Nov. 4, 1941. E. W. STEVENS 2,261,306

FEED CONTROL FOR PNEUMATIC TOOLS

Filed Dec. 8, 1938 2 Sheets-Sheet 1

Fig. 1.

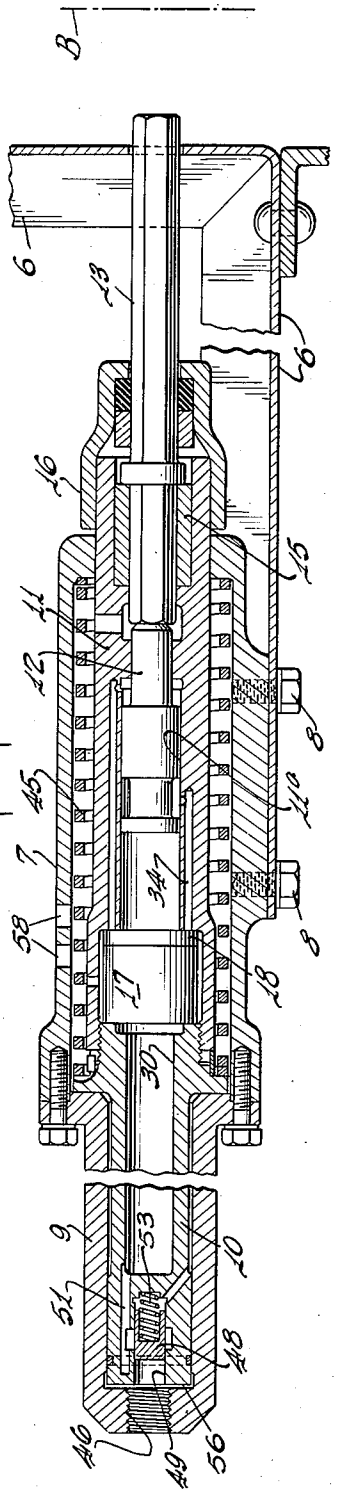
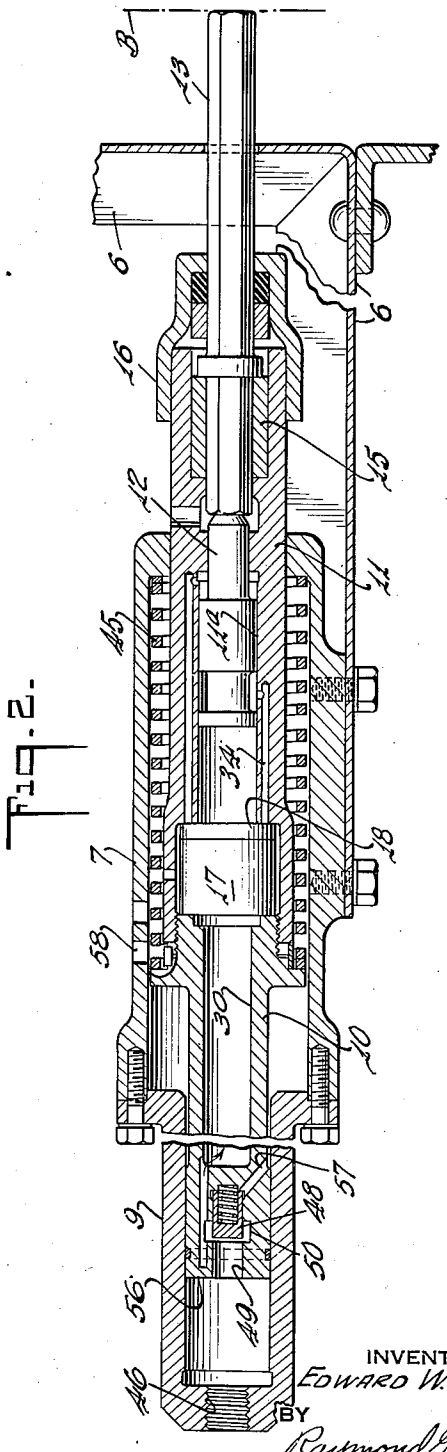


Fig. 2.



