by a quick manual movement, the valve remained only partly open during a considerable portion of the travel of the piston.

It is sometimes desired to deliver a blow of less than maximum force, and this can be accomplished by moving the trigger 34 very slowly, to allow time for pressure to build up in back of the piston while the exhaust ports 32c and 32a are being slowly covered. Pressure behind the piston may then cause it to move before the throttle valve is opened wide. Thus the invention provides for either a light or heavy blow depending on the trigger action. A fast movement of the trigger provides full line pressure to the rear face of the piston, the instant the port 30 is uncovered and allows full pressure to be exerted on the piston throughout the full forward stroke. A slow operation of the trigger produces a slow start and slow acceleration of the piston, as well as a restricted flow of live air to follow up the piston on its working stroke. The lightness of blow is governed entirely by the speed with which the trigger valve is opened. The slower it is opened the lighter will be the resultant blow.

While the invention has been particularly described with reference to a single illustrative embodiment, it will be apparent that many changes and adaptations thereof may be made within the spirit of the invention and within the scope of the appended claims.

What is claimed is:

1. A percussive fluid pressure operated tool of the single impact type comprising a cylinder providing a piston chamber, a hammer piston reciprocable therein, manually controlled means for admitting pressure fluid to the rear end of the piston chamber to drive the piston forwardly, means for admitting holding pressure fluid to the front end of the piston chamber to return the piston and hold it normally at the rear end of the cylinder, and means for intercepting holding pressure fluid seeping toward the rear of the piston, said last-mentioned means comprising an annular groove in the piston and a cylinder port connected to exhaust, said port being positioned

to register with the groove when the piston is held at the rear end of the cylinder.

2. A percussive fluid pressure operated tool of the single impact type comprising a cylinder providing a piston chamber, a hammer piston reciprocable therein, manually controlled means for admitting pressure fluid to the rear end of the piston chamber to drive the piston forwardly, means for admitting holding pressure fluid to the front end of the piston chamber to return the piston and hold it normally at the rear end of the cylinder, and means for retarding the building up of pressure behind the piston in response to pressure fluid seepage toward the rear of the piston, said last-mentioned means comprising an annular groove in the piston and a cylinder port connected to exhaust, said port being positioned to register with the groove when the piston is held at the rear end of the cylinder, and an exhaust passage communicating with the extreme rear end of the piston chamber.

3. A percussive fluid pressure operated tool according to claim 2 in which manually controlled means are provided for first disconnecting said cylinder port from exhaust, then admitting live pressure fluid to said cylinder port, and then closing said exhaust passage.

4. A percussive tool comprising a cylinder providing a piston chamber, a piston reciprocable therein, an inlet passage in said cylinder connected at one end to a source of live pressure fluid and at its other end terminating in a port in said piston chamber near the rear end of the latter, a passageway leading from the extreme rear end of the piston chamber to exhaust whereby to oppose the building up of pressure behind the piston, and means for cutting off said passageway from exhaust during the time that pressure fluid is being supplied to said inlet passage.

5. A fluid pressure operated percussive tool of the single impact type comprising a cylinder providing a piston chamber, a piston reciprocable therein, a source of live pressure fluid, a pair of ports in the cylinder, one of which is at the front end of the piston chamber and the other of which is near the rear end thereof, a grip handle connected to the rear end of the cylinder, a throttle valve in said handle, adapted in one position to connect the rear cylinder port to said pressure fluid source, a second valve in said handle, a passageway from said second valve to the front cylinder port, said second valve being adapted to connect said passageway to live pressure fluid and simultaneously connect the rear port to exhaust, and a single manipulative trigger engageable with both valves, said trigger being adapted by continuous movement in one direction first to actuate the second-mentioned valve to cut off the supply of pressure fluid to the front end of the cylinder and then to actuate said throttle valve to admit live pressure fluid to the rear cylinder port.

6. A percussive tool according to claim 5 in which an exhaust passage is provided for the extreme rear end of the cylinder and the second-mentioned valve is arranged to close said passage prior to the time that the throttle valve is moved to completely open position to admit live pressure fluid to said rear cylinder port.

EDWARD W. STEVENS. 70

CERTIFICATE OF CORRECTION.

Patent No. 2,101,159.

December 7, 1937.

EDWARD W. STEVENS.

It is hereby certified that error appears in the printed specification of the above numbered patent requiring correction as follows: Page 3, second column, line 59, claim 5, after "fluid" insert the words through said passageway; and that the said Letters Patent should be read with this correction therein that the same may conform to the record of the case in the Patent Office.

Signed and sealed this 8th day of February, A. D. 1938.

(Seal)

Henry Van Arsdale,
Acting Commissioner of Patents.