United States Patent

[11] **3,563,134**

[72] Inventor **Harvey B. Rodstein**
6419 Shenandoah, Los Angeles, Calif. 90034

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Continuation-in-part of application Ser. No. 766,259, Oct. 9, 1968, now abandoned.

[54] **AIR-OPERATED TOOL**
7 Claims, 9 Drawing Figs.

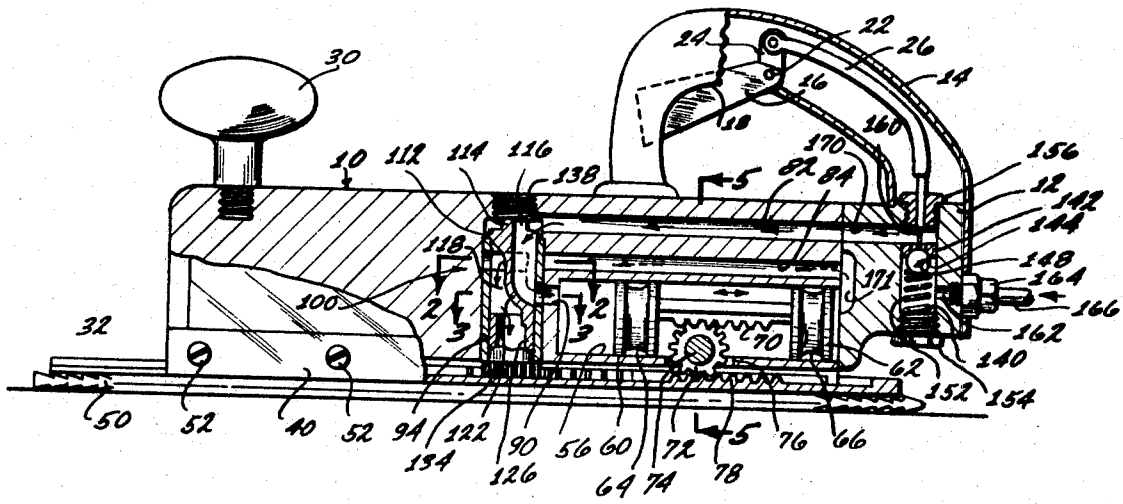
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[51] **Int. Cl.** **F01l 31/18,** F01b 9/00
[50] **Field of Search** ..... 91/351 (Cursory), 352 (Cursory), 354 (Cursory), 349; 92/136; 173/(Inquired); 51/170.3 (Cursory)

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Primary Examiner—Paul E. Maslousky
Attorney—Herzig and Walsh

ABSTRACT: The device is an air-operated tool, particularly of the type used for rubbing, sanding or filing, that is, having a reciprocatory motion. The tool embodies a single double-ended piston in a bore, with a rack positioned between the ends of the piston. A reciprocatable shoe carries a second rack and a pinion gear is mounted between the two racks on a transverse axis the piston and shoe reciprocating in opposite directions. A rotary-type valve controls the admission to, and exhaust air from, the opposite ends of the piston while reciprocation is imparted to the shoe. The mass of the piston is balanced with respect to the shoe whereby vibration of the tool during operation is reduced to a minimum.