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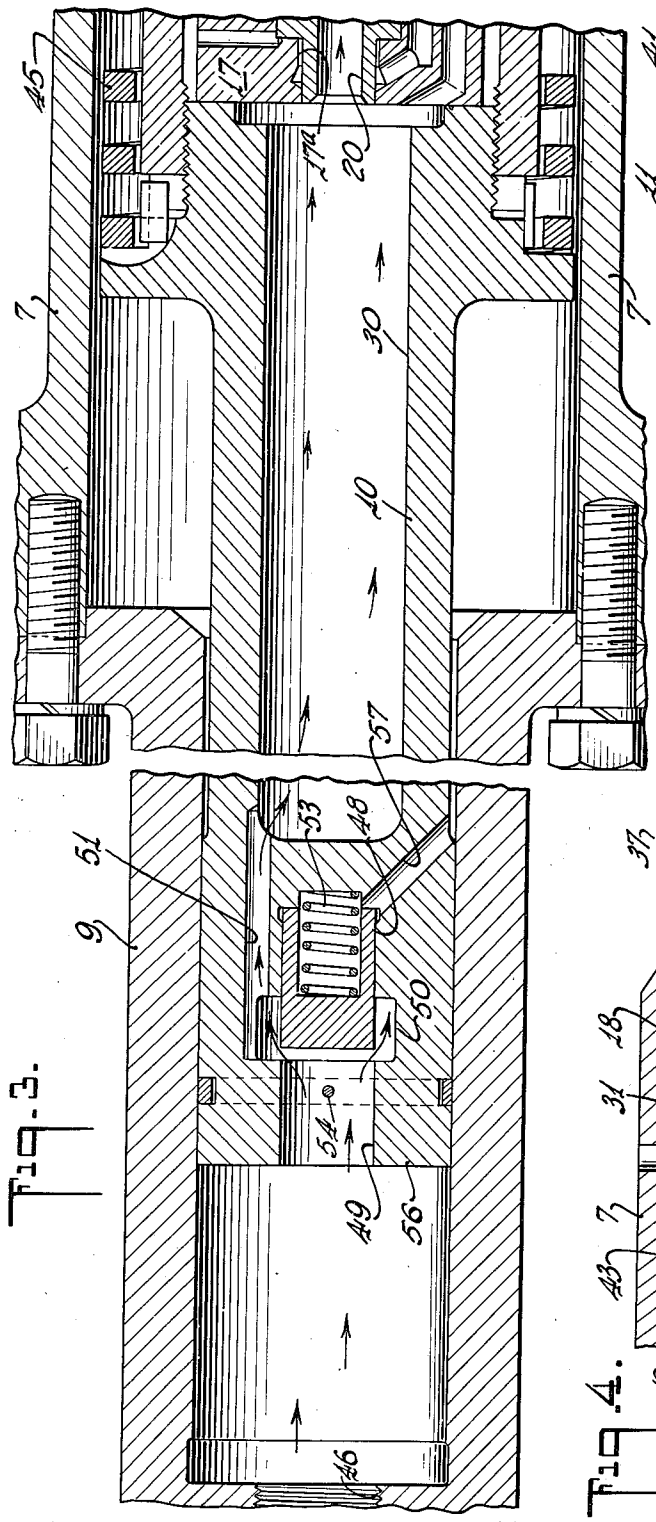


Fig. 3.

