July 15, 1952 V. C. STERRETT 2,603,191

PERCUSSION CYLINDER

Filed Nov. 29, 1946 2 SHEETS—SHEET 1

Fig. 1.

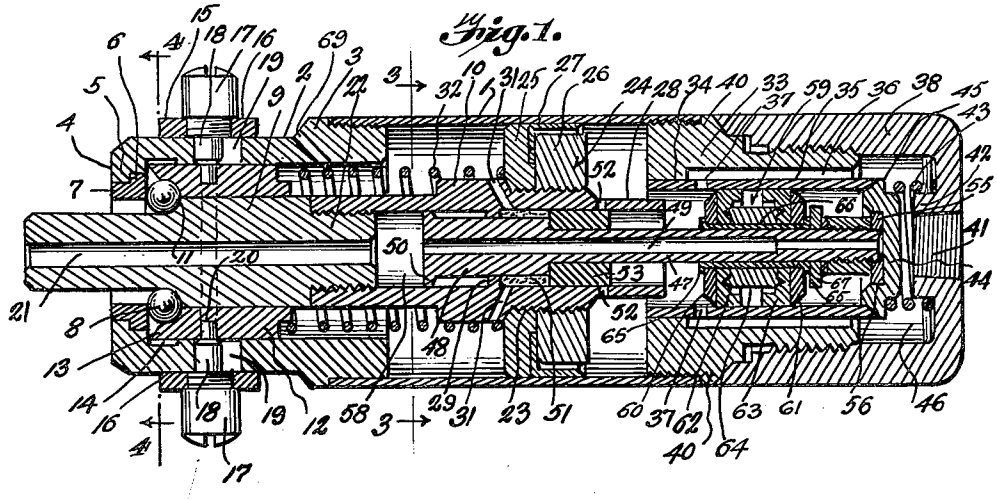


Fig. 2.

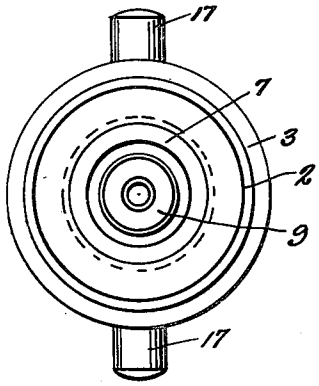


Fig. 3.

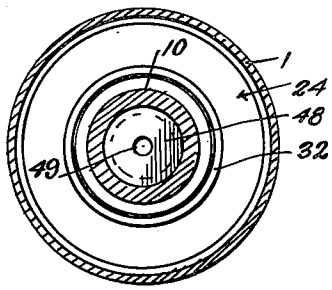


Fig. 10.

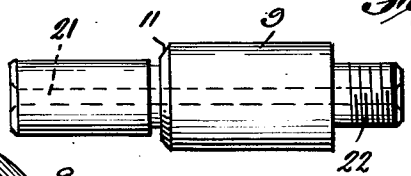
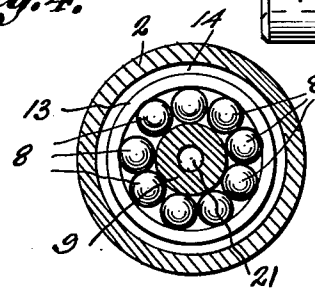


Fig. 4.



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Fig. 5.

