J. W. CANTY.

FLUID ACTUATED TOOL.

APPLICATION FILED OCT. 27, 1908.

981,530. Patented Jan. 10, 1911.

2 SHEETS—SHEET 1.

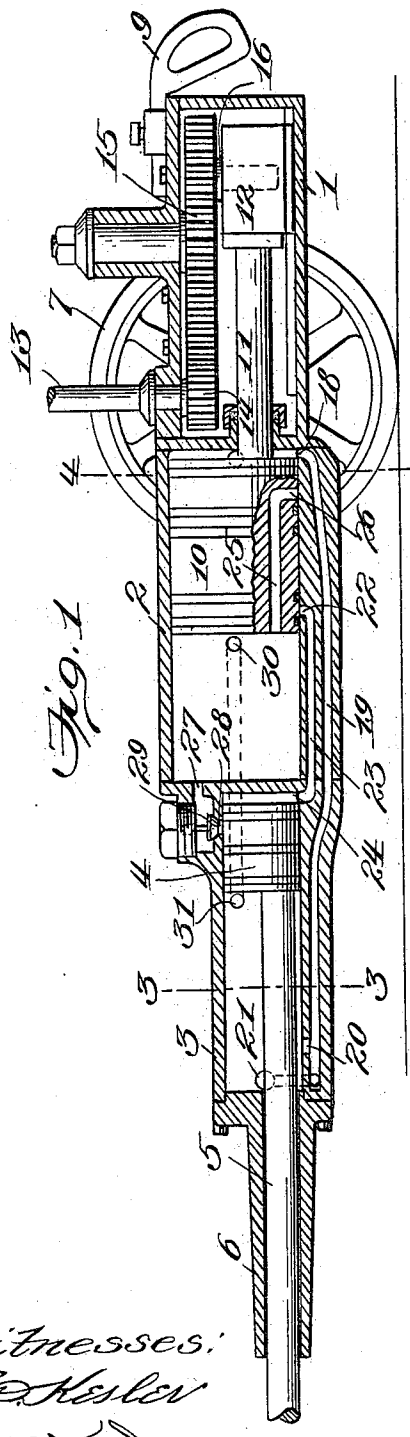

Fig. 1.

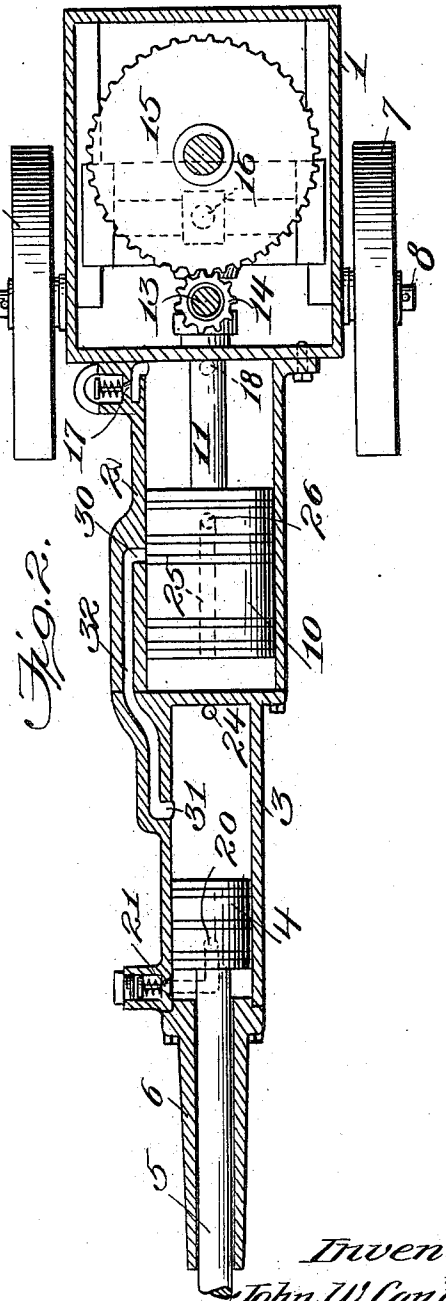

Fig. 2.

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Fig. 3.