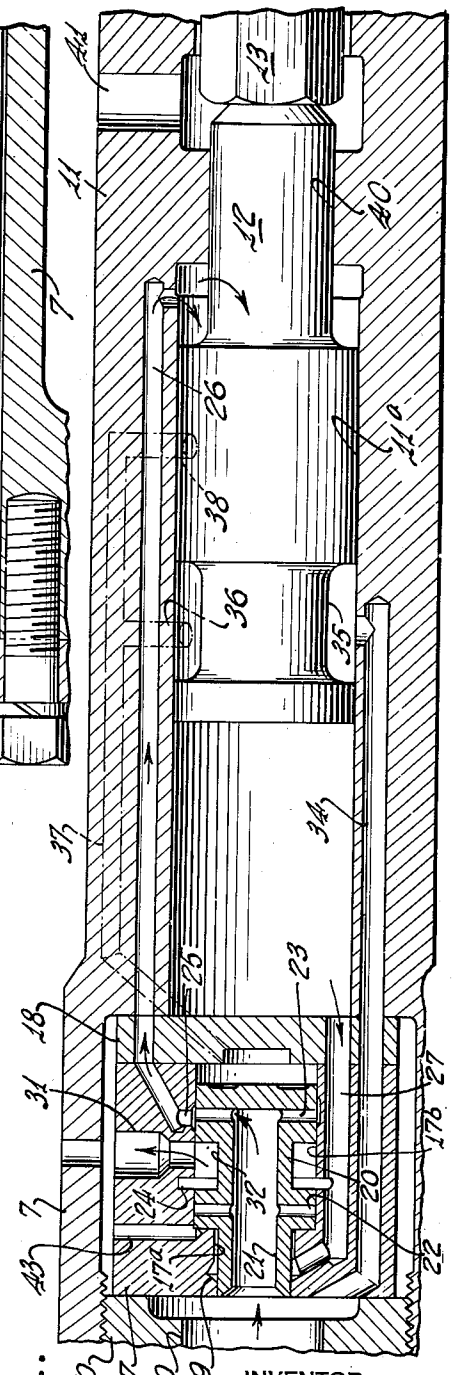


Fig. 4.

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FEED CONTROL FOR PNEUMATIC TOOLS

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Application December 8, 1938, Serial No. 244,508

2 Claims. (Cl. 121—9)

This invention relates to pneumatic tools, particularly of the type which is provided with an air operated feed device for moving the tool or machine as a unit into and out of operative relation with the apparatus on which the tool operates.

An object of the invention is to control the supply of air to the pneumatic tool whereby to inhibit operation of the tool while it is being moved in either direction by the feed device. Another object is to obviate the need for separate control mechanisms for the supply of air to the feed and pneumatic tool respectively.

A feature of the invention is an automatic throttle or control valve associated with the feed piston and arranged to admit air to the pneumatic tool motor while the feed device is at rest in the extended position, and to cut off the supply of air to the motor before the tool is moved out of contact with the work. Automatic opening of the throttle valve at the proper time is made possible by the fact that pressure in the feed cylinder builds up to a sufficient value to open the valve only upon termination of the extending movement of the feed.

The pneumatic tool is preferably, though not necessarily, of the percussive type and may be used in many different applications, for example, as a jam riveter or as a vibrator. It has been found that a vibrator embodying the invention is well suited for shaking the collected metal particles from the screens and electrodes in the practice of the Cottrell smelting process.

In the accompanying drawings which illustrate one embodiment of the invention, and in which the first two figures are on a reduced scale:

Fig. 1 is a longitudinal sectional view of a pneumatic vibrator and feed device therefor, the parts being shown in the inoperative position;

Fig. 2 is a view similar to Fig. 1 but showing the pneumatic tool moved into operative relation with the work, just before the pressure fluid is admitted to the tool;

Fig. 3 is a fragmentary longitudinal section of the feed for the pneumatic tool, the position of the parts corresponding to that shown in Fig. 2; and

Fig. 4 is a longitudinal section of a portion of the percussive motor in the pneumatic tool, showing the distributing valve, hammer piston and associated passages, the position of the parts corresponding to that shown in Fig. 2.

