

[72]	Inventor	Lange, Wilfried 1 Brockhold, 3101 Altenhagen, Germany
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Primary Examiner—Paul E. Maslousky
Attorney—Hibben, Noyes & Bicknell

[54] **PNEUMATIC PERCUSSION DEVICE**
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F15b 15/17

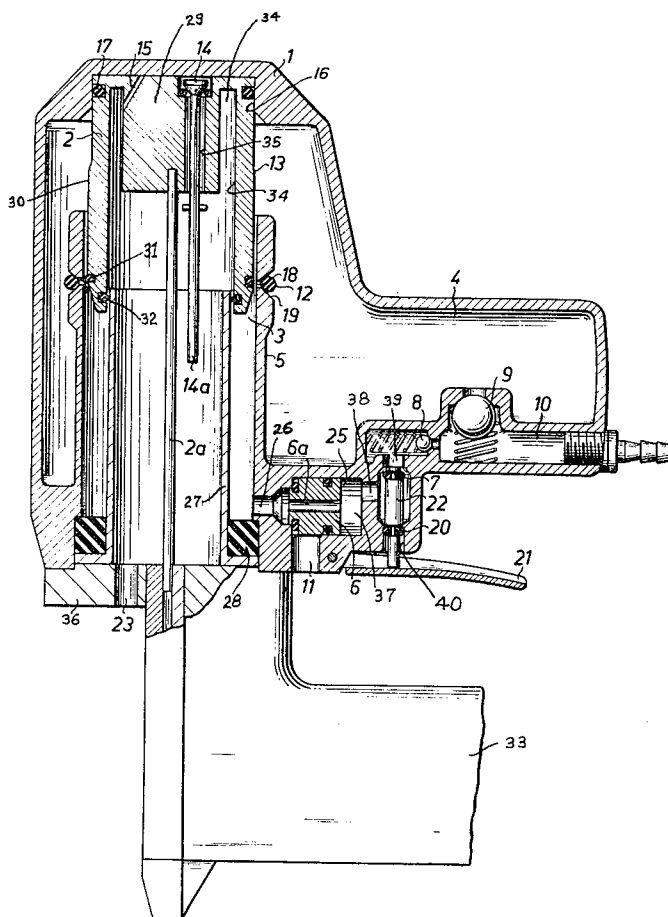
[50] **Field of Search**..... F15615/17
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224, 404, 461, 417 R, 417 A; 92/108

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ABSTRACT: In a pneumatically operated percussion device, a working cylinder with a differential-type piston reciprocable therein is in constant communication with a compressed-air reservoir to cause the driving stroke. The piston is cup-shaped with an open lower end and has a cylindrical sleeve for engaging an annular chamber in the working cylinder. The bottom wall of the cylinder has an outlet for venting air from the cylinder to the atmosphere during the driving stroke. In the initial position of the piston, the annular chamber communicates with an air supply line, and during the driving stroke of the piston the annular chamber is vented. At the completion of the driving stroke a venting valve in the piston is opened, and air from the supply line is admitted to the annular chamber to return the piston to its initial position.