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SHEET 1 OF 2

FIG. 1

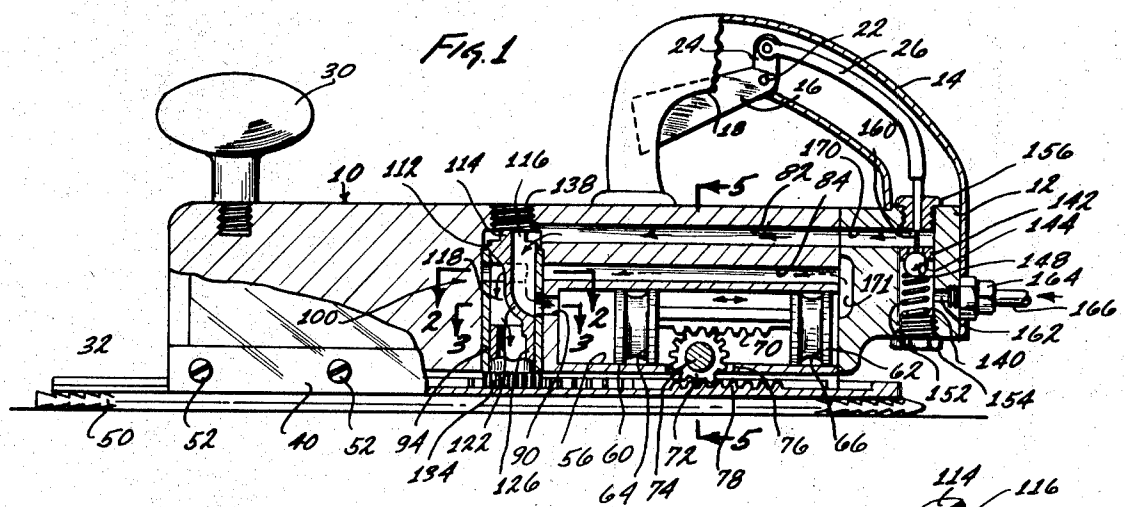


FIG. 2

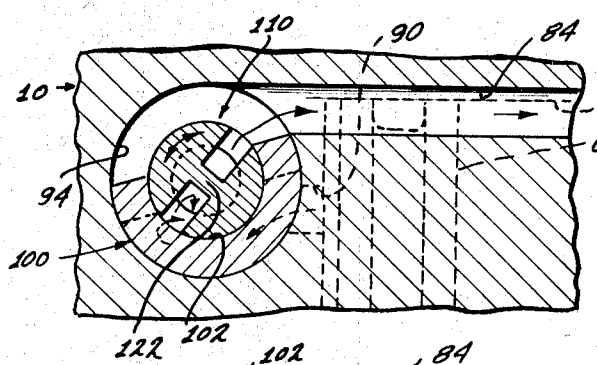


FIG. 3

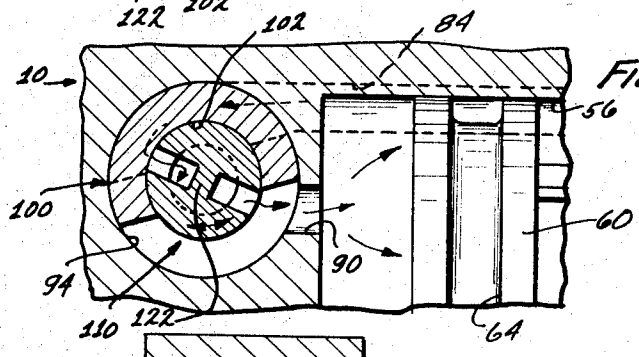


FIG. 5

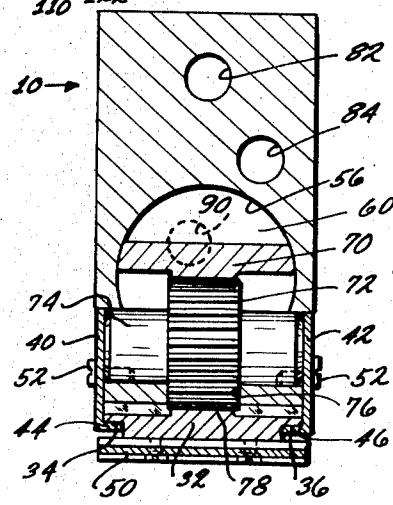
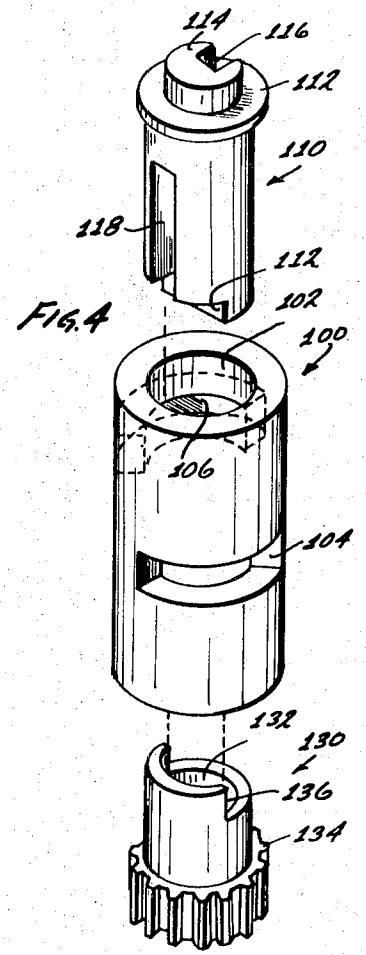