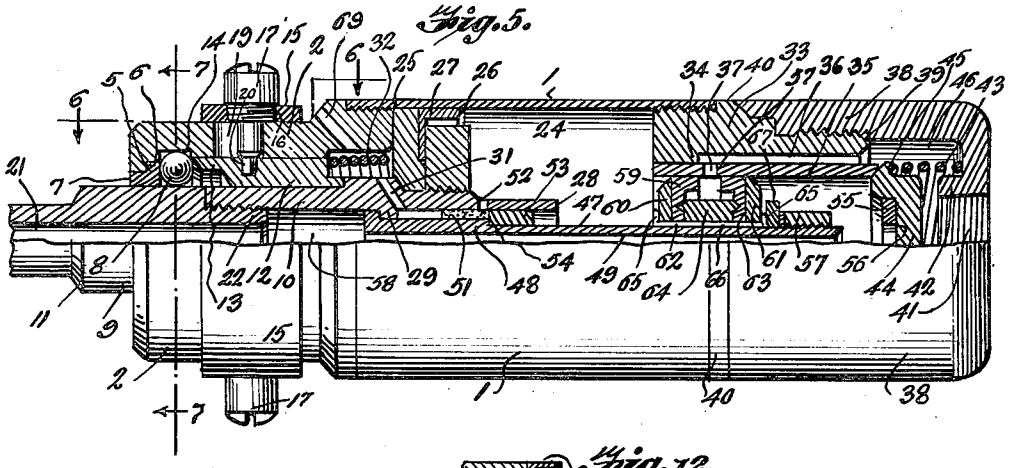


Fig. 6.

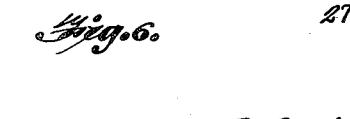
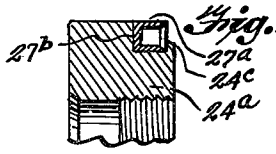


Fig. 12.



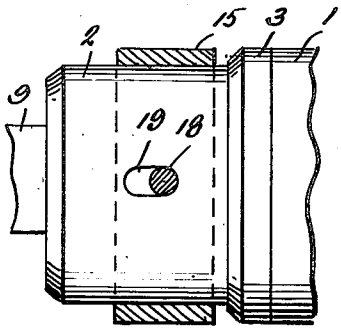


Fig. 7.

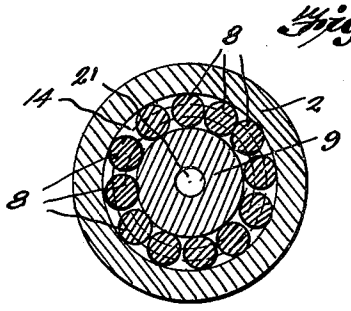


Fig. 8.

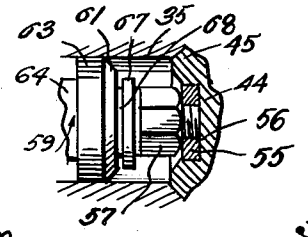


Fig. 9.

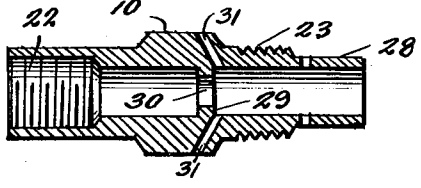
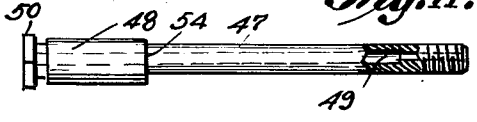


Fig. 11.



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UNITED STATES PATENT OFFICE

2,603,191

PERCUSSION CYLINDER

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Application November 29, 1946, Serial No. 713,163

4 Claims. (Cl. 121—30)

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This invention relates to a percussion cylinder and it is one object of the invention to provide such a cylinder with locking mechanism which confines a quantity of compressed air back of a piston assembly and which, by manual control or otherwise, is releasable at the will of the operator, and allows sudden freedom of a sufficient quantity of compressed air to act upon the piston assembly and cause the same to be shifted outwardly or forwardly at high speed away from the compressed air chamber.

Another object of the invention is to provide a percussion cylinder wherein a piston rod is rigidly attached to the piston assembly and moved with the piston assembly and thus given the same sudden impulse of velocity as the piston assembly during operation of the device, the entire mass thus taking on dynamic energy in accordance with the physical law of mass times velocity.

Another object of the invention is to provide a percussion cylinder wherein the piston rod projects outwardly from the front end of the cylinder for delivering a powerful blow upon an object, the piston rod being also adapted to have a tool applied thereto and project from the front end of the piston rod in position for use. Therefore the device will be very useful as a tool for piercing or punching holes in metal, upsetting rivets or metal rods, driving nails, tacks or brads, where products are manufactured in quantity production or as a pneumatic hammer carrying a drill for cutting concrete or similar work.