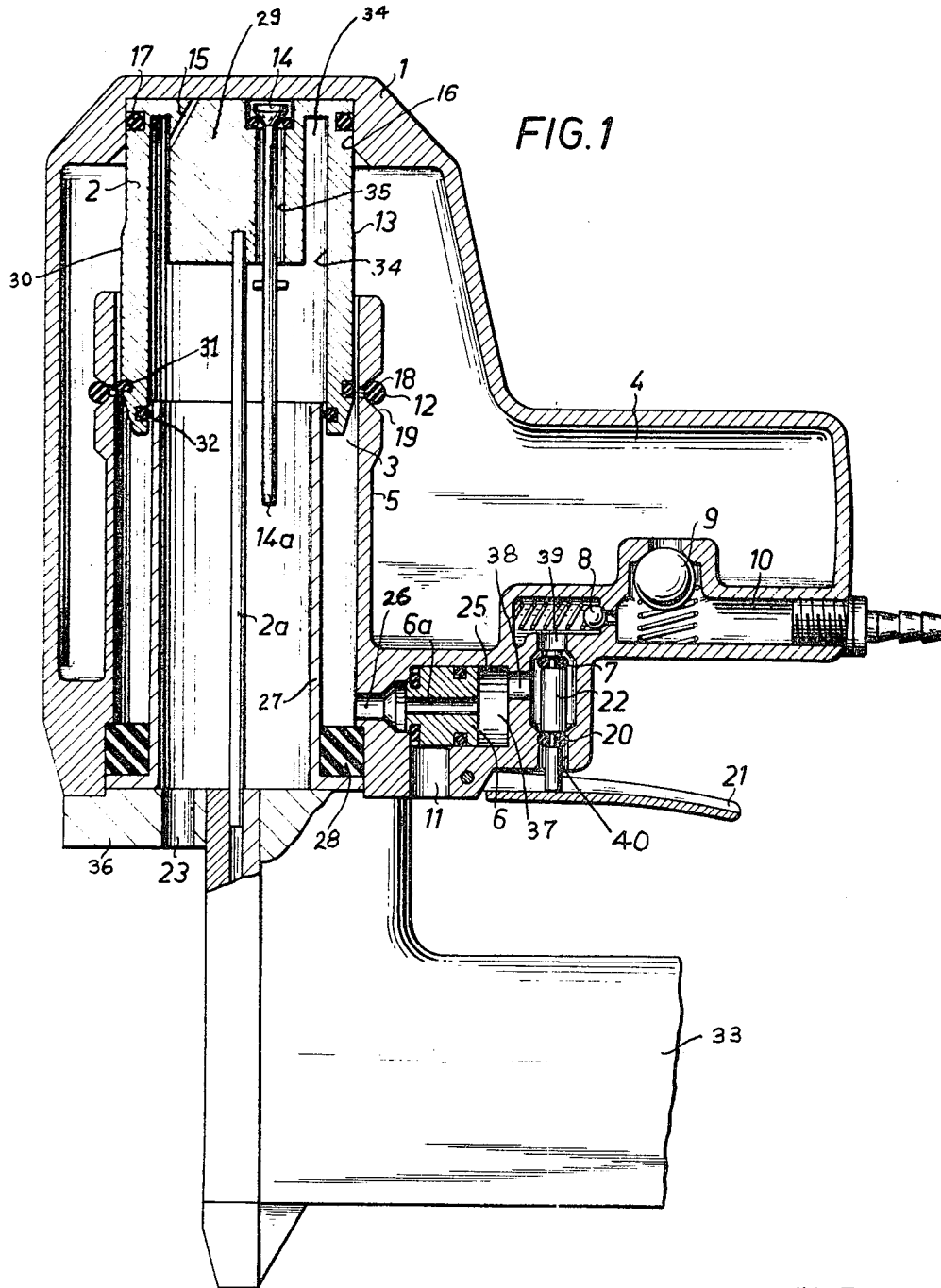
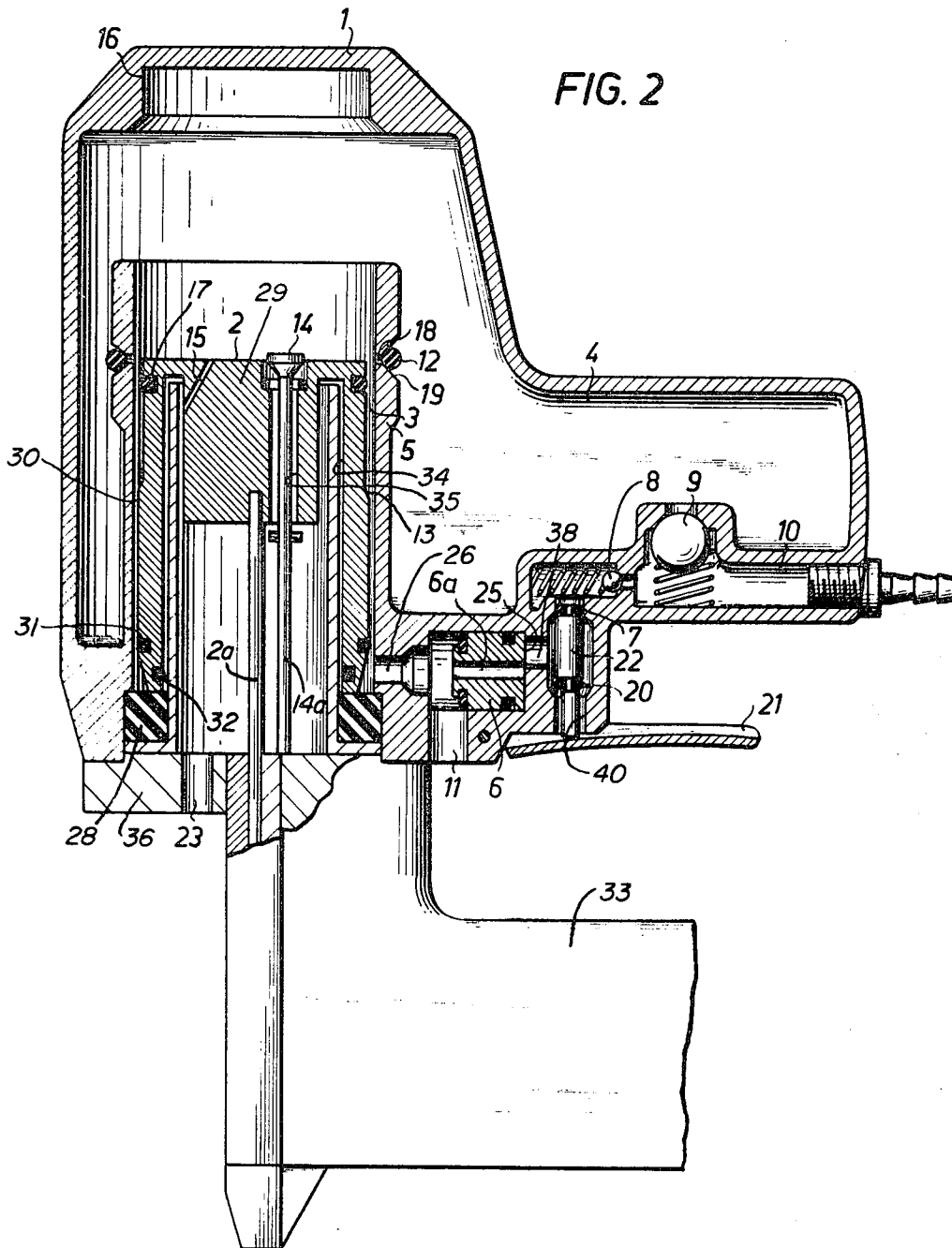


