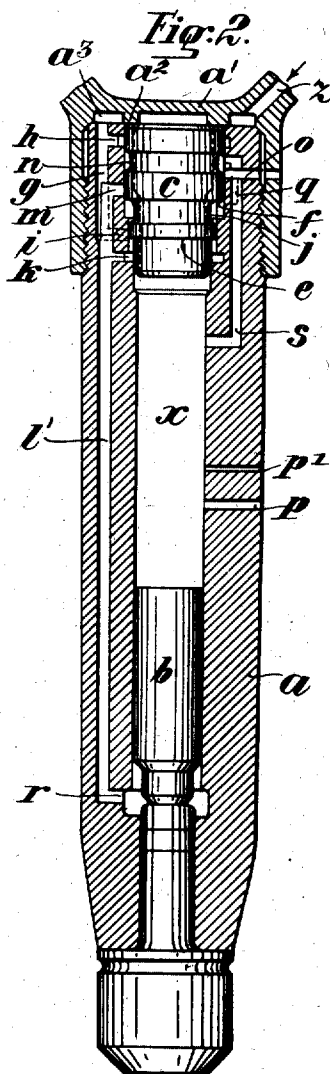
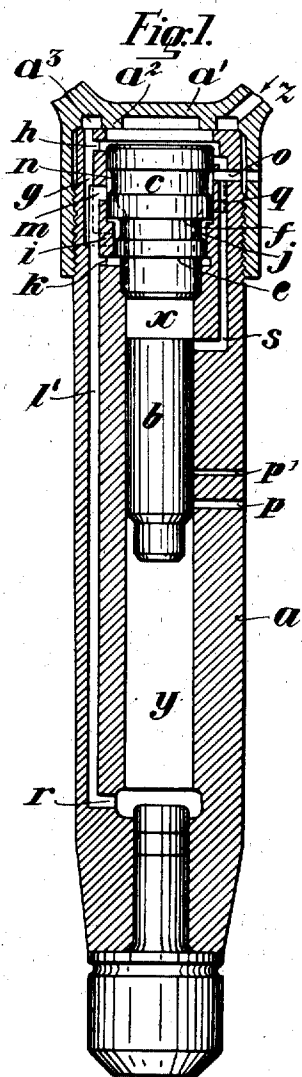


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APPLICATION FILED SEPT. 22, 1915.

Patented Nov. 20, 1917.
2 SHEETS—SHEET 1.