Another object of the invention is to provide a tool of this character wherein retracting mechanism is of such construction that the whole moving mechanism retracts automatically to a reset position after each forward movement and may be immediately driven forwardly for another striking movement.

Another object of the invention is to provide a percussion cylinder having ports and vents and valves so arranged that when the device is in use the piston will be automatically reciprocated at a rapid rate of speed.

The invention is illustrated in the accompanying drawings wherein:

Fig. 1 is a sectional view taken longitudinally through a percussion cylinder of the improved construction showing the piston rod in its retracted position.

Fig. 2 is a view looking at the front end of the percussion cylinder.

Fig. 3 is a transverse sectional view taken along the line 3—3 of Figure 1.

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Fig. 4 is a sectional view taken along the line 4—4 of Figure 1.

Fig. 5 is a view partially in elevation and partially in longitudinal section showing the piston rod in its extended position.

Fig. 6 is a fragmentary view taken along the line 6—6 of Figure 5.

Fig. 7 is a sectional view taken along the line 7—7 of Figure 5.

Fig. 8 is a fragmentary view showing the rear end of a valve rod in elevation and adjoining portions in section.

Fig. 9 is a view showing the piston rod in longitudinal section.

Fig. 10 is a side elevation of the piston rod head.

Fig. 11 is a view showing the valve-shift rod in elevation, a portion being in section.

Fig. 12 is a fragmentary sectional view of a modified form of piston.

This percussion cylinder has a cylindrical casing 1 formed of strong metal and having its front end portion internally threaded and screwed into engagement with the rear end portion of a housing head 2 which is formed with a circumferentially extending shoulder 3 against which the casing abuts. The housing head 2 projects forwardly from the casing and at its front end is formed with an opening having its rear portion enlarged to form an annular seat 5 to receive the outstanding flange or shoulder 6 of a ring 7 which fits snugly in the opening and constitutes an annular abutment for engagement by the balls 8. These balls surround the elongated piston rod head 9 of a piston rod 10 which has its forward portion of reduced diameter in order to form a bevelled shoulder 11. A sleeve 12 fits snugly about the piston rod 10 and at its front end is counterbored to form a forwardly projecting annular flange 13 of such internal diameter that when the piston rod and its head are in the retracted position shown in Figure 1 the lip will fit about the balls and hold them snugly about the reduced forward portion of the piston rod head 9 where they will be engaged by the sloping shoulder 11 and prevent outward movement of the piston rod 10 and its head to an extended position. When the sleeve 12 is shifted rearwardly to the position shown in Figure 5 the balls may be moved radially away from the piston rod head 9 by cam action of the shoulder 11 into the annular groove 14 formed in the housing head 2 and the piston rod head 9 may then move forwardly to the extended position shown in Figure 5. A collar 15 fits about the housing head 2 and

is formed with threaded openings 16 to receive threaded studs 17 which have stems 18 that project inwardly through slots 19 formed in the housing head 2 and fit into an annular groove 20, formed about the sleeve 12. When the sleeve is shifted rearwardly by pressure applied to the studs 17 the balls will be freed from the flange 13 and the piston rod head 9 and the piston may have reciprocating movement longitudinally in the casing and the head 2. A bore 21 extends longitudinally through the piston rod head 9 axially thereof for its entire length and constitutes a passage through which air may escape to the atmosphere.