FIG. 1

INVENTOR

WILFRIED LANGE

by *Hibben, Hayes & Bicknell*
ATTORNEYS



INVENTOR

WILFRIED LANGE

by *Hibben, Noyes & Bicknell*
ATTORNEYS

PNEUMATIC PERCUSSION DEVICE

DESCRIPTION

The present invention relates to a pneumatically operated percussion device especially to a portable stapling device for driving fastening means such as staples and the like into a workpiece by means of a driver which is actuated by a piston operated by compressed air. The piston is returned to its initial position by pneumatic operation after completion of its driving stroke.

It is known in the art to store the air which is necessary for returning the piston in an air chamber surrounding the working cylinder. This chamber receives the air displaced by the piston during its driving stroke and additional compressed air from an air reservoir. During the driving stroke of the piston the interior of the working cylinder beneath the piston must be vented to the atmosphere to avoid counterpressure in the cylinder during the driving stroke. By such venting of the cylinder a large loss of compressed air is provoked whereby the efficiency of the percussion device is considerably reduced. The air storage chamber and the usual air inlet valve of the working cylinder are expensive. Further, they increase the weight of the device and make its manipulation difficult.

It is an important object of the present invention to provide a pneumatically operated percussion device in which the consumption of compressed air is reduced in comparison to the prior art devices.

Another object of the invention is the provision of a pneumatic stapler of smaller dimensions and of lower weight, than hitherto.

A further object is to provide a pneumatic fastener device which eliminates the intake valve for the admission of compressed air to the working cylinder.

These and other objects and features will become apparent from the following description in connection with the accompanying drawings in which by way of an example a portable pneumatic fastener implement is represented as a preferred embodiment of the invention. In the drawings:

FIG. 1 is a cross-sectional view of the fastener tool embodying this invention with the parts in their initial position; and

FIG. 2 is the same sectional view with parts in position after completion of a driving stroke.