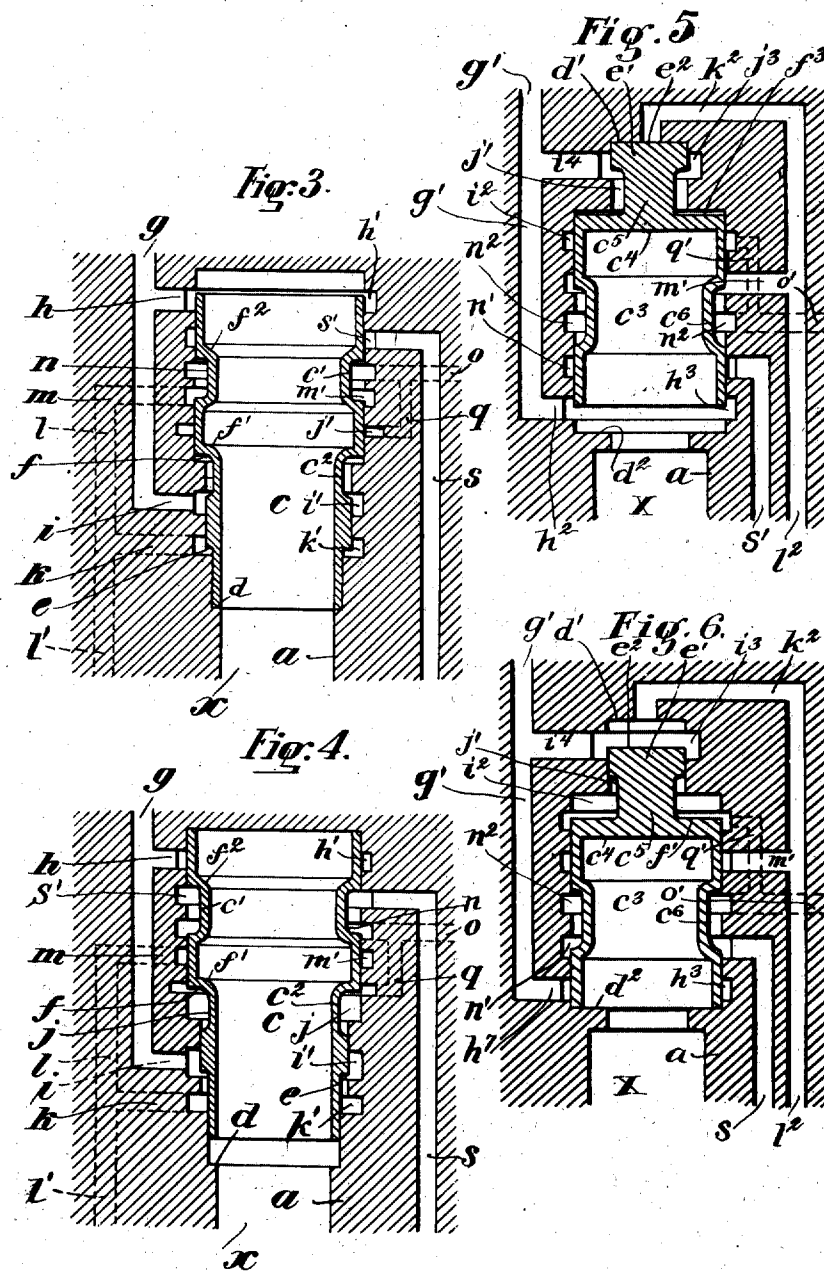


Inventor.
Charles Christiansen
By *Henry [Signature]* atty.

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UNITED STATES PATENT OFFICE.

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PNEUMATIC TOOL.

1,247,080.

Specification of Letters Patent.

Patented Nov. 20, 1917.

Application filed September 22, 1915. Serial No. 52,070.

To all whom it may concern:

Be it known that I, CHARLES CHRISTIANSEN, a citizen of the German Empire, resident at Gelsenkirchen, in the Kingdom of Prussia, German Empire, have invented new and useful Improvements in Pneumatic Tools, of which the following is a specification.

In known pneumatic tools, particularly riveting hammers, rams, and the like, controlling gears have been used in which the controlling member is moved in one direction by the air compressed by the piston in the cylinder, and is moved in the reverse direction by the fresh air pressure acting on a permanently loaded surface. Controlling gears of this kind have the disadvantage, that the reversing is not effected sufficiently quick and easy. If, for instance, the surface on which the fresh air pressure acts permanently, is made too large, the back-pressure in reversing, by means of the air compressed in the cylinder, will become too great. If, on the other hand, the said surface is made too small, the reversing by means of the fresh air pressure is performed too slowly, and only after a considerable drop in pressure in the cylinder has occurred.

The object of the present invention is to obviate these disadvantages. While the reversing of the controlling member in one direction is effected in known manner by the air compressed by the piston in the cylinder, the invention consists in providing means for reversing in the other direction by the fresh air acting successively on two different sized surfaces of the controlling member. In this case one surface, generally the larger, serves to quickly and powerfully start the reversing by means of fresh air, whereas the smaller surface is at the same time put under load, so that the reversing is completed by the pressure on this surface and the controlling member is held in its reversed position. By such means, the fresh air pressure acting on a large surface is utilized for reversing in one direction, while only the smaller surface is opposed to the reversing in the opposite direction. Thus the reversing is facilitated in both directions.

In the accompanying drawings, Figures 1 and 2 are longitudinal sections through

the central axis of a pneumatic tool embodying my invention with the controlling valve and the piston in different positions. 55

Figs. 3 and 4 are vertical sections through the cylinder and controlling valve on an enlarged scale in a plane at an angle to the plane of Figs. 1 and 2, clearly illustrating the course and arrangement of the passages. 60

Figs. 5 and 6 are vertical sections of a modification of the controlling valve in the form of a cup-shaped slide.

In Figs. 1 to 4 of the drawings *a* designates the cylinder and *b* the piston adapted to reciprocate therein, said cylinder being closed by a head *a'* screwed onto the rear end thereof. The head has an internal annular rib *a²* forming an annular air passage *a³*, which is connected to an air supply pipe (not shown) through a passage *z*. 70

The passage *a³*, communicates with an admission passage *g*, Fig. 3, which extends longitudinally through the wall of the cylinder, and is adapted to communicate with the interior of the latter, near its top, through a transverse passage *h* and annular channel *h'* and at a point below the latter the passage *g* is adapted to communicate with the cylinder through a transverse passage *i* and an annular channel *i'*. 80

A control valve *c* is reciprocally mounted in the cylinder between the head *a'* and an annular valve seat *d* formed in the interior wall of the cylinder. The lower portion of the valve wall is reduced in thickness to form a small annular shoulder *e*, on the outer periphery of the valve, and substantially midway between the two ends of the valve, the diameter is increased to form an annular shoulder *f* on its outer surface and annular shoulders *f'*, *f²*, on its inner surface. The shoulders *f*, *f'*, and *f²*, are larger than the shoulder *e*, so as to form larger pressure areas, the purpose of which will be hereinafter explained. 95

In the inner wall of the cylinder, between the valve seat *d* and the annular channel *i'* there is formed an annular groove *k'*, which is connected, by a transverse passage *k*, with a passage *l* extending upward longitudinally through the wall of the cylinder. The passage *l* communicates with a transverse passage *m* which terminates in an annular 100

channel m' and above the latter there is an annular channel n open to the atmosphere through an exhaust passage b . Communication between channels m' and n is had through an annular groove c' in the valve c when the latter is seated.

