United States Patent [19]

Leoni et al.

[11] **3,741,314**

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[54] **PNEUMATIC SCREWDRIVER**

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[73] Assignee: **Nuova L. A. P. I., Cavriago (Reggio Emilia),** Italy

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[30] **Foreign Application Priority Data**

May 25, 1970 Italy.....46873A/70

[52] **U.S. Cl.**..... **173/93.6,** 81/52.3

[51] **Int. Cl.**..... **E21b 33/03**

[58] **Field of Search**..... 173/93, 93.5, 93.6, 173/104; 81/56, 52.3; 192/30.5

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[57] **ABSTRACT**

Pneumatic screwdriver comprises a rotor driven by compressed air, a weight reciprocated by compressed air and turned by said rotor, and a drive member connected to be rotated by said weight only when said weight is near one end of its reciprocating path of travel.

2 Claims, 11 Drawing Figures

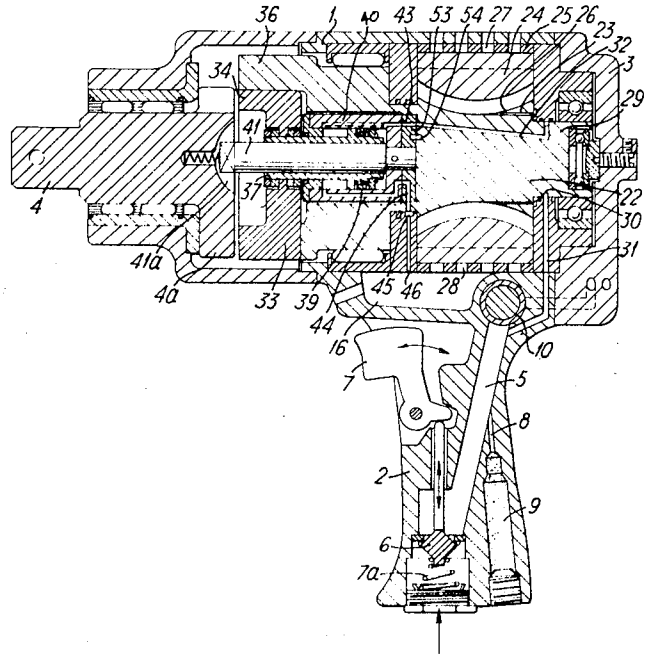


Fig. 1.