The invention, when embodied in a vibrator, may be mounted on a bracket 6 supported in fixed relation to the striking block or other apparatus receiving the vibrating impulses, the position of the striking block being indicated by the broken line B in Figs. 1 and 2. The illustrative vibrator comprises a cylinder casing 7 secured by bolts 8 to the bracket 6. To the rear end of the casing 7 is bolted an extension of smaller diameter, said extension providing a feed cylinder 9. The feed cylinder receives a feed piston 10, the front end of which is screwed to a motor cylinder 11. The latter provides a piston chamber 11a in which a hammer piston 12 reciprocates. The piston is arranged to deliver impacts to a working implement 13 by means of which the hammer blows are transmitted to the striking block or other device receiving the vibrations. The working implement is mounted in the cylinder by the usual chuck 15 and retainer member 16.

Any suitable type of distributing valve may be used for controlling the reciprocations of the hammer piston. As shown best in Fig. 4, the rear end of the motor cylinder 11 is counterbored to receive a valve chest 17 and valve cap 18, the latter providing a closure for the rear end of piston chamber 11a. The parts 17 and and 18 are clamped together by the screw threaded connection between feed piston 10 and motor cylinder 11. The valve chest 17 has a bore 17a and a counterbore 17b. The counterbore receives a distributing valve 20 with a sliding fit. Bore 17a has a restricted portion at its rear end into which fits an extension on the distributing valve 20 when the latter is in its rearmost position. The distributing valve has a central bore 21 terminating short of the front end of the valve and from this bore radiate two axially spaced sets of bores 22 and 23. Bores 22 register with valve chest groove 24 when the valve is in its forward position. Bores 23 register with groove 25 when the valve is in its rearmost position as shown in Fig. 4. Groove 25 is connected to the front end of the piston chamber 11a by passage 26, while groove 24 leads to the rear end of the piston chamber through passage 27. The passage last named also communicates with a groove 29 in the bore 17b of the valve chest 17. Live air is supplied to the distributing valve through a central bore 30 in the feed piston 10. Valve chest 17 has an exhaust port 31 leading to atmosphere and the valve 20 has an annular groove 32 adapted to connect the exhaust port alternately with the valve chest grooves 24 and 25.

Assuming that the feed piston bore 30 is supplied continuously with live air and that the parts of the fluid pressure motor are in the posi-

tion illustrated in Fig. 4, live air flows through the central bore 21 of the valve 20, through radial holes 23, annular groove 25 and passage 26 to the front end of the piston chamber 11a to effect the rearward or return stroke of the piston 12. During this return stroke, the air is exhausted from the rear end of the piston chamber through passage 27, grooves 24 and 32, and exhaust port 31. The distributing valve 20 is held in its rear position, as shown, by live air flowing from supply bore 30 through cylinder passage 34, around the neck 35 of piston 12, through port 36 and passage 37 which terminates at the forward extremity of the counterbore 17b in the valve chest 17 to cause the pressure to act against the front end of the distributing valve. The valve 20 is held in this rearward position until after port 36 is cut off by the larger diameter portion of the piston and, at about the same time the port 38, also connected to passage 37, is uncovered by the piston to continue the supply of live air through passage 37 until the small diameter of the piston is withdrawn from the small diameter bore 40 in the cylinder. At this point, the front end of the piston chamber 11a is vented through bore 40 and cylinder exhaust port 41, the pressure holding the distributing valve in its rearward position is relieved, and the valve trips forward owing to the constant pressure applied to the rearwardly facing portions of the valve.