FIG. 4



INVENTOR
HARVEY B. RODSTEIN

BY Herzig + Walsh
ATTORNEYS

FIG. 6

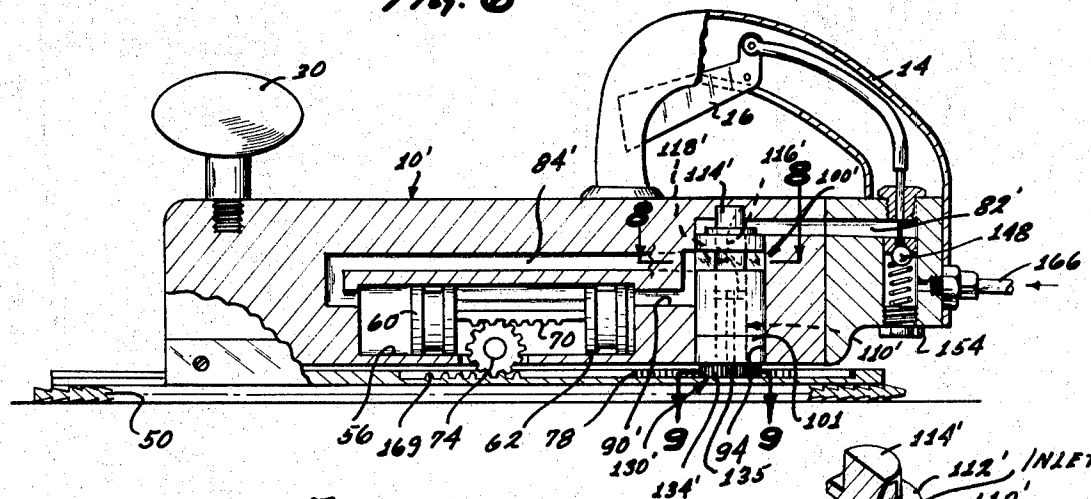


FIG. 8

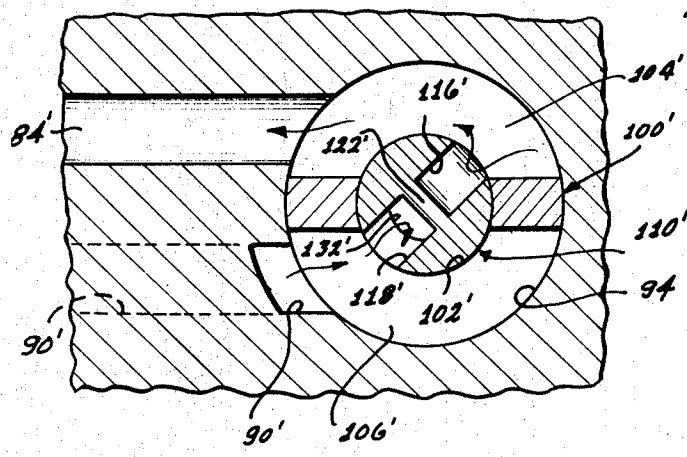


FIG. 7

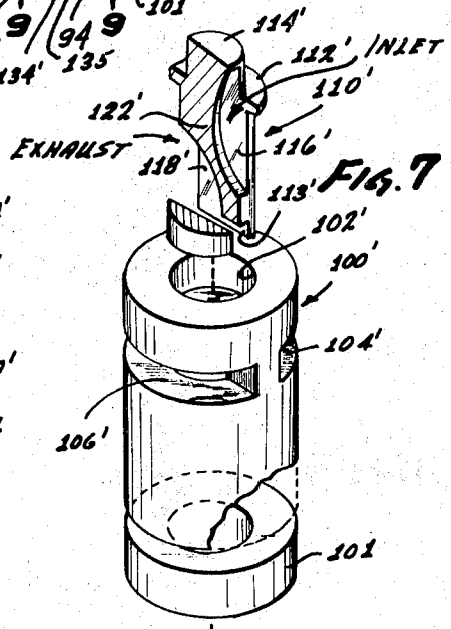
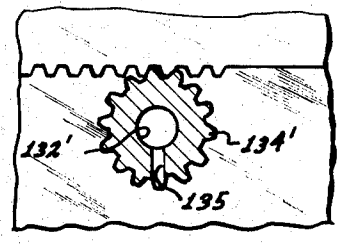
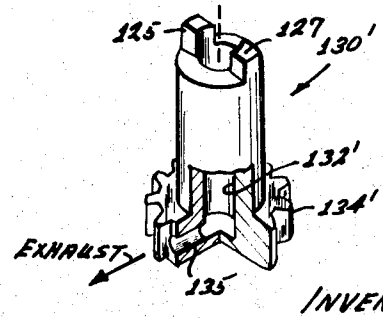


FIG. 9





INVENTOR
HARVEY B. RODSTEIN

BY Hezig + Walsh

ATTORNEYS

AIR-OPERATED TOOL

This application is a continuation-in-part of application Ser. No. 766,259, filed Oct. 9, 1968, now abandoned.

SUMMARY OF THE INVENTION

The invention is an air-operated tool of the type particularly adapted for sanding, rubbing or filing operations and the like.

The tool is held manually while operating, the reciprocatory motion being imparted to a shoe carried by the tool by means of air supplied under suitable pressure to the tool.

Various types of mechanisms have been known in the prior art adapted for use in this type of tool for imparting reciprocatory motion to a shoe. It is characteristic of the design and construction of tools of this type that it is desired that the operating parts be simple, sturdy, and dependable and easily maintainable, while at the same time being simple in construction. It is further desired that the operating parts be compact and that they do not occupy any more physical space than necessary.

It is also desired that the body of the tool be subjected to minimum vibration while in operation.

It is the primary object of this invention to provide air-operated driving means for a tool of the type described and capable of meeting all of the aforesaid characteristic requirements in an optimum way.

In a preferred form of the invention the reciprocating shoe is driven by way of racks with a pinion gear on a transverse shaft mounted between them. That is, the pinion gear is in a vertical position. A single double-ended piston is provided with a rack extending between the ends of the piston in a position to engage the pinion which drives the rack carried by the reciprocating shoe. Valve means, preferably in the form of a vertical rotary valve, is provided in order to alternately admit air to opposite ends of the piston and to exhaust air therefrom.

It is a particular feature of the invention that a single driving pinion is used, cooperating with the racks in a position between the opposite ends of the double-ended piston which operates in a common bore in the body of the tool. It has been found that a simplified construction of this type is very effective for the purposes desired, is compact, and simple in construction, and adapts itself very well to the purposes intended.