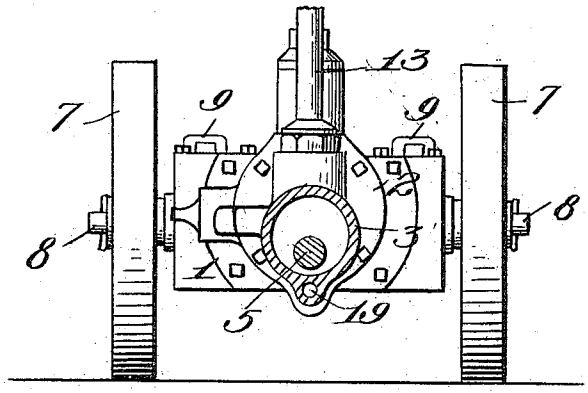
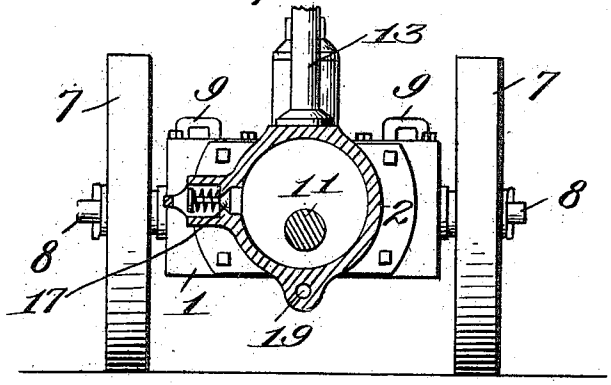


Fig. 4.



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UNITED STATES PATENT OFFICE.

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FLUID-ACTUATED TOOL.

981,530. Specification of Letters Patent. Patented Jan. 10, 1911.

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To all whom it may concern:

Be it known that I, JOHN W. CANTY, a citizen of the United States, residing at Florence, in the county of Fremont and State of Colorado, have invented new and useful Improvements in Fluid-Actuated Tools, of which the following is a specification.

My present invention relates to improvements in fluid-actuated tools or implements of the general type involving a reciprocatory fluid driven tool piston or plunger such being used in coal-cutting, mining machines, rock drills, hammers, riveters and similar apparatus, and it has for its object primarily to provide an improved tool of this character wherein the tool piston is driven by a fluid suddenly released under high compression, such fluid after driving the tool plunger by a quick blow being returned to a compressing cylinder whereby it is recompressed and introduced to the tool piston for the next blow or stroke, the forward movement or power stroke of the tool piston being accelerated by exhaustion of the fluid in front thereof, while the retracting stroke of the tool piston is accomplished by introducing compressed fluid to its forward side, the driving fluid of the tool being repeatedly compressed and expanded within the machine so that a relatively high efficiency is obtained as distinguished from a machine of this character wherein the air is exhausted to the atmosphere after each stroke of the tool.

Further objects of the invention are to provide an improved tool of this character wherein the fluid is controlled automatically by the movements of the pistons acting as valves, and also to provide such a tool wherein the rods of the pistons are offset below the axes of their respective cylinders, a reduction in the vertical height of the machine being thereby attained so that the machine may be placed in relatively inaccessible places, and turning of the pistons within their cylinders is prevented.

To these and other ends, the invention consists in certain improvements, and combinations and arrangements of parts, all as will be hereinafter more fully described, the novel features being pointed out particularly in the claims at the end of the specification.

In the accompanying drawing: Figure 1 represents a longitudinal section of a fluid-actuated tool constructed in accordance with my present invention; Fig. 2 represents a horizontal section of the tool, the parts being shown in the position which they occupy immediately after the tool piston has traversed its power stroke; and Figs. 3 and 4 represent transverse sections of the machine taken on the lines 3—3 and 4—4, respectively, Fig. 1.

Similar parts are designated by the same reference characters in the several views.

In the accompanying drawing, I have shown my present invention as applied to an electrically-driven coal-cutting or mining machine. It will be understood, however, that I have shown only one specific embodiment of the invention and that the same is not limited to the precise details or the arrangement of the parts, as these features may be varied in adapting the invention to different uses.

In the present instance, the machine comprises a casing which may be composed of castings made in a suitable number of parts according to the convenience of manufacture, the casing being provided at its rear end with a gear box 1 and in advance of the gear box is arranged a fluid-compressing and controlling cylinder 2 and a cylinder 3 for the tool operating piston. The tool operating piston 4 is provided with a rod 5 which extends through a forwardly extending bearing sleeve 6, the cutting or other appropriate tool being attached to the rod of the tool piston. In order to facilitate the movement of the machine from place to place, a pair of supporting wheels 7 are preferably mounted upon trunnions 8 which extend from the opposite sides of the gear box, and handles 9 may be secured to the gear box in order to facilitate the manipulation of the machine. Mounted within the cylinder 2 is a fluid-compressing and controlling piston 10, the latter being provided with a piston rod 11 which extends rearwardly into the gear case and is provided with a cross-head 12. Any suitable means may be employed for reciprocating this piston, a motor shaft 13 being journaled in the top of the box and provided with a pinion 14 which coöperates with a gear 15, the latter having a crank pin 16 which coöperates with the cross-head 12 so as to convert the rotary motion from the motor shaft into reciprocatory motion which will operate the piston 10 upon its forward and return strokes.

Fitted in the rear portion of the cylinder 2 is a fluid inlet valve 17, the same being a check valve of suitable construction whereby a supply of air may be drawn into this cylinder upon the initial starting of the machine, although a return flow of fluid from this valve is prevented. In the rear end of the cylinder 2 is provided a port 18, the latter communicating by the passage 19 to a port 20 and an inlet valve 21 both formed in the forward portion of the tool cylinder 3, the valve 21 being arranged in proximity to the forward end of this cylinder while the port 20 is arranged nearer to the center of the cylinder, that portion of the cylinder between the port 20 and the forward wall thereof serving as a cushion to retard the forward stroke of the tool piston. A port 22 is formed in a wall of the cylinder 2 at a point intermediate its ends, this port communicating by a passage 23 to a port 24 formed in the rear end of the cylinder 3. The piston 10 is also provided with a passage 25 which leads from the forward side thereof and terminates in a port 26, the latter extending to the cylinder-engaging surface of the piston, and when the same registers with the port 22 in the cylinder wall, the highly compressed fluid in the forward end of the cylinder 2 will be conducted through the passage 23 and port 24 to the space behind the tool-operating piston 4. The forward wall of the cylinder 2 is provided with a port 27 while the wall of the cylinder 3 at a point adjacent to the rear end thereof is provided with a port 28, a check valve 29 controlling the passage of fluid between these ports whereby the fluid may be conducted from the rear side of the piston 4 to the forward side of the piston 10. The wall of the cylinder 2 at a point intermediate its ends is also provided with a port 30, this port being uncovered by the piston 10 when the latter reaches the limit of its return stroke, and the cylinder 3 is also provided with a port 31 which is so arranged as to be uncovered by the piston 4 when the latter reaches the limit of its return stroke, the ports 30 and 31 being connected by a passage 32 whereby fluid from the forward side of the piston 4 may be conducted to the forward side of the piston 10 immediately before the latter begins its compression stroke.

In order to reduce as much as possible the vertical height of the machine, the piston rod 11 of the piston 10 is offset below the axial center of its center, and the rod 5 of the piston 4 is likewise offset below the axis of the cylinder 3 so that the bottom of the gear case and the two cylinders are in approximately the same horizontal plane. By so offsetting the rods of these pistons, turning of the same within their respective cylinders is also prevented, and in this manner, a proper registration of the port in the piston 10 with the corresponding port in the cylinder wall is insured.

In operating a fluid-actuated tool constructed in accordance with the present embodiment of my invention, power is applied preferably by an electric motor to the motor shaft, and this rotary motion in turn is converted into reciprocatory movement whereby the fluid-compressing and controlling piston 10 is reciprocated from one end of its cylinder to the other with a regular motion. Assuming the piston to start from the right hand position as shown in Fig. 1 and that the machine is being started initially, the initial charge of air or other fluid is admitted to the rear end of the cylinder 2 through the inlet valve 17, the forward movement of the piston 10 causing the necessary suction. Upon the return motion of the piston 10, the inlet valve being closed will cause the fluid in rear of the piston 10 to be trapped and compressed, this fluid being discharged through the port 18, into the passage 19 and this air is then conducted first through the valve 21 and then through the port 20 into the forward end of the cylinder 3. The tool piston 4 will either occupy a position at the rear end of the cylinder 3 or will be moved into such position, thereby uncovering the port 31 and permitting the fluid admitted to the forward side of this piston to be transferred through the passage 32 and port 30 into the space of the cylinder 2 in front of the piston 10. Upon the next forward stroke of the piston 10, the fluid at the forward side thereof will be trapped and compressed until the piston 10 approaches or reaches the limit of its forward or compression stroke at which time the confined fluid will be very highly compressed. As this piston 10 reaches or approaches the limit of its forward stroke, the port 26 will register with the port 22 in the cylinder wall, thus permitting the highly compressed fluid at the forward side of the piston 10 to be instantly released and, in passing through the passage 23 and port 24, discharges into the cylinder 3 at the rear side of its piston 4 causing an instantaneous stroke of this piston which will deliver the desired blow upon the tool. During the forward stroke of the piston 10, the air or fluid in the forward end of the cylinder 3 will be exhausted through the port 20, passage 19 and port 18 which opens into the cylinder 2 at the rear side of the piston 10, and the reduced pressure or partial vacuum thus formed in front of the tool-operating piston 4 will cause an accelerated movement thereof upon its power stroke. As the piston 10 is retracted, it will compress a body of fluid at its rear side which fluid is conducted through the port 18, passage 19 and first through the valve 21 and subsequently through the port 20 into the forward end

of the cylinder 3, thereby causing a retraction of the piston 4. The retracting movement of the piston 4 causes the fluid at the rear side thereof to be discharged through the port 28, valve 29 and port 27 into the forward end of the cylinder 2, and as the piston 4 reaches the limit of its rearward stroke, it uncovers the port 31 and allows any fluid under pressure in the forward end of the cylinder 3 to pass through the passage 32 and port 30 into the forward end of the cylinder 2. After the tool has been started, the cycle of operations just described is repeated, and as the fluid is not exhausted from the tool piston into the atmosphere after expansion but is conducted back into the compressing cylinder, a relatively high efficiency of the tool is insured.

By constructing the cylinder of the fluid-compressing piston of an area larger than that of the cylinder containing the tool-operating piston, a very high compression of the fluid supplied to the latter to drive it on its power stroke may be obtained, the pressure being regulated by the clearance at the forward end of the fluid-compressing cylinder.

I claim as my invention:

1. A fluid-actuated tool comprising a tool-operating piston, a fluid-compressing piston having a fluid passage leading from its forward side and terminating in a lateral port, a casing forming cylinders to inclose said pistons, a port being formed in the wall of the cylinder for the compressing piston and arranged to register with the lateral port thereof when said piston approaches the limit of its compression stroke, a passage being formed in said casing and extending from the port in the cylinder for the compressing piston to the rear side of the tool-operating piston, ports being formed in the rear end of the cylinder for the compressing piston and the forward portion of the cylinder for the tool-operating piston, said ports being connected by a passage formed in said casing for conducting compressed fluid from the rear side of the compressing piston to the forward side of the tool-operating piston during the entire return stroke of the compressing piston.

2. A fluid-actuated tool comprising a casing having cylinders formed therein, a tool-operating piston reciprocable in one of said cylinders, a fluid-compressing piston reciprocable in the other cylinder and having a fluid passage extending rearwardly from its forward side and terminating in a lateral port, a passage being formed in said casing and terminating at one end in a port arranged at the rear side of the tool-operating piston, and at its opposite end in a second port arranged to register with the lateral port of the compressing piston when the latter reaches the end of its compression stroke, a second passage being also provided which terminates in a port arranged at the rear end of the cylinder inclosing the compressing piston and the forward side of the tool-operating piston, and a transfer passage extending from the forward side of the tool-operating piston to the forward side of the compressing piston and having ports which are uncovered by the respective pistons when retracted.

3. A fluid-actuated tool comprising a casing having a pair of cylinders formed therein, and arranged one in front of the other, the axis of the rear cylinder being offset above the axis of the forward cylinder, a tool-operating piston mounted in the forward cylinder, a fluid-compressing piston mounted in the rear cylinder and having a fluid passage extending from its forward side and terminating in a lateral port, a fluid passage being formed in the casing and having one port opening at the rear side of the tool-operating piston and a second port arranged to register with the lateral port of the fluid-compressing piston when the latter is operated on its compression stroke, and a piston rod for the fluid-compressing piston offset below the axis of said piston.

4. A fluid-actuated tool comprising a casing having a pair of connected cylinders formed therein, one arranged in front of the other, a tool-operating piston mounted in said front cylinder, a piston rod connected to said piston and offset below the axis of its cylinder, and means in the other cylinder for supplying compressed fluid to said piston to drive the same on its power stroke.

5. A fluid actuated tool comprising a relatively large compression cylinder and a relatively small cylinder connected to an end thereof, a tool operating piston mounted in the smaller cylinder, a fluid compressing piston mounted in the larger cylinder, said compressing piston and its cylinder having passages capable of developing and suddenly delivering highly compressed fluid from the forward side of the fluid compressing piston to the rear side of the tool operating piston when the compressing piston approximately reaches the limit of its compressing stroke, and passages being provided in the walls of said cylinders for conducting fluid from the forward end of the cylinder containing the tool operating piston to the rear end of the larger compression cylinder wherein such fluid is expanded to minimize pressure at the forward side of the tool operating piston during its working stroke and for conducting compressed air from the rear end of the compressing cylinder to the forward end of the smaller cylinder containing the tool operating piston during the entire return stroke of the compressing piston for producing a return movement of the latter.

6. A fluid-actuated tool comprising a cas-

ing having a pair of cylinders arranged one in front of the other, the front cylinder having its axis offset below the axis of the rear cylinder, a tool-operating piston mounted in the front cylinder, a piston rod connected to said piston and offset below the axis of its cylinder, and a fluid-compressing piston mounted in the other cylinder and having an operating rod offset below the axis of its cylinder, passages being provided for conducting compressed fluid from the cylinder containing the compressing piston to the tool-operating piston to drive the latter on its power stroke, and passages being also provided in said casing for conducting compressed air from the opposite side of the compressing piston to the forward side of the tool-operating piston to retract the latter.

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

JOHN W. CANTY.

Witnesses:
W. P. WILBOR,
E. E. SCHUYLER.