After the valve has been shifted forward, live air flows into passage 27 from two sources—the registering radial bores 22 and annular groove 24, as well as the annular groove 29 in the valve chest 17 which is now uncovered by the small diameter portion of the valve. Since passage 27 leads direct to the rear end of the piston chamber 11a, the piston 12 is driven forward on its power stroke. The exhaust from ahead of the piston escapes through cylinder bore 40 and exhaust port 41. The piston then delivers a blow to the working implement 13. If the working implement is not in place, the forward blow of the piston is cushioned by air trapped in the forward end of the piston chamber. As the piston, during its forward movement, uncovers the port 36, the neck portion 35 of the piston establishes a connection between the source of live air and the front extremity of the distributing valve 20, by way of passages 34, 35, 36 and 37. The front area of the valve is only partly balanced by live air acting in the opposite direction, since the rearwardly exposed shoulder on the valve is vented through a port 43. The valve then trips back to the position shown in Fig. 4 to complete a cycle of operation.

From the above description it will be apparent that whenever the feed piston bore 30 is supplied with pressure fluid, the hammer piston will reciprocate under the control of the distributing valve apparatus, which may be of the form shown and described, or of any other suitable type familiar to those skilled in the art of pneumatic tools. The present invention provides an automatic means for admitting air to the bore 30 at the time that the working implement 13 is held in operative relation with the striking block B or other object receiving the impacts.

The feed piston 10, motor cylinder 11 and working implement 13 are movable axially as a unit relative to the stationary casing 7 with which the cylinder 11 has a sliding fit. A compression spring 45 surrounds the cylinder 11. The spring engages the casing 7 at its front end and a flanged portion of the feed piston at its rear end, whereby to tend to hold the pneumatic tool assembly in its rearmost position.

Movement of the feed piston 10 against spring pressure is effected by pressure fluid admitted to the interior of the feed cylinder through a threaded opening 46 to which may be attached a suitable air hose (not shown). The pressure fluid in the feed cylinder acts against the rear end of the feed piston 10 to oppose the spring pressure. A feature of the invention is an automatic control or throttle valve 48 slidably mounted in a bore 49 in the feed piston. The bore is adapted to communicate with an annular recess 50 which is connected by a passage 51 to the bore 30 at the front end of the feed piston. A compression spring 53 urges the control valve 48 to a position (shown in Fig. 1) in which it cuts off communication between the forward end of the bore 49 and the annular recess 50. Pin 54 limits forward movement of the valve. The spring is adapted to yield to open communication therebetween upon application of sufficient fluid pressure against the rear face of the valve.

When the machine is at rest, as illustrated in Fig. 1, the heavy coil spring 45 holds the motor cylinder assembly in its rearmost position. Likewise the control valve is held in its rearmost or closing position by the spring 53. When compressed air is admitted through connection opening 46, it acts on the rear face 56 of the air feed piston 10 and forces the motor cylinder assembly forward until movement of the implement 13 is arrested by contact with the striking block situated along the line B. During the forward movement of the feed piston 10, the control valve 48 remains closed, due to the fact that the area of the rear end of this valve is much less than the area 56 on the feed piston, and for the further reason that the expansion of the air chamber in back of the feed piston reduces the rate at which the pressure in said chamber rises. When the implement 13 makes contact with the striking block, the feed piston 10 stops moving and permits the pressure in the air feed cylinder chamber to build up very quickly to nearly line pressure. This additional pressure acting on the rear face of the valve 48 is now sufficient to overcome the tension of the coil spring 53 and force the control valve to its forward position wherein it admits live air from the bore 49 through the annular recess 50, passage 51 and bore 30 to the automatic distributing valve 20, resulting in the operation of the hammer motor in the manner hereinbefore described. Thus, the hammer piston 12 is caused to begin the delivery of a succession of impacts to the working implement 13 automatically upon completion of the movement of the implement into operative relation with the striking block B.

When the supply of compressed air through the feed cylinder opening 46 is cut off, the pressure is immediately reduced in the air feed cylinder chamber, which allows the spring 53 to shift the control valve 48 to its rear position and cut off the supply of air to the hammer piston 12 before the large coil spring 45 can return the motor cylinder 11 and feed piston 10 against the gradual reducing pressure of the air which is trapped in the air feed cylinder 9. The rear face of the control valve 48 is vented to atmosphere continuously through ports 57 and 58.