Significantly in the invention a single double-ended piston is used which drives a single shoe, the piston and shoes moving in opposite directions. An extremely significant aspect of the invention is that the mass or weight of the double-ended piston is balanced against the mass or weight of the reciprocatable shoe whereby the purpose is achieved of minimizing the vibration of the tool. In this manner important objects of the invention are accomplished. Simplicity and economy of parts is realized because there is but a single double-ended piston and shoe driven thereby. It has been commonplace and conventional in the prior art in tools of this type to have a pair of pistons which are alike and a pair of shoes which are alike and the pistons and shoes symmetrically arranged with the mass of one piston and shoe balanced against an identical piston and shoe moving in opposite directions. Balancing is, of course, easy in such a symmetrical arrangement, but, of course, the duplicate pistons and shoes are present which adds to the weight, bulkiness, costs and maintenance aspects. In the herein invention by balancing the mass of the single piston against the shoe the vibration is minimized although the tool only has the one piston and shoe. The elimination or minimization of vibration is, of course, extremely important since if the tool vibrates appreciably while in use it has very detrimental effect on the operator holding the tool since his hands become numb and insensitive and the discomfort prevents use of the tool except for short periods.

In the particular exemplary form of tool disclosed herein the shoe is substantially longer than the double-ended piston and its bore. The piston and its bore may have a position over one end of the shoe with the shoe guided along its length or the piston and its bore may have an intermediate position over the shoe at the center part of the body of the tool.

Another object of the invention resides in the particular positioning of the piston and its bore whereby to realize desirable results in the overall operation.

In the preferred form of the invention, the rotary type valve is operated by a second pinion rotating about a vertical axis and a further rack carried by the reciprocating shoe. Further objects of the invention reside in the attainment in the manner stated of the characteristics of simplicity and compactness of construction, accompanied by effectiveness of operation and service and ease of maintainability.

Further objects and additional advantages of the invention will become apparent from the following detailed description and annexed drawings, wherein:

FIG. 1 is a view partly in section of one form of the invention;

FIG. 2 is a sectional view taken along the line 2–2 of FIG. 1;

FIG. 3 is a sectional view taken along the line 3–3 of FIG. 1;

FIG. 4 is an exploded perspective view of the valve means;

FIG. 5 is a sectional view taken along the line 5–5 of FIG. 1;

FIG. 6 is a view partly in section of a preferred form of the invention;

FIG. 7 is an exploded perspective view of the valve means of the form of the invention shown in FIG. 6;

FIG. 8 is a sectional view taken along the line 8–8 of FIG. 6;

FIG. 9 is a sectional view taken along the line 9–9 of FIG. 6.

Referring now more in detail to the various figures of the drawings:

Numeral **10** designates the body of the tool which may be made of any suitable material and may be fabricated by casting or other suitable processes.

FIG. 5 shows the cross-sectional shape of the body of the tool.

Numeral **12** designates the rear part of the body of the tool, which may be made as a separate section and attached to the body by any suitable means.

Numeral **41** designates the handle of the tool, which is hollow, as shown, and which is shaped to have its forward part attached to the body **10** and its rear part attached to the rear section **12** of the tool.

Numeral **16** designates a control handle or lever which extends through an opening **18** in the handle **14** and which is pivoted at **22**. The member **16** is in the form of a bellcrank lever, having a lever part **24**, to which is pivotally attached a curved stem **26** that operates the control valve for the air supply for the tool which is within the rear section **12**. The valve will be described presently.

At the forward part of the body **10** is another handle **30** in the form of a knob attached to the body **10** by being threaded into it.

At the bottom of the tool is a reciprocatable shoe **32** which has cutouts at its lower outside edges, as designated at **34** and **36** in FIG. 5. The shoe is held in position by sideplates **40** and **42**, which have inwardly extending flanges as shown at **44** and **46**, which engage in the undercuts **34** and **36** at the side edges of the shoe **32** to hold it in position while allowing it to reciprocate.

Attached to the shoe **32** may be any suitable type of tool, such as a file, as shown at **50**, or the tool may be a rubbing or sanding tool.