The device of the present invention is characterized by the open communication of the upper terminal portion of the working cylinder with a compressed-air reservoir without the use of an intake valve and by the provision of means for admitting compressed air from an air supply line to said compressed-air reservoir.

Preferably the piston is of the differential or stepped type and cup shaped, the upper portion of which has a smaller diameter and defines an annular shoulder and the lower portion of which comprises a cylindrical sleeve slidable in and guided in an annular chamber. Said chamber is enclosed by the working cylinder and the latter is surrounded by the compressed-air reservoir. The compressed-air reservoir communicates via the annular chamber and valve means with a compressed-air supply line a venting valve in the piston can connect the reservoir with the atmosphere.

Referring now to the drawings, the portable pneumatic stapler embodying the invention comprises a body casing 1 with a working cylinder 5 within which a piston 2 is slidably mounted. The piston 2 is cup shaped and of the differential type with an upper portion 29 of smaller diameter than the working cylinder 5. The lower portion 30 of piston 2 comprises a sleeve which is sealed against the interior of the sidewall of the working cylinder 5 by means of a resilient packing ring 31. The piston portions 29 and 30 define an annular shoulder 13. A handle section of the body casing 1 encloses a compressed-air reservoir 4, which is in permanently open connection with the upper end portion of the working cylinder 5, as is best shown in FIG. 2 of the drawings. A tube wall 27 is inserted in the working cylinder 5 and defines with its sidewall an annular chamber 3. The sleeve-like lower piston

portion 30 slides in this annular chamber 3 and by means of a packing ring 32 is sealed against the external surface of the tube wall 27. A driver 2a is secured to the upper piston portion 29 and serves to drive staples from a magazine 33 into a workpiece when the piston 2 performs its working stroke, as is conventional.

In the initial position of the piston 2, as is shown in FIG. 1, its upper portion 29 engages a cylindrical recess 16 of the cover of the body casing 1 and is sealed off by a packing ring 17 slidable on the cylindrical face of the recess 16. The upper piston portion 29 has an annular clearance 34 into which during the working stroke of the piston 2 the tube wall 27 fits. A narrow bore or passage 15 of the upper piston portion 29 connects the clearance 34 with the upper face of piston 2. The upper piston portion 29 further comprises an axial bore 35 which is closed off at its upper end by a vent valve 14 secured to the upper end of a valve rod 14a. This valve rod is longer than the axial length of the whole piston 2 whereby in its lower terminal position as shown in FIG. 2 the vent valve 14 is opened. When piston 2 performs its working or return stroke or is in its initial position as shown in FIG. 1 the vent valve 14 is closed.

The bottom wall 36 of the working cylinder 5 is provided with an outlet opening 23 for venting the air from the working cylinder 5 displaced by the piston 2 during its working stroke to the atmosphere. This bottom wall 36 carries the flange-shaped lower end of the tube wall 27 and a resilient bumper 28 for limiting the downward travel of piston 2. Adjacent the bumper 28 a port 26 is arranged which communicates with a differential piston valve 6 provided with an axial passage 6a and slidably mounted in a valve housing 37. Said valve housing 37 is provided with an outlet opening 11 and communicates via a port 38 with a control valve 7 which comprises a valve stem 22 movable by a trigger lever 21. Valve stem 22 carries at its lower portion a vent valve 20 which communicates via a clearance 40 of the lower end portion of valve stem 22 with the atmosphere. The control valve 7 via a port 39 and a spring-loaded ball valve 8 communicates with an air admission chamber or passage 10. A spring-loaded ball valve 9 connects the air admission passage 10 with the air reservoir 4 which via ports 18 in the sidewall of the working cylinder 5 communicates with the annular chamber 3. Said ports 18 are normally closed by a resilient ring 12 inserted in an annular groove 19 on the external surface of the sidewall of the working cylinder 5. Ports 18 and ring 12 constitute a one-way or nonreturn valve between the annular chamber 3 and the air reservoir 4.