The piston rod 10 has its forward portion of externally reduced diameter and internally threaded so that it may be screwed into engagement with the threaded shank or rear portion 22 of the piston rod head 9, and the rear portion of the piston rod 10 is of reduced diameter and threaded to form a shank 23 about which is mounted a piston 24 formed of discs or blocks 25 and 26 between which a cup 27 formed of leather, composition or other suitable material is clamped when the discs or blocks are screwed tightly upon the shank of the piston rod. Instead of forming the piston as set forth above it may be formed as shown in Figure 12. This piston 24a is of an annular one-piece formation and about its rear portion is formed a circumferentially extending seat 24b to receive the cup 27a which is channel-shaped in cross section and held in place by the bead 24c. The extreme rear portion of the piston rod 10 is of additionally reduced diameter and forms a sleeve 28 which projects rearwardly from the shank 23 of the piston rod. An annular flange 29 defining a reduced opening 30, as shown in Figure 9, is formed within the piston rod and rearwardly of this flange the piston rod is formed with radially extending ports 31 formed at a forward incline so that they communicate with the portion of the casing forwardly of the piston when the piston is in the position shown in Figure 1 and communicate with the interval cavity of the housing head when the piston is in the position shown in Figure 5. A helical spring 32 fits about the piston rod with one end abutting the sleeve 12 and its other end bearing against the piston and urging the piston and the piston rod 10 and piston rod head 9 rearwardly in opposition to action of air in the casing rearwardly of the piston. When the piston is shifted forwardly by air pressure the spring is pressed forwardly into the rear portion of the housing head 2, as shown in Figure 5, and upon release of air pressure back of the piston the spring shifts the piston rearwardly and moves the piston rod and its head toward the retracted position of Figure 1.

The rear end portion of the casing is internally threaded to receive a hollow rear head 33 which has its forward portion internally thickened, as shown at 34 so that the sleeve 35 which extends longitudinally through the rear head 33 will be spaced from the walls of the head for the major portion of its length and thus provide a passage 36 from which lead ports 37. A cap 38 is screwed upon the threaded rear portion of shank 39 of the rear head 33 and has its internally bevelled front end tightly engaging the bevelled rear surface of the annular flange 40 formed about the rear head 33, and integral therewith and engaged by the rear end of the casing 1. A threaded opening 41 surrounded at its inner end by a collar 42 is formed through the center of the cap 38 so that a pipe or hose leading from a supply of air under pressure may be connected with the implement and about this collar 42 engages the rear end of a helical spring 43 which has its front end portion engaged about a cap 44 so that the cap will be urged forwardly and the bevelled front face of its flange 45 forced into the rear end of the sleeve 35 where it has wedging fit and forms a tight closure for the rear end of the sleeve. Air entering the chamber 46 defined by the cap 38 flows forwardly through the passage 36 and through the ports 37 and the forward portion of the sleeve 35 into the cylinder of the casing 1 rearwardly of the piston and acts upon the piston to force the piston forwardly and move the piston rod 10 and its head 9 forwardly to the extended position of Figure 5 when the sleeve 12 is shifted rearwardly and the balls allowed to move radially of the piston rod head 9 to the releasing position.

A valve-shift rod 47 which has an externally thickened forward portion 48 extends longitudinally through the piston rod 10 and the sleeve 35 in axial relation thereto and through the rod 47 is formed a longitudinally extending bore or passage 49. A flange 50 surrounds the front end of the shift rod so that the enlarged forward portion thereof will be spaced from walls of the piston rod and provide a passage 51 which communicates with the rear portion of the casing by way of ports 52 formed through the sleeve 28. When the piston rod and its head are in the retracted position shown in Figure 1 the ports 52 are blocked or closed by a sleeve valve 53 which fits slidably about the shift rod and engages the shoulder 54 shown in Figure 11 at the rear end of the forward portion 48 of the shift rod 47. When the collar 15 is shifted rearwardly and the piston rod head allowed to move forwardly the flange 29 engages the flange 50 and the rod is shifted forwardly but during forward movement of the piston rod relative to the shift rod the ports 52 move to a position forwardly of the valve sleeve, as shown in Figure 5, and air may then flow through the ports 52 and the passage 51 and from passage 51 through the ports 31 into the portion of the casing in front of the piston. A gasket 55 fits into a pocket-like recess 56 formed in the front face of the cap 44 and when the shift rod 47 is moved rearwardly to the position shown in Figure 1 a nut 57 screwed upon the threaded rear end of the shift rod engages the gasket and forms a seal about the rear end of the shift rod, and as the rear end of the passage 49 is now sealed instead of being unobstructed as shown in Figure 5 the gasket prevents flow of air through the passage 49 of the shift rod into the chamber 58 of the piston rod from which air flows through the passage 21 of the piston rod head. A valve 59 of piston-like formation is carried by the shift rod 47 for controlling flow of air through the port 37 and has end members or disks 60 and 61 engaged by cups 62 and 63 which are clamped against ends of a sleeve or spacer 64 by the outwardly flared ends 65 of a tubular core 66 which passes through the valve elements of the valve and hold them in close fitting compact engagement with each other. Referring to Figure 8 it will be seen that a shock-absorbing washer 67 and steel thrust washers 68 fit about the shift rod 47 between the spool valve 59 and the nut 57 and prevent damage by blows delivered during operation of the device.