The sideplates **40** and **42** may be held in position by screws, such as shown at **52**.

The driving mechanism of the tool will next be described.

Within the body **10** is a longitudinal bore **56** and movable in this bore are pistons or piston ends **60** and **62**, having a construction as shown, embodying angular grooves shown at **64** and **66**, between the end surfaces of the pistons.

Positioned between the pistons **60** and **62** is a rack bar member **70**, having teeth on its underside, and this rack meshes with a pinion gear **72**. The pinion gear **72** is mounted on a transverse shaft **74** that is journaled in bores in the side parts of the body at **10**. The lower part of the pinion gear **72** is positioned in or extends through an opening **76** in the lower part of the body **10**, so that it can mesh with rack **78** carried by the shoe **32**.

As may be seen, the pinion **72** is partly within the bore **56** in a position between the pistons or ends of the double-ended piston and extends through the opening **76** so as to mesh with the rack **78**.

In the body **10** are additional elongated bores **82** and **84** positioned above the bore **56**, as may be seen, and also the bore **90** at the end of bore **56**. See FIG. **1**.

Next will be described the valving mechanism that controls the operation of the driving means for the reciprocatable shoe.

Numeral **94** designates a vertical bore in the body **10**, which can communicate with the bore **56** through the bore **90**. Positioned in the bore **94** is cylindrical spool or sleeve **100** as may be seen in FIG. **4** which forms a part of the rotary valve mechanism. The sleeve **100** has a bore **102** and in one side there is provided an angular or arcuate cutout **104**, having an angular extent as shown of somewhat less than 180°.

In the opposite side of the spool or sleeve **100** is a similar arcuate cutout **106** of a similar angular extent.

Numeral **110** designates a rotary cylindrical valve member that fits into the bore **102** in the member **100**. The member **100** has a top flange **112** which engages on the top of the spool or sleeve **100**. It has an extending upper part **114** of smaller diameter, in the side of which is an axial rectangular slot **116**, as shown. In the opposite side of the body of the member **100** is a similar axial rectangular slot **118**. These slots within the member **110** are separated by a septum, as shown at **122** in FIG. **1**, providing for a flow of air within the rotary valve as will be described presently.

The member **110** has a 180° cutaway at the bottom end, as designated at **126**.

Numeral **130** designates the drive member for the rotary valve means. It comprises a tubular member as shown, having a bore **132**, and at the lower end it carries spur or pinion gear **134**. At the upper end it has a 180° cutaway **136** which is complementary to the cutaway **126** at the bottom of member **110**. The barrel of the drive member **130** fits into the lower end of the bore **102** of the spool or sleeve **100** and the member **110** fits into the upper end of the bore **102**, so that these parts come into a position as shown in FIG. **1** just below the threaded bore **138** in the body **10**, which can be closed by a screwplug.

Section **12** of the body **10** has in it a vertical bore **140**, in which is a ring member **142** having a bore **144**, which forms a valve seat for a ball valve **148** which is biased against the valve seat by a coil spring **152**. The lower end of the bore **40** is closed by a screwplug **154**. The upper end of bore **140** is closed by a similar screwplug **156**, through which extends the operating stem **26** which has a small extending stem **160** that can open the ball valve **148** by unseating it.

In section **12** is a bore **162** to which is attached a suitable fitting **164** for connection to a source of air pressure through line **166**. The section **12** also has a bore **170** that aligns with the bore **82** in the body **10**.

It will be observed, of course, that the double-ended piston **60—62** reciprocates in a direction oppositely to the reciprocation of the rack **78** and shoe **50**. The pinion gear **72** is fixed. The mass or weight of the double-ended piston is balanced against the weight of the shoe and the rack **78**. The result of this is that vibration of the body of the tool as a whole resulting from the reciprocation of the parts is minimized or eliminated. This is an important result for reasons explained in the foregoing. As may be seen this is accomplished in a tool having only the one double-ended piston and rack and shoe driven thereby. In the form of the invention shown the double-ended piston is positioned over the shoe at one end thereof adjacent one end of the tool and the valve is ahead of the double-ended piston. Other arrangements are possible as described hereinafter.