The operation of the stapling device is as follows: The initial position of the driving mechanism is illustrated in FIG. 1. To drive a fastening means into a workpiece, the operator will grasp the handle of the body casing 1 and squeeze the trigger lever 21 whereby the valve stem 22 of the control valve 7 is lifted into the position shown in FIG. 2, so as to close the port 39 and open the vent valve 20. The air within the annular chamber 3 through the port 26, and the outlet opening 11 of the differential piston valve 6, is permitted to escape to the atmosphere. The air in the compressed-air reservoir 4 acts on the annular shoulder 13 of the piston 2, whereby piston 2 starts to descend. As soon as piston 2 has moved from the cylindrical recess 16, the air from the reservoir 4 acts upon the whole upper face of the piston 2 and presses it downward whereby the driver 2a separates a staple from the staple strip in magazine 33 and drives it into the workpiece. The air displaced by the piston during its driving stroke escapes from the interior of the working cylinder 5 through the outlet opening 23 to the atmosphere.

When the piston has terminated its downward stroke, it will abut the bumper 28. At the same time the rod 14a abuts the cylinder bottom wall 36 and opens the vent valve 14 of the upper piston portion 29, as is shown in FIG. 2.

As the trigger lever 21 was squeezed only for a short time to the position shown in FIG. 2 to start a working stroke and returns to its initial position as shown in FIG. 1, also the con-

trol valve 7 and its valve stem 22 move downward, whereby the air in the compressed-air admission passage 10 via the opened ball valve 8 flows through ports 39, 38, valve housing 37, passage 6a and port 26 into the annular chamber 3. The air acting on the rear face 25 of the differential piston valve 6 moves it to its terminal left-hand position as shown in FIG. 1, whereby the outlet opening 11 is closed. The air flowing into the annular chamber 3 now returns the piston 2 to its initial or retracted position, as the valve rod 14a has closed its vent valve 14. The air from the cylindrical recess 16 displaced by the piston 2 at the end of its return stroke escapes through the narrow passage 15, the clearance 34, the interior of the working cylinder and the outlet opening 23 to the atmosphere.

In the upper terminal or initial position of piston 2 the compressed air from the air admission passage 10 flows through the valve assembly 8, 7, 6, the port 26, the annular chamber 3, and the ports 18 into the reservoir 4 and replaces the air quantity which had been consumed by the preceding working stroke. As the piston during its return stroke partly compresses the air within the air reservoir 4, only a small quantity of air under pressure flows from the annular chamber 3 through the ports 18 into the reservoir 4 to produce here the primary air pressure, which only depends on the spring tension of the ball valve 9.

The present invention is of considerable advantage for pneumatic equipment of all kinds, and in particular for portable pneumatic stapling devices and on account of the limited consumption of air under pressure allows a high efficiency.

As for the device embodying this invention the hitherto customary air intake valve is not necessary, a simple structure and a low weight are attained. This advantage is of particular importance for portable devices for driving in staples, nails and other fasteners, the manipulation of which is made easier. The invention is also of importance for pliers and packing devices for stapling the lids of cardboard boxes.

What I claim is:

1. In a pneumatically operated percussion device compris-

ing a body portion containing a cylinder having a sidewall and a bottom wall at one end thereof, a cup-shaped differential-type piston in said cylinder, said body portion defining an air reservoir around said cylinder, said air reservoir being in permanent communication with the opposite end of said cylinder, a tubular member in said cylinder carried by the bottom wall and defining with said sidewall an annular air chamber, said piston having an annular clearance for receiving said tubular member, an air admission chamber, and valve means for admitting compressed air from said air admission chamber to said annular air chamber and to said air reservoir.

2. The device of claim 1 wherein said cup-shaped differential-type piston comprises a lower cylindrical sleeve, said sleeve being guided within and sealed against said annular air chamber, said sidewall of said cylinder having ports and check valve means closing said ports so that said air reservoir may be filled from said annular air chamber.

3. The device of claim 1 wherein vent valve means is arranged in said differential-type piston, said vent valve means having a valve rod which at the end of the driving stroke of said piston abuts the cylinder bottom wall, whereby said vent valve means is opened to enable a return of the piston.

4. The device of claim 1 wherein a valve assembly comprising a manually operable control valve is mounted in a passage connecting said air admission chamber with said annular air chamber.

5. The device of claim 1 wherein a spring-loaded ball valve is disposed between said air admission chamber and said air reservoir.

6. The device of claim 1 wherein a cover of said body portion comprises a cylindrical recess for receiving said cup-shaped differential-type piston when in its initial retracted position.

7. The device of claim 6, wherein said piston is provided with a bore for venting the air from said cylindrical recess which is displaced by the piston on its return stroke.

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