An annular stepped channel j is formed in the cylinder wall between channels i' and m' and communication between the passages i' and j is had when the valve is seated, through an annular groove c'' formed in the valve below the shoulder f . Communication is had between channels k' and i' past the reduced lower end portion of the valve when the latter is raised from its seat, as shown in Fig. 4, and communication between said channels is cut off by the larger portion of the valve above the shoulder e when the valve is seated, as shown in Fig. 3.

The channel j is connected with the exhaust passage b by a passage q which is controlled by the enlarged portion of the valve between the grooves c' , c'' , said passage q being closed when the valve is seated as shown in Fig. 3.

A longitudinal passage l' extends downward from the transverse passage k and is connected with the cylinder at the lower end thereof by a transverse passage r .

s indicates an exhaust passage extending longitudinally through the cylinder and which opens into the interior of the latter near the valve seat (Fig. 1) and opens near the upper end of the valve into an annular groove s' which is adapted to communicate with the channel n through the groove c' when the valve is raised (Fig. 4) and closed by the upper end portion of the valve when the latter is seated (Fig. 3).

The cylinder is vented to the atmosphere through ports p , p' , which are controlled by the piston.

The operation of the above described valve mechanism is as follows: With the parts in the position shown in Figs. 1 and 3 with the piston at the rear end of its stroke and the valve c at the forward limit of its movement, live air admitted at z flows through passage a^3 into passages g and h and channel k' over the top of valve c down through its interior to the rear of the piston b and drives the latter forward. Air passing through the valve exerts pressure on the interior annular shoulders f' , f'' , so that the valve is not prematurely raised from its seat to cut off the supply to the piston. As soon as the piston passes the exhaust ports p' , p , the pressure in the valve and space a of the cylinder behind the piston is relieved.

Live air enters passage z simultaneously with the admission of air to passage h , and flows from passage i into channel i' , through groove c'' into channel j and against the exterior shoulder f . Simultaneously with the

reduction of pressure inside the valve the air in channel j raises the valve from its seat d and closes passage k . The live air in channel i' now acts on the smaller shoulder e and maintains the valve in its raised position (Fig. 4). The channel j is now vented to the atmosphere through passages q and o . As soon as the valve is raised, the interiors of the valve and cylinder are vented through passage s , channels s' and n , and passage o .

The live air is now admitted from passage i ; channel i' past the reduced portion of the valve below the shoulder e into the channel k' , passage k , passage l' and passage r into the space y of the cylinder below the piston b and drives the latter back.

As soon as the piston in its backward movement passes the intake or lower end of the passage s , the air in the cylinder and valve above the piston is compressed to such an extent that back pressure of air on the shoulders f' , f'' , overcomes the pressure of the live air on small shoulder e , consequently, the valve is moved downward from the position shown in Fig. 4 to the position shown in Fig. 3 and the operation repeated. In other words, upon the downward stroke of the piston b , air is first admitted to the larger pressure surface f to initiate the movement of the valve, as this requires more force than is necessary to keep the valve in motion when once started to move. Port i is then cut off, and air is admitted to the smaller surface e' to complete the movement of the valve, so that the valve strikes its seat with a very small force, thus saving wear on both seat and valve. Upon reversal of the piston b compression of air thereby causes pressure on the unbalanced internal surface f'' , which is opposed by pressure on the parallel surface e , and thereafter the surface e is vented and pressure exerted on the larger surface f to cause the easy seating of the valve.

In the modified form shown in Figs. 5 and 6, the controlling valve c^3 is in the form of an inverted cup and is axially movable between an upper and lower annular valve seat d' , d'' , respectively. An air admission passage g' communicates with a supply pipe (not shown) as in Fig. 1. Said passage extends longitudinally through the wall of the cylinder a and is adapted to communicate with the interior of the cylinder through a transverse passage h^3 which terminates in a stepped annular channel h^3 surrounding the valve seat d'' .

The upper closed end of the valve projects into a stepped annular chamber i^3 , the upper portion of which is of substantially the same diameter as said upper end of the valve. The chamber i^3 has an axial opening j^3 at the top adapted to communicate with a

stepped annular channel i^2 surrounding the valve seat d' the channel i^2 communicating with a transverse passage i^4 which communicates with the longitudinal passage g' .