The operation of the tool will next be described. The operation is illustrated in FIGS. **2** and **3**, which illustrate the positions of the rotary valve means.

The tool is grasped by the handles **14** and **30** and the operator can push upwardly on the control lever **16** to open or unseat the ball valve member **148** in the section **12**. This admits air under pressure from the line **166** through the bores **170** and **82** to the rotary valve. Pressure is applied first to one of the pistons **60** and **62** and then to the other, the pressure being exhausted from that piston opposite from the one to which the pressure is being applied. FIG. **1** illustrates the flow of pressure to the piston **60**.

The air moves from bore **82** into the slot **116**, and then downwardly through the valve member **110** to the bore **90** and into the chamber at the left end of piston **60** for driving the piston assembly to the right. This flow is illustrated in FIG. **3**. At this time air is exhausted from the chamber opposite the end of piston **62**. This takes place through the cutout or cavity **171** in the section **12**, through the bore **84** into the angular opening **106** in the valve body **100**, and then downwardly through the slot **118** and into the bore **132** of the drive member **130**, through which the air is exhausted.

The piston assembly and rack **70** are driven to the right looking at FIG. **2**, rotating pinion gear **72** in a clockwise direction, and thus driving the rack **78** and shoe **32** to the left. When this happens the rack **169** is driven to the left along with the shoe **32**, and it rotates the pinion gear **134** rotating the valve member **100** in a counterclockwise direction looking at FIGS. **2** and **3**. This rotates the spool or sleeve member **100** from the position of FIG. **3** through substantially 180° from the position shown in FIG. **3**. The vertical slot **116** is now brought into position to communicate with the arcuate cutout **106**, in the barrel **100** which communicates with the bore **84**, allowing air under pressure to be delivered through the cutout or cavity **170** to the end of piston **62**.

As may be observed, air from the bore **82** can pass around the extending part **114** at the end of the valve member **110**, so as to enter the channel **116** in any position of the member **110**. At this time the air is exhausted from the chamber at the end of piston **60** through the bore **90**, the cutout **104** into the vertical channel **118**, and thence through the bore **132** to exhaust. In this manner, whenever the valve **148** is unseated air under pressure is applied to the mechanism which reciprocates the shoe **32** in response to the movements of the rotary valve as driven by the rack **169** and pinion **134**. The operation is smooth and positive with vibration minimized.

FIGS. **6**, **7**, **8** and **9** show a modified form of tool which is different primarily in respect to the positioning of the double-ended piston. In this form of the invention the double-ended piston is positioned at the center part of the body of the tool over the middle of the reciprocating shoe. This is a preferred manner of positioning the double-ended piston. All parts in FIGS. **6**, **7**, **8** and **9** that are the same as corresponding parts in the previous embodiment are identified by the same reference characters and, therefore, the description need not be repeated. With respect to parts in FIGS. **6**, **7**, **8** and **9** that are modified but otherwise correspond to a part in the previous embodiment such parts are identified by similar reference characters primed.

In the modification of FIGS. **6**, **7**, **8** and **9** the rotary valve is positioned to the rear of the double-ended piston although it could have other positions. The conduits leading to the opposite ends of the double-ended piston are identified by the numerals **84'** and **90'**.

The rotary valve is shown more in detail in FIGS. **7** and **8**. The rotary valve **110'** operates within the cylinder or spool **100'** which is received in the vertical bore **94** in the body **10'** of the tool. The member **110'** has a top flange **112'** which engages on the top of the spool or sleeve **100'** which has a bore **102'**. It has an extending upper part **114'** of smaller diameter. The member **110** has diametrically disposed axial slots having curved inner surfaces as designated at **116'** and **118'**. These slots within the member **110'** are separated by a septum as designated at **122'**.

