No. 849,578. PATENTED APR. 9, 1907.

C. E. SHADALL.

MOTOR FOR ROCK DRILLS AND SIMILAR TOOLS.

APPLICATION FILED AUG. 8, 1904.

Fig. 1.

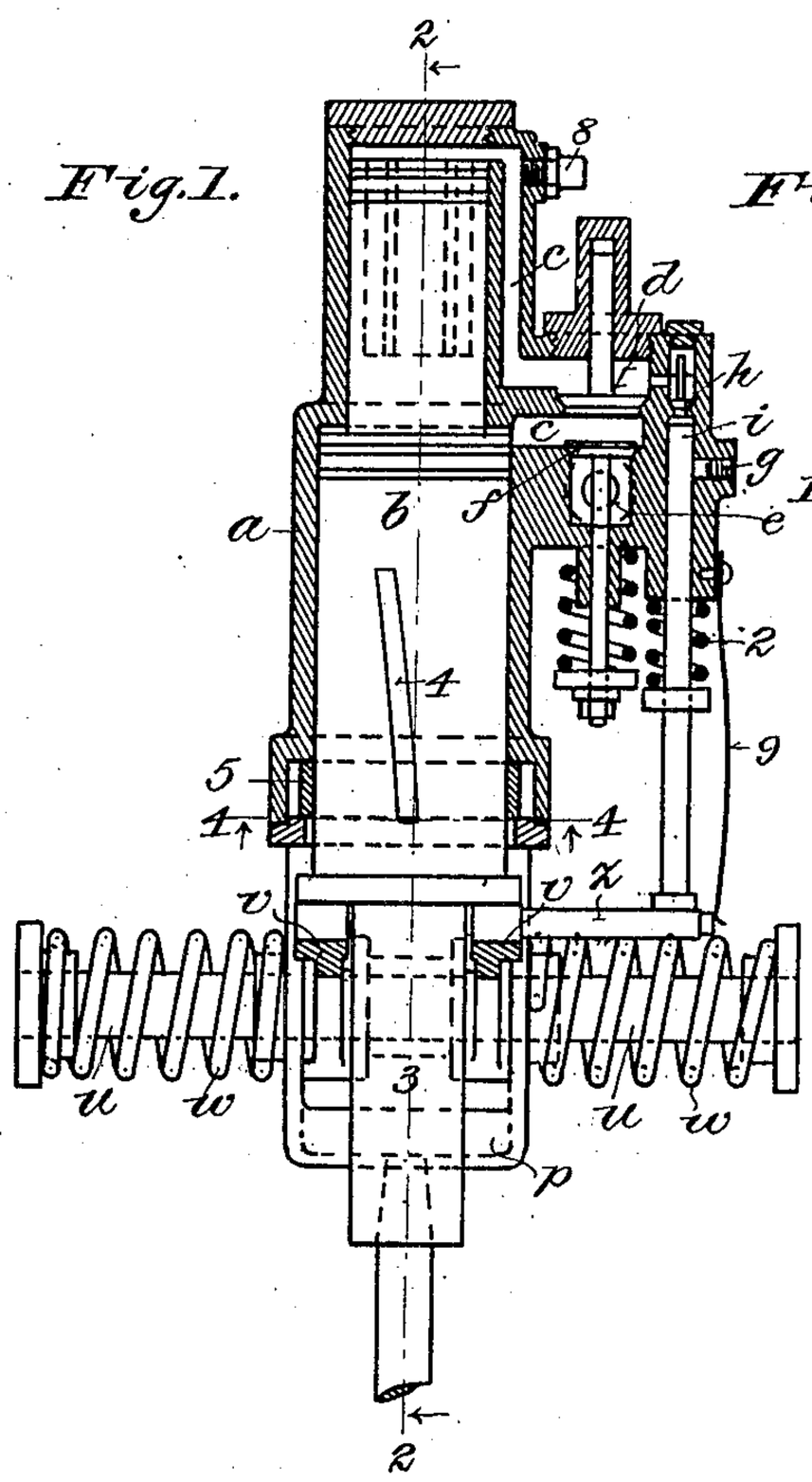


Fig. 2.