5 The valve has a stem c^5 on its upper end forming an annular shoulder f^2 , said stem having a head e' adapted to close the opening j' and cut off communication between the stepped chamber i^2 and the passage g' .

10 A transverse passage k^2 opens into the stepped channel i^2 and is controlled by the top surface e^2 of the head e' . This passage k^2 communicates with a passage l^2 which extends longitudinally through the wall of the cylinder and opens into the latter at the lower end thereof, the same as passage l' in Figs. 1 and 2.

A passage o' which communicates with the atmosphere extends transversely through the cylinder and is connected with the stepped annular channel i^2 by means of a passage q' which is controlled by the valve. This exhaust passage o' is also arranged to communicate with the longitudinal passage l^2 through a transverse passage m' which is adapted to communicate with said passage o' through an annular groove c^6 formed in the outer periphery of the valve.

s' indicates an exhaust passage extending longitudinally through the cylinder and opening into the latter below the lower valve seat d^2 and communicating with an annular channel n' which is adapted to communicate through the annular groove c^6 , with an annular channel n^2 in direct communication with the exhaust passage o' .

The operation of the modified form is as follows: With the valve in the position shown in Fig. 5 with the piston at the rear end of its stroke, live air admitted through g' flows through passage h^2 beneath the lower edge of the valve c^3 . This air acts on the piston b to drive it forward and simultaneously acts on the inner closed end c^4 of the valve and holds it in open position. Air from passage g' will also flow through passage i^4 , channel i^2 , opening j' onto the shoulder f^2 of the valve. As the area of the shoulder f^2 is less than the area of the end c^4 of the valve, the air acting on the shoulder cannot move the valve until the pressure within the valve and cylinder is reduced by the piston opening the ports p, p' . As soon as this reduction of pressure takes place, the air acting on the shoulder f^2 moves the valve down or forward closing the opening j' , opening the port of passage k^2 , and closing communication with the exhaust passage o' by closing passage m' . The air now flows through the passage k^2 , and passage l^2 into the interior of the cylinder below the piston and drives the latter back.

The downward or forward movement of the valve closes the opening j' and vents the

chamber i^2 to the atmosphere through passages q' and o' . Pressure on the head e' is sufficient to hold the valve on its seat d^2 during a portion of the return or back stroke of the piston. The space x of the cylinder is vented to the atmosphere after the piston passes the ports p, p' , through the passage s' which, at the forward or downward movement of the piston, is vented to the atmosphere through the annular groove c^6 , annular channel n' and passage o' . As soon as the upper end of the piston passes the lower end of passage s' and closes the same, compression takes place in the cylinder above the piston and inside the valve and exerts a pressure on the large surface of the end c^4 sufficient to overcome the pressure of live air on the small top surface e^2 of the head e' , thus raising the valve from the position shown in Fig. 6 to the position shown in Fig. 5, and permits the live air to flow beneath the lower end of the valve.

The transference of pressure from the larger surface f^2 to the smaller surface e' upon closing the valve, and vice versa upon opening is for the same purpose as described with reference to Figs. 1-4.

I claim:—

1. A pneumatic tool comprising a cylinder, a piston therein and a cylindrical open ended distributing valve therein having a plurality of pressure surfaces thereon differing in area, air passages communicating with said surfaces, and to supply pressure air to both ends of said cylinder, said valve having a large pressure area to initiate the movement of said valve in one direction, means to relieve the pressure on said surface after initiation of its movement and means bringing into operation, after the said relief of pressure, a smaller pressure surface to complete the movement of said valve in said direction.

2. A pneumatic tool, comprising a cylinder, a piston therein and a cylindrical open-ended distributing valve having a plurality of pressure surfaces thereon, air passages communicating with said surfaces, one of said surfaces being a large surface to initiate the movement of said valve in one direction, means to disconnect said surface from its air supply and vent the surface to the atmosphere, and another smaller surface maintained under air pressure during the remainder of the movement of said valve to complete the movement of the said valve in the same direction.

3. In a pneumatic tool, a cylinder, a piston therein, and a cylindrical open-ended valve at one end of said cylinder, said valve having an internal pressure surface and two external annular pressure surfaces of different areas, means including ports and passages cooperating with said valve and its

pressure surfaces to initiate the movement
of the valve in one direction by action on
the larger external surface and before com-
pleting the valve movement to vent the pres-
5 sure on the smaller valve surface, and upon
reversal of said valve to relieve the pressure
from said smaller external surface and exert
pressure on the larger of said surfaces.

In witness whereof I have hereunto set
my hand in presence of two witnesses.

CHARLES CHRISTIANSEN.

Witnesses:

J. D. ZIESECKE,
EL. KAEMPERS.