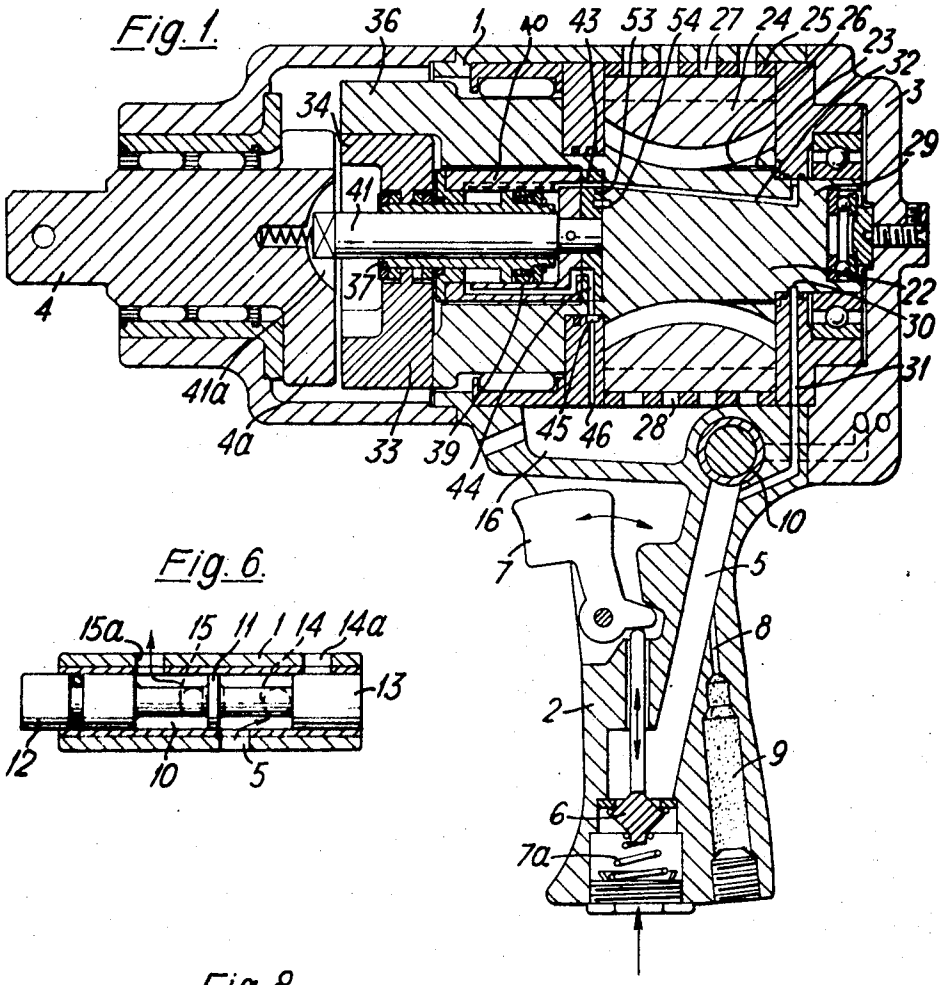


Fig. 6.

Fig. 8.

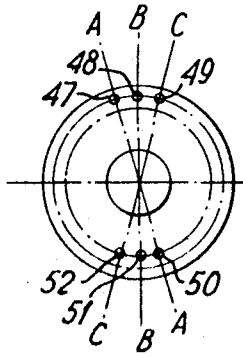
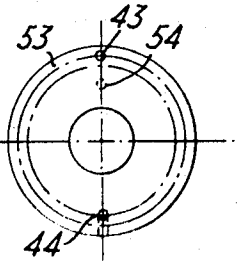


Fig. 7.



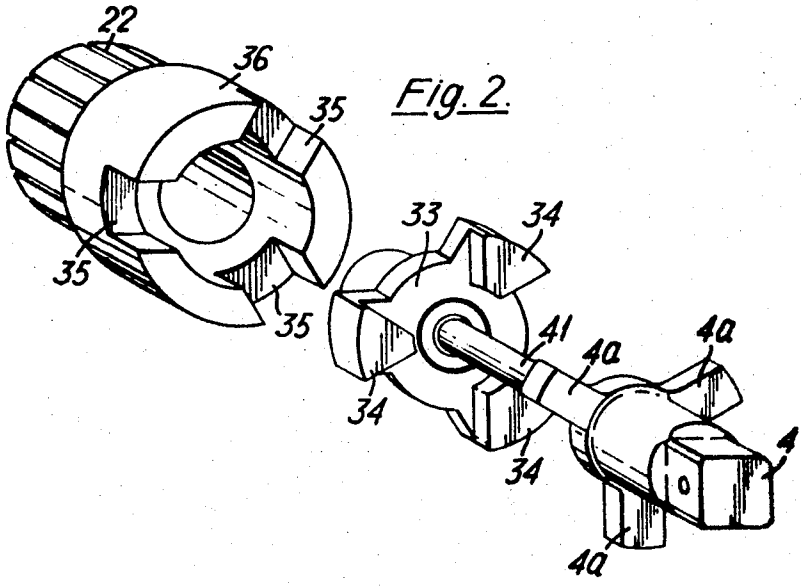


Fig. 2.

Fig. 3.

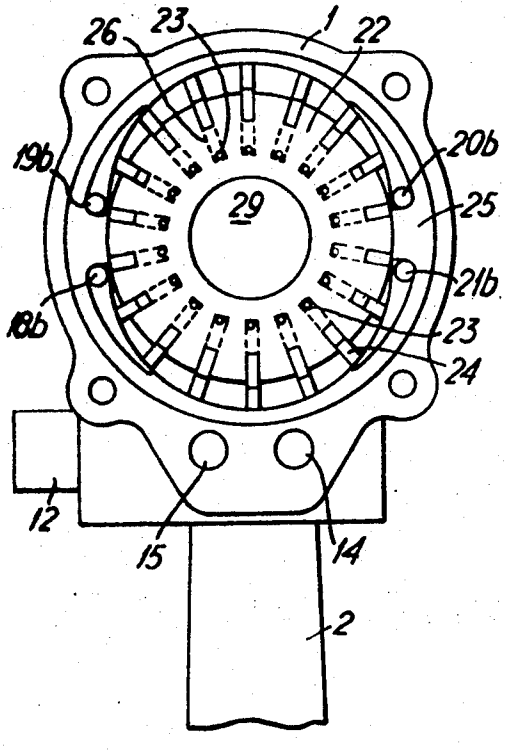
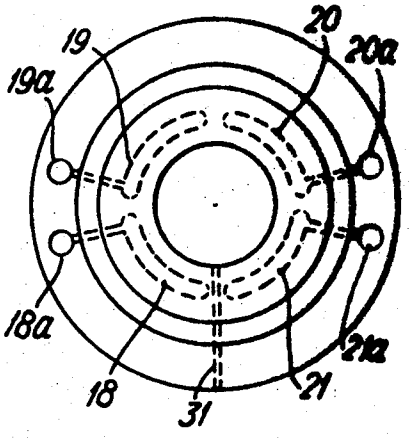


Fig. 4.