When this pneumatic tool or percussion cylinder is in use a hose is screwed into the inlet 41 and air under pressure enters the cap 38 and fills the chamber 46 and since the valve 59 is in the position shown in Figure 1 the air will flow through the passage 36 and the ports 37 into the forward portion of the sleeve 35 and fill the rear portion of the casing 1 about the sleeve 28 so that the piston 24 will be subjected to air pressure. The air pressure is such that when the collar 15 is shifted rearwardly and the sleeve 12 shifted rearwardly the piston rod 10 will be moved forwardly and cause the piston rod head 9 to be moved forwardly to the extended position of Figure 5. As the piston rod moves forwardly the ports 52 move to a position in front of the sleeve 53 so that air in the rear portion of the casing may flow through the ports 52 and the passage 51 and through the ports 31 into the forward portion of the casing and the flange 29 then engages the flange 50 and causes the shift rod 47 to be carried forwardly with the piston rod and move the valve 59 forwardly into blocking relation to the ports 37. The spring 32 is compressed during forward movement of the piston rod and when the ports 37 are blocked the spring will expand and shift the piston rod rearwardly and spent air in the rear portion of the casing will flow into the front portion of the casing and out through the exhaust port 69 to the atmosphere. During rearward movement of the piston rod the shift rod 47 at first remains stationary but when the rear end of the piston rod engages the valve 59 this valve and the shift rod will be carried rearwardly until the valve is out of blocking relation to the ports 37 and air under pressure may again enter the rear portion of the casing and act upon the piston and shift the piston rod forwardly while the shift rod remains in the position shown in Figure 1 with its rear end abutting the cap 44. The parts will then again be in the position shown in Figure 1 and air under pressure will again act upon the piston and move the piston rod and its head forwardly to the extended position. This reciprocating movement of the piston rod and its head will continue at a rapid rate of speed as long as the collar 15 is in the rearwardly moved position, but when the collar 15 is returned to the position shown in Figure 1 operation of the tool will cease as the balls 8 will then prevent forward movement of the piston rod and its head. Air in the rear portion of the sleeve 35 may flow freely through the passage 49, chamber 58, and the passage 21 and discharge into the atmosphere as long as the rear end of the thrust rod 47 is out of engagement with the cap 44. Therefore formation of an air cushion in the rear portion of the sleeve will be prevented and rearward movement of the thrust rod 47 and the spool valve 59 will not be interfered with. The fact that the rear end of the sleeve 35 is closed by a spring-pressed cap permits the elements to be easily assembled and also assures a right closure of the rear end of the passage 49 when the thrust rod is in the position shown in Figure 1.

Having thus described the invention, what is claimed is:

1. A pneumatic tool comprising a cylindrical casing, heads at front and rear ends of said casing, a sleeve in the front head having its bore disposed axially of the casing and the heads, a cap carried by the rear head and defining an air chamber having an inlet at its outer end for air under pressure, a piston rod shiftable longitudinally in the casing and the sleeve and having its forward portion projecting outwardly from the front head, means releasably holding the piston rod in a retracted position, a piston about the piston rod, a spring about the piston rod between the sleeve and the piston urging the piston rod and the piston rearwardly, said piston rod having a longitudinal bore and being formed with side ports communicating with the casing in front of the piston and with other ports communicating with the casing back of the piston, the front head having an outlet port, a sleeve in the rear head having its walls spaced therefrom for a portion of its length and together therewith forming an air passage leading forwardly from the air chamber in the cap, there being ports formed through the sleeve and connecting with the front end of the air passage, a tubular shift rod extending longitudinally through said sleeve in the rear head and into the rear portion of the piston rod and having a lost motion connection with the piston rod, a valve carried by the shift rod and moved out of blocking relation to the ports of the piston rod back to the piston when the piston rod is shifted forwardly independent of the shift rod, a valve carried by the shift rod within the sleeve and moved therewith into blocking relation to the ports of the sleeve when the shift rod is moved forwardly, and a closure for the rear end of the sleeve having closing engagement with the rear end of the shift rod when the shift rod is in a rearwardly moved position.