The member **110'** has a transverse diametral slot **113** at the bottom thereof.

Spool member **100'** has a bore **102'** and in one side there is provided an angular or arcuate slot or cutout **104'** having an angular extent of somewhat less than 180°. In which opposite

of the spool **100'** is a similar arcuate slot or cutout **106'** of a similar arcuate extent.

Numeral **130'** designates the drive member for the rotary valve means. It comprises a tubular member as shown having a bore **132'** and at the lower end it carried a spur or pinion gear **134'** which is driven by the rack **169**. At the upper end it has diametrically opposed axial lugs **125** and **127** which fit into the slot **113'** in the member **110'** for rotating it in the bore **102'**. The barrel of the drive member **130'** fits into the bore **102'** in the spool **100'** and the member **110'** fits into the bore **102'** also as may be seen in the FIGS. with the extending part **114'** exposed to the channel **82'** as shown.

The operation of the tool of FIGS. **6**, **7**, **8** and **9** will next be described. The operation is illustrated in FIGS. **7** and **9** which illustrate the rotary valve means and its operation.

The tool is grasped as described in connection with the previous embodiment and the pressure is controlled by the handle **16** as already described. Pressure is admitted first to one and then the other of the double-ended piston, pressure being exhausted from one end while applied to the other.

The air moves from bore **82'** in the groove or slot **116'** in one position of the valve and then through the arcuate slot **104'** into the channel **84'** to the bore opposite the end of the piston **60**. At this time pressure at the other end of the piston exhausts through the channel **90'** to the arcuate slot **106'** and downwardly through the bore **132'** in the member **130'** to exhaust through the radial port **135** in the gear **134'**. Piston **60** moves to the right driving shoe **50** and racks **78** and **169** to the left. This rotates valve member **110'** into its opposite position wherein air is exhausted from the chamber at the end of position **60**, through channel **84'**, cutout **100'**, slot **118'** and bore **102'** to port **135**. Pressure is now admitted through slot **116'** from bore **82'** to cutout **104'** and channel **90'** to the chamber at the end of piston **62** for moving it in the opposite direction.

From the foregoing those skilled in the art will understand and appreciate the nature and construction of the invention and the manner in which it achieves and realizes all of the objects set forth in the foregoing and the advantages, as well as the many advantages that are apparent from the detailed description.

The foregoing disclosure is representative of preferred forms of the invention and is to be interpreted in an illustrative rather than a limiting sense, the invention to be accorded the full scope of the claims appended hereto.

I claim:

1. A manually held fluid-actuated tool comprising a body defining a cylinder bore, piston means comprising a single double-ended piston reciprocatable in the bore, valve means having communication with said bore and means whereby the valve means are operated in response to the reciprocation of the piston means to control admission and release of fluid pressure with respect to the bore for actuating the piston means, rack means carried by the piston means, a reciprocatable shoe, a rack carried by said reciprocatable shoe, and a driving pinion gear interposed between said racks whereby the piston means and shoe are driven in opposite directions, the mass of the reciprocatable piston means being balanced with respect to the mass of the reciprocatable shoe whereby vibration of the device is reduced to a minimum.

2. A tool as in claim **1** wherein said first rack is positioned between opposite ends of the piston means.

3. A tool as in claim **1** having the single double-ended piston positioned over the reciprocatable shoe.

4. A tool as in claim **3** wherein the piston means has a central position between the ends of the reciprocatable shoe.

5. A tool as in claim **1** including a further rack driven by said piston means, said valve means being a rotary-type valve and a pinion gear driven by said further rack operating said rotary valve means.

6. A tool as in claim **5** wherein the axis of the rotary valve means is vertical.

7. A tool as in claim **1** wherein said valve means is positioned at one end of the bore.