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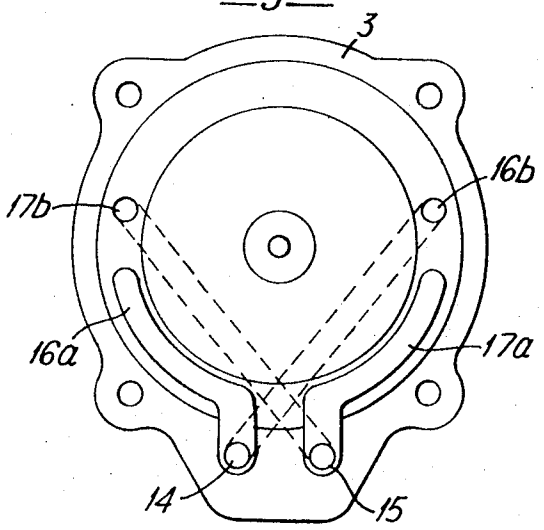


Fig. 9

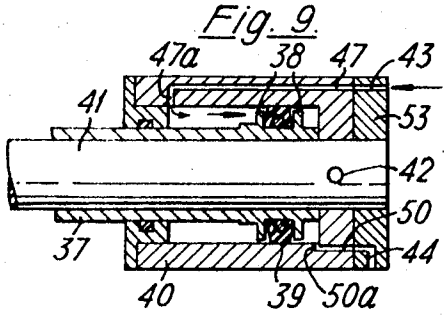


Fig. 10.

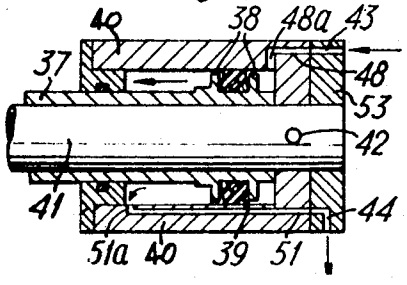
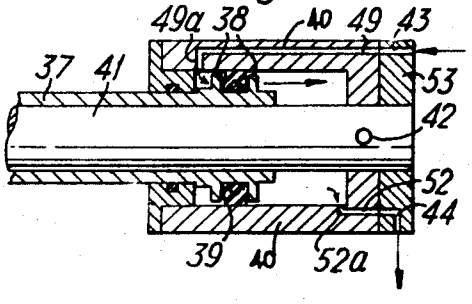


Fig. 11.



PNEUMATIC SCREWDRIVER

SUMMARY OF THE INVENTION

Automatic screwdrivers driven by a small compressed air motor are well known. These ordinarily comprise a weight inside the casing, which weight is adapted to be brought into temporary contact with the driving member of the device by translational movement along the axis of the screwdriver. The driving member is in turn brought into contact with the head of the screw or the bolt to be turned. In the known devices, the translational movements of the movable weight along the that result from contact between the weight and a fixed cam, which, at each revolution, imparts to the movable weight an impulse toward the front, while the weight is returned to its rearward position by means of a spring. Each axial impulse corresponds to temporary contact between the weight and the driving member. Devices made in this manner have certain characteristic disadvantages in their operations resulting from their construction. These disadvantages are due principally to the impacts which the mechanical components undergo in the course of operation. The known devices also have the disadvantage that their operation is unbalanced, particularly because they use a small single chamber motor. This small motor rotates in a path which is eccentric with respect to the cylinder of the motor and this eccentricity is the greater as the diameter of the cylinder of the motor itself increases.

The greater the eccentricity the smaller the diameter of the shaft must be, and this impairs the strength of the shaft. The consequence is that the transverse dimensions of a small motor must fall within certain well defined limits so that increases in power require an increase in axial dimensions of the motor itself.

Since, for an equal weight, the machine has a greater efficiency when its moment of inertia is greater with respect to the axis of rotation, it is obvious that, for substantial power, the increases in power obtained by means of increases in the axial dimensions of the motor are not proportionally as great as those resulting from increases in the moment of inertia with respect to the axis.