2. A pneumatic tool comprising a cylindrical casing having front and rear heads, an air chamber back of the rear head having an air inlet, a member in the front head having a bore extending longitudinally of the casing, a tubular piston rod shiftable longitudinally in the casing and through the bore of the member in the front head, means for releasably securing the piston rod retracted, a piston carried by said piston rod and disposed in the casing between the front and rear heads, the piston rod being formed with a longitudinal bore and with side ports in front of and in back of the piston, a spring urging the piston and the piston rod rearwardly, a sleeve in the rear head having its ends communicating with the air chamber and the rear end of said casing, there being space about the sleeve forming an annular air passage leading from said air chamber about the sleeve and communicating with the side ports formed through the front end portion of said sleeve, the front head being formed with an air exhaust port, a shift rod extending longitudinally through the sleeve and into the rear portion of the bore of the piston rod and carrying a front valve normally in blocking relation to the ports of the piston rod back of the piston and a rear valve normally out of blocking relation to the ports in the front end portion of the sleeve, the piston rod having a lost motion connection with the shift rod and when shifted forwardly first moving its ports out of blocking relation to the front valve of the shift rod and then having engagement with the shift rod to carry the shift rod forwardly with the piston rod and move the rear valve of the shift rod into blocking relation to ports of the sleeve.

3. A pneumatic tool comprising a cylindrical casing having front and rear heads and an air chamber back of the rear head having an air inlet, a member in the front head formed with a bore extending longitudinally of the casing, a

tubular piston rod shiftable longitudinally in the casing and through the bore of the member in the front head from a retracted position to an extended position, a piston carried by said piston rod, a sleeve in the rear head surrounded by an annular air passage extending forwardly from the chamber, said sleeve having its front end connecting with the portion of the casing back of the piston and near its front end being formed with side ports connecting with the annular air passage, the front head being formed with an exhaust port and the piston rod being formed with side ports located in front of and back of the piston and allowing flow of air forwardly through the tubular piston rod past the piston during rearward movement of the piston, a shift rod movable longitudinally through the sleeve and the tubular piston rod and carrying front and rear valves for controlling flow of air through the side ports of the sleeve and the rear ports of the piston rod, and a lost motion connection between the piston rod and the shift rod whereby the piston rod may have longitudinal movement relative to the shift rod for a portion of its movement and effect movement of its rear ports into and out of blocking relation to the front valve of the shift rod and then carry the shift rod longitudinally with it and move the rear valve of the shift rod out of blocking relation to the side ports of the sleeve in the rear head.

4. A pneumatic tool comprising a cylindrical casing, an air chamber at the rear end of said casing having an air inlet, a head at the front end of said casing formed with an exhaust port

and provided with a bore, the rear head having an air inlet port, a tubular piston rod shiftable longitudinally through the casing and the bore of the head from a retracted position to an extended position, a piston carried by said piston rod within the casing and moving with the piston rod longitudinally in the casing, a spring urging the piston and the piston rod rearwardly, there being an air passage extending forwardly from the air chamber and communicating with the casing back of the piston, the tubular piston rod being formed with side ports in front of and back of the piston and establishing communication through the piston rod between portions of the casing back of and in front of the piston, a shift rod slidable longitudinally by action of the piston rod, and valves for controlling flow of air through the rear ports in the piston rod and through the air passage carried by the shift rod and moved to adjusted positions by movement of the piston rod when the actuating rod is moved longitudinally during movement of the piston rod.

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