The force of the spring 53 should be much less than the opposing force of line pressure against the rear face of the valve, but greater than the amount of opposing air pressure that develops

during the time the feed cylinder chamber is extending in order to prevent the hammer piston 12 from delivering impacts until the working implement 13 has been moved into operative position. During the operation of the pneumatic vibrator, the control valve remains open continuously as long as air under line pressure is supplied through opening 46. During the last part of the cycle, the operation of the hammer piston is stopped before contact is broken between the implement 13 and striking block B.

When the invention is employed in the practice of the Cottrell smelting process, the machine is mounted for cooperation with a striking block that is connected to a screen or electrode. The latter is vibrated from time to time in order to release the metal particles that have collected and this can be accomplished by supplying compressed air through the opening 46 in the feed cylinder for the desired period of time. Upon admission of air to the feed cylinder, the machine automatically moves into operative position relative to the striking block and vibrates the latter by delivering impacts to the working implement 13 only during such time as the implement is held in engagement with the block at the proper pressure. The invention prevents damage to the elements receiving the vibrations and moreover obviates the necessity of separate controls for the feed cylinder and hammer motor. If desired, a plurality of vibrators may be operated simultaneously from a single control valve.

The invention is not limited to pneumatic tools for vibrating, but has varied applications, for example, as a jam riveter, constructed and arranged to deliver impacts to the rivet set after the latter has been moved into operative relation to the rivet. Moreover, the distributing valve is not indispensable as the principle of the invention could be applied to a pneumatic motor of the valveless or semi-valveless type.

What is claimed is:

1. In a percussive vibrating tool, the combination of a motor cylinder providing a piston chamber, a hammer piston reciprocable therein, a working implement supported in said cylinder to receive the impacts of said piston and adapted to transmit the impacts to the object to be vibrated, a feed device for said tool interposed between the motor cylinder and a fixed support, said feed device comprising piston and cylinder elements, one of said elements being connected to said motor cylinder and the other being secured to said fixed support, means for admitting pressure fluid to the interior of the feed cylinder to extend said motor cylinder and bring said working implement into engagement with said object, a spring adapted to be overpowered by said pressure fluid for tending to collapse the feed device, a passageway leading to the pneumatic tool for supplying pressure fluid for operating the pneumatic motor, a throttle valve supported within the feed piston of said feed device and movable coaxially of said piston for controlling said passageway, and means operative upon a reduction in pressure in the feed cylinder for closing said throttle valve prior to movement of the feed device toward collapsed position and while said working implement is still in engagement with said object, said means including a spring mounted within the feed piston of said feed device.

2. In a percussive vibrating tool, the combination of a cylinder having a longitudinal passage therein, a working implement supported by said cylinder and positioned at the forward end of said passage adjacent the object to be vibrated, a hammer piston movable within said passage to deliver blows of percussion to said working implement, a fixed support for said cylinder including a cylindrical portion enclosing the rear end of said cylinder, means for introducing pressure fluid into the cylindrical portion of said fixed support to move said cylinder in a forward direction relatively to said fixed support and bring said working implement into engagement with the object to be vibrated, a yielding means resisting relative movement of said cylinder and acting to return said cylinder to normal when the supply of pressure fluid is cut off, a bore in the rear end of said cylinder communicating with the longitudinal passage therein for introducing pressure fluid into said passage to effect operation of said hammer piston, means for controlling the flow of pressure fluid to said longitudinal passage including a throttle valve positioned in said bore and movable coaxially of said cylinder to opened and closed positions with respect to said longitudinal passage in response to pressure variations in the cylindrical portion of said fixed support, a yielding means urging said throttle valve to closed position, and a limit stop positioned within said bore for limiting the movement of said valve by said yielding means.

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