The object of the present invention is to provide a screw driving device controlled by a small compressed air motor which does not have the disadvantages which result from the driving impacts of the mobile weight.

Another object of the present invention is to provide a screw driving device which has the highest axial moment of inertia which is compatible with the weight and power of the device.

Yet another object of the present invention consists in providing means for controlling a compressed air actuated screwdriver in a simple way which increases both the strength, and durability of the device, and renders it economical to construct.

The objects of the invention are attained by the translational movement along the axis of the movable weight in dependence upon automatic pneumatic control means and by also providing a motor having more than one cylinder so that the radial components of the forces are symmetrically balanced and the axis of the rotating cylinder is coaxial with the axis of the shaft of the motor, while the flywheel and rotor of the motor are made in one piece.

The operating characteristics and construction of the invention will appear more clearly from the following description which refers to the attached drawings illustrating a preferred embodiment of the invention, which embodiment is given purely by way of illustration and example:

FIG. 1 is a longitudinal section through the device according to the invention;

FIG. 2 is a perspective view of the assembly comprising the rotor, the flywheel, the weight, and the driving member, shown in an exploded arrangement;

FIG. 3 shows the device according to the invention as seen from the rear, with the end closure and the air distributing disc removed;

FIG. 4 shows the air distributing disc;

FIG. 5 shows the end closure;

FIG. 6 shows the valve which may be operated from the outside and which makes it possible to reverse the direction in which the compressed air is supplied and consequently the direction of rotation of the motor;

FIG. 7 shows the air distributing disc for the piston which controls the translation of the mobile weight;

FIG. 8 shows in plan view the cylinder in which the piston moves;

FIG. 9 is a sectional view of the same cylinder taken along the line A—A of FIG. 8;

FIG. 10 is a sectional view of the same cylinder taken along the line B—B of FIG. 8; and

FIG. 11 is a sectional view of the same cylinder taken along the line C—C of FIG. 8.

In these figures reference numeral 1 indicates the casing which carries a pistol grip 2 and is closed at one end by a cap 3. A drive member 4 projects from the other end and which may, through any suitable tool, be brought in contact with the head of the screw or the bolt. The handle 2 has a passageway 5 for admitting compressed air, which passageway may be opened or closed by valve 6 actuated by a trigger 7 and biassed closed by a spring 7*a*. A duct 8 containing a felt 9 soaked in oil intersects the passageway 5. This passageway leads to a cylindrical chamber 10 having a transverse axis, best seen in FIG. 6. A piston 11 is movable inside this chamber by means of pushbutton 12 and 13 (FIG. 6) manually actuated from the outside, and directs the flow of air through one or two circuits which lead to the orifices 14 and 15. The cylinder 10 also has exhaust ports 14*a* and 15*a* which are in communication with the chamber 16 in the casing. As best seen in FIG. 5, the end member 3 which closes the rear end of the casing 1*a* has a passageway which leads to the orifice 14 and comprises a shallow groove 16*a* and a deeper duct 16*b*. The groove 17*a* and the duct 17*b* which lead to the orifice 15 are formed in like manner in the end member 3. As best seen in FIG. 4, the end member 3 and the casing 1 hold a distributor disc which has four front grooves 18, 19, 20 and 21 which lead to the ports 18*a*, 19*a*, 20*a* and 21*a*. These ports are positioned opposite the grooves in the end member as hereinafter described.

The port 18*a* is opposite the duct 17*a;* the port 20*a* is opposite the duct 17*b;* the port 19*a* is opposite the duct 16*b;* and the port 21*a* is opposite the duct 16*a*, so that the direction of the rotation of the rotor 22 is, in FIG. 3, clockwise when the piston 11 is in the position shown in FIG. 6. The flow of air reaches the port 23 through the grooves 19 and 21, which holds the vanes 24 in their outermost position. The ports 18*a*, 19*a*, 20*a*

and 21*a* are in communication with the ports 18*b*, 19*b*, 20*b* and 21*b* and with the distribution ducts which, in the body of the cylinder 25, lead to these openings.

The casing 1 contains a cylinder 25 having an elliptical section inside of which the rotor 22, which is centered on the axis rotates. This rotor carries a plurality of radially directed seats 26 in which the vanes 24 are carried. In the diametral vertical plane shown in FIG. 1, the elliptical chamber has at its apex a row of exhaust ports 27 which communicate directly with the exterior and, at its bottom, a row of exhaust ports 28 which communicate with the chamber 16 and, therethrough, with the exterior.