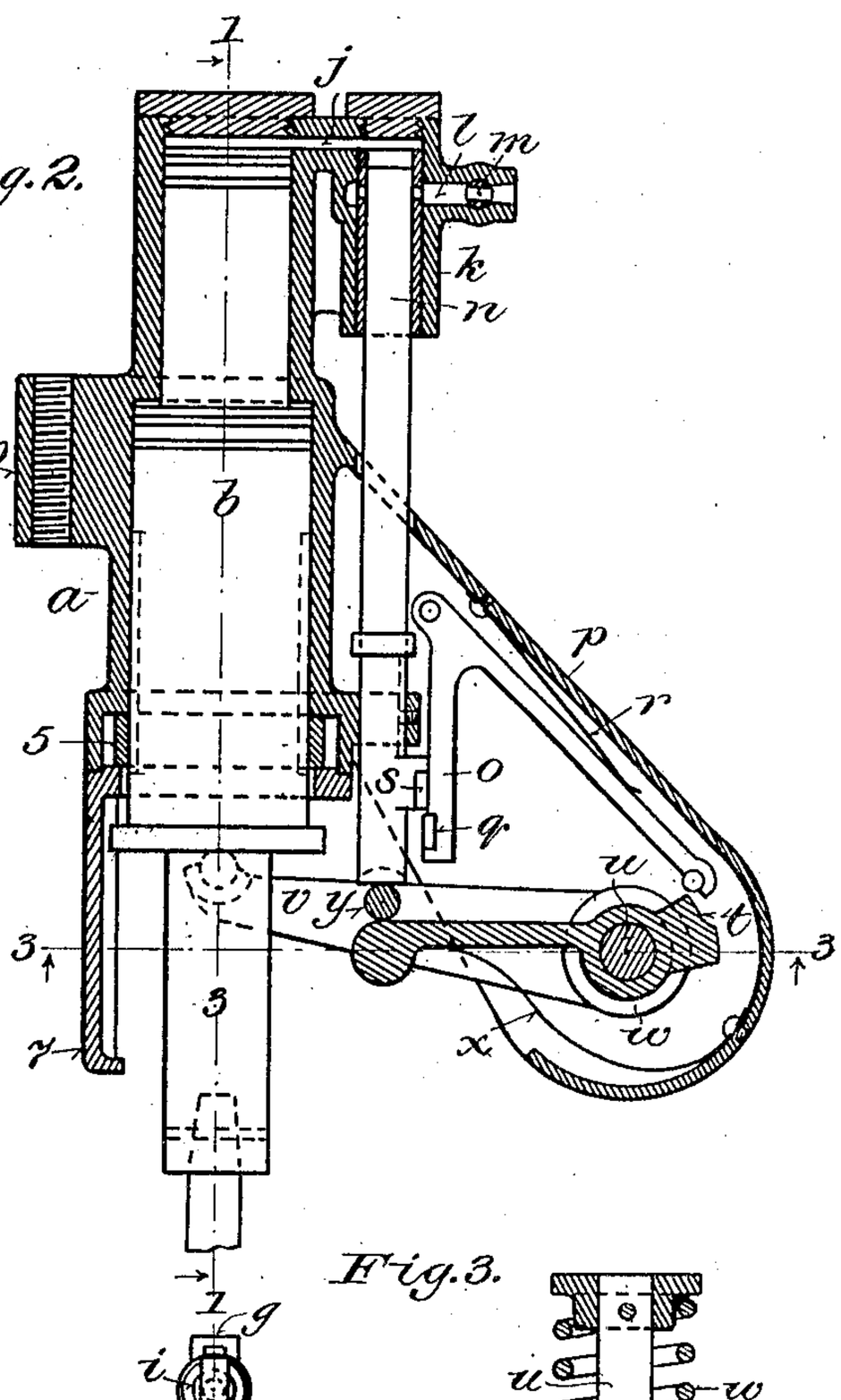


Fig. 3.

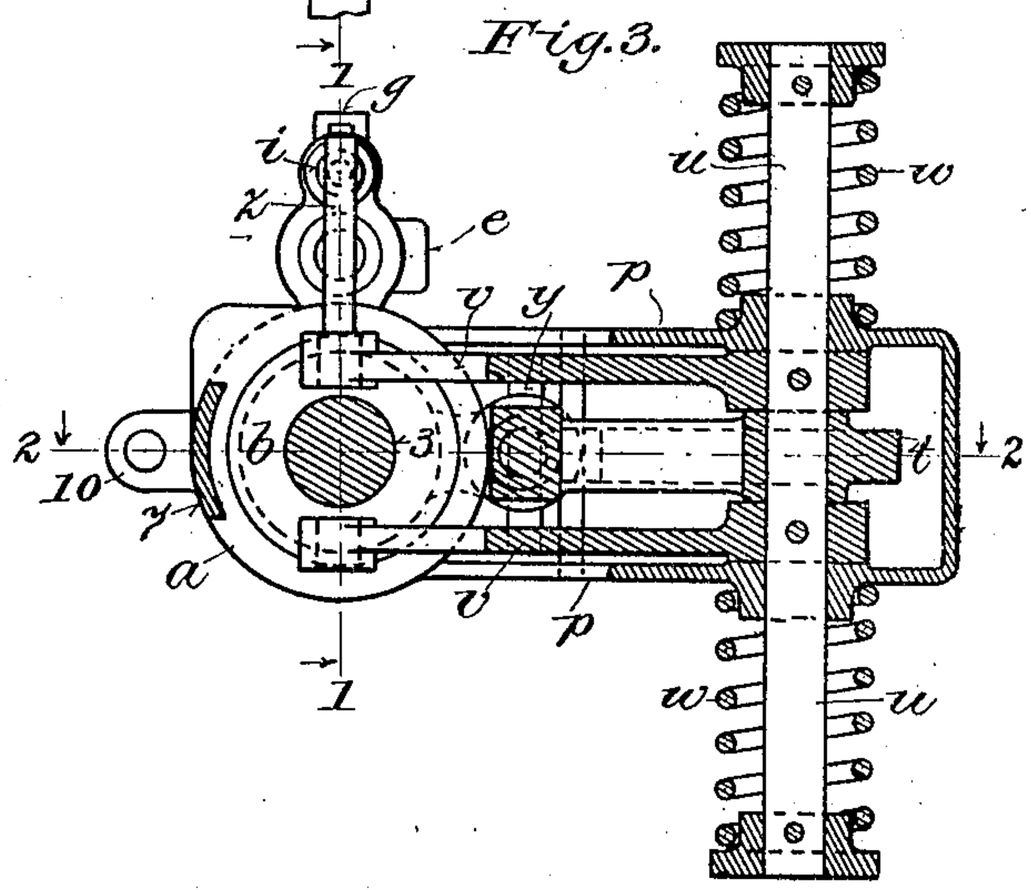
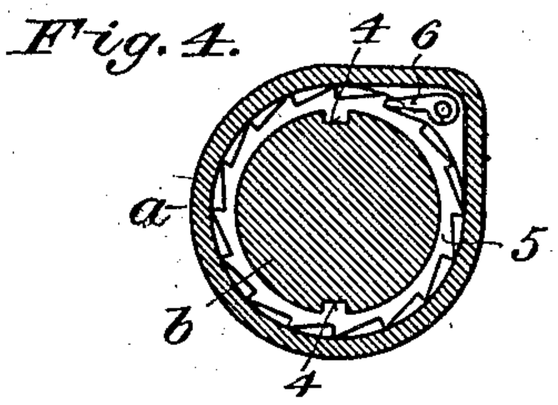


Fig. 4.



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UNITED STATES PATENT OFFICE.

CHARLES E. SHADALL, OF MILWAUKEE, WISCONSIN, ASSIGNOR OF ONE-HALF TO FREDERICK L. HORNEFFER, OF MILWAUKEE, WISCONSIN.

MOTOR FOR ROCK-DRILLS AND SIMILAR TOOLS.

No. 849,578. Specification of Letters Patent. Patented April 9, 1907.

Application filed August 8, 1904. Serial No. 219,876.

To all whom it may concern:

Be it known that I, CHARLES E. SHADALL, a citizen of the United States, residing at Milwaukee, in the county of Milwaukee and State of Wisconsin, have invented certain new and useful Improvements in Motors for Rock-Drills and Similar Tools, of which the following is a specification, reference being had to the accompanying drawings, forming a part thereof.

The main object of this invention is to operate rock-drills and similar tools directly by the explosion of gas or a mixture of air and gas or oil vapor and to adapt an internal-combustion motor to perform this class of work.

It consists in certain novel features of construction and in the peculiar arrangement and combinations of parts, as hereinafter particularly described, and pointed out in the claims.

In the accompanying drawings like letters designate the same parts in the several figures.

Figure 1 is a vertical medial section on the line 1 1, Figs. 2 and 3, of a motor embodying the invention. Fig. 2 is a similar section at right angles to that of Fig. 1 on the line 2 2, Figs. 1 and 3. Fig. 3 is a cross-section on the line 3 3, Fig. 2; and Fig. 4 is a cross-section on the line 4 4, Fig. 1.

The motor herein shown and described is an internal-combustion engine of the two-cycle type in which the charge is ignited at every working stroke of the engine.

Referring to the drawings, *a* is a differential cylinder having smaller and larger coaxial parts or bores, and *b* is a differential piston fitted to work in the two parts of said cylinder. The cylinder is formed or provided on one side with a passage *c*, connecting the smaller end of the cylinder with the adjacent end of the larger part thereof. This passage is provided with a check-valve *d*, which opens toward the smaller end of the cylinder. The cylinder is also formed or provided with an air-supply passage or connection *e*, which communicates with the passage *c* below the valve *d*, or it may be made to open into the larger part of the cylinder next to the smaller part independently of said passage *c*. It is provided with a spring-seated check-valve *f*, which opens inwardly.

g is a gas or oil supply connection which communicates, through a passage controlled by an inwardly-opening check-valve *h*, with the passage *c*, particularly when oil is used; but when gas made outside of the motor is used it may be introduced into the cylinder independently of the passage *c*. A reciprocating plunger *i* is fitted in the oil or gas supply passage below the valve *h* for forcing oil or gas into the passage *c* and thence into the smaller end of the cylinder or directly into the cylinder. This plunger is operated by means hereinafter explained. From the upper smaller end of the cylinder an exhaust-passage *j* leads into the exhaust-valve chamber *k* on one side of the cylinder and thence through ports in the valve-bushing into a passage *l*, opening to the atmosphere. The passage *l* is provided with a cock *m* for throttling the exhaust, and thereby regulating the speed of the piston or the frequency of its active or working strokes by checking its movement more or less on the return strokes.

n is a reciprocating exhaust-valve fitted to work in the bushing in the chamber *k* and normally closing the ports in said bushing. Its stem is guided at its lower end in a bearing provided therefor on the lower end of the cylinder, and it is held normally closed by a latch *o*, consisting of an angular lever fulcrumed at its angle to a bracket or housing *p*, which is formed on or attached to the cylinder. One arm of this lever is provided with a latch-block *q*, which is normally held by a spring *r* in engagement with a corresponding block *s* on the valve-stem. The other arm of said lever projects normally into the path of a weighted cam *t*, which is loosely or pivotally mounted on a rocker-shaft *u*, supported horizontally and transversely to the cylinder by bearings in the housing *p*. Upon this shaft are fixed two arms *v*, one on each side of the cam *t*, and the free ends of these arms are held by torsion-springs *w* in engagement with the lower end of the piston *b*, the springs *w* being attached at one end to collars on the ends of the shaft *u* and at the other end to the housing *p*. The weighted arm of the cam *t* is held normally by a spring *x* against a cross-bar *y*, connecting the rocker-arms *v* and serving as a stop for the cam. This cross-bar is arranged to engage with the lower end of the stem of the exhaust-valve to close said valve in the upward or return move-

ment of the rocker and piston. One of the arms *v* is provided with a pin *z*, arranged to engage with the lower end of the plunger *i* and to move it upward against the tension of a retracting-spring 2.

The piston *b* is provided at its lower end with a socket or tool-holder 3, and it is formed in opposite sides of the larger part thereof with spiral or inclined grooves 4, engaged by projections in the bore of a ratchet-wheel 5, which is loosely held in an annular recess in the lower end of the cylinder. The ratchet-wheel is held against turning in one direction by a pawl 6, pivoted to the cylinder in said recess, as shown in Fig. 4, but is permitted to turn in the other direction. A stop 7 is attached to the lower end of the cylinder to prevent the downward movement of the piston beyond a certain extreme limit.

In Fig. 1, 8 designates a plug provided in the usual or any suitable manner with sparking points or electrodes (not shown) for igniting the charge at the beginning of each working stroke of the piston, and 9 is a spring-contact arranged to be engaged by the pin *z* and to close and break the circuit of the igniter in the usual or any suitable manner at or near the upper limit of the return strokes of the piston. On one side the cylinder is formed or provided with a nut 10, as shown in Fig. 2, by which it is connected with an adjusting-screw parallel with the axis of the cylinder for moving the drill or other tool, with the motor, toward and from its work and for feeding the tool forward, with the motor, as the work progresses. This adjusting-screw and the frame or stand carrying it in the well-known manner common to rock-drills constitute no part of the present invention and are therefore not shown.

The motor herein shown and described operates as follows: A charge of gas or oil vapor mixed with air being introduced