The rotor 22 has a peripheral groove 30 which is in direct communication with the air inlet duct 5 through a duct 31. This groove 30 feeds a duct 32 which supplies the control means or the device which reciprocates the mobile weight 33.

Referring now to FIG. 2, it will be seen that this mobile weight comprises a star-shaped member having three radial arms 34 which are constantly engaged in three seats 35 in a fly wheel 36 which is cup-shaped and integral with the rotor 22.

The arms 34 each have a projecting portion which is adapted to contact one of the radial arms 4*a* projecting from the driving member or chuck of the machine when the mobile weight is forwardly projected. This mobile weight 33 is attached to a tubular member 37 (FIGS. 9–11) which carries axially spaced flanges 38 which cooperate with the annular ring 39 to form a piston inside the cylinder 40. The cylinder 40 is connected to the central shaft 41 by means of a pin 42 which passes therethrough, said shaft being connected at 41*a* to the drive member 4 so as to turn therewith.

Between the end of the cylinder 40 and the rotor 22 is a disc 53, which is caused to rotate with the rotor by the key 54. The disc 53 has an upper bore 43 which communicate with the duct 32 and a lower bore 44 at a different radial distance from its center, which communicates with a circumferential slot 45, which in turn communicates through the duct 46 with the chamber 16 and therethrough with the exterior of the machine. The bore 43 and the bore 44 lead during the rotation of the disc 53 to the orifices 47, 48, 49, and 50, 51, 52 in one face of the cylinder 40. The order in which the said orifices are reached depends upon the direction of the rotation of the rotor. The orifices 47, 49 and 51 are the ends of three ducts 47*a*, 49*a* and 51*a* which open into one end of the cylinder 40 while the orifices 48, 50 and 52 are the ends of the ducts 48*a*, 50*a* and 52*a* which open into the opposite end of the cylinder 40. Each time the orifice 43 in the disc 53 comes opposite the orifice 48 in the cylinder 40 the piston formed by the flanges 38 is forced forward and, together with the tubular member 37 and the mobile weight 33 which is fixed thereto. During the execution of this translational movement the forward movement terminates when the movable mass 33 strikes the drive member or chuck 4 of the machine, which member received a torsional pulse in the same direction of rotation as the rotor 22. Of course, the separation of the movable member 33 from the drive member 4 takes place when the reciprocal rotation of the cylinder 40 with respect to the disc 53 brings the orifice 43 into alignment with either of the openings 47 and 49, which results in the return of the cylindrical member 37 to its initial position.

It is obvious that the alignment of the duct 44 with any one of the orifices 50, 51 and 52 permits air to escape from the end of the cylinder 40 on the opposite side of the piston 38 from the air inlet.

It will thus be seen that, during one revolution through 360°, regardless of the direction of rotation, there are three phases, in one of which the piston 38 is driven forward, in another of which this piston is driven backward, while a third phase is neutral since air enters the cylinder 40, it has no effect on the piston 38 because the latter is already in the position into which this air would have forced it.

The invention is not, of course, limited to the single embodiment described above and variations and improvements may be made therein without thereby departing from the basic principles of the invention as hereinbefore described.

What is claimed is:

1. In a power screwdriver having a drive member and a coaxial pneumatic motor for driving said drive member, the improvement according to which said motor comprises a plurality of chambers and said screwdriver comprises a rotor coaxial with said drive member and driven by said motor, a weight coaxial with said drive member mounted to be driven in rotation by said rotor but axially slidable with respect thereto, and pneumatic means for reciprocating said weight, comprising a piston chamber within said rotor, a piston within said piston chamber connected to said movable weight, and means for supplying air under pressure to said chamber on opposite sides of said piston alternately, said drive member and weight being provided with inter-engaging means through which said weight rotates said drive member when said weight is at one end of its axial path of travel, but which are disengaged when said weight is at the other end of its path of travel.

2. Screwdriver as claimed in claim 1, in which said pneumatic means also comprises a shaft connected to turn with said rotor and projecting into said piston chamber, a cylinder connected to rotate with said shaft and defining said piston chamber, passageways in said cylinder for admitting air to said piston chamber and for exhausting air from said piston chamber on opposite sides of said piston, and air supply and exhaust ducts in said rotor positioned to align with the passageways in said cylinder successively upon relative rotation between said rotor and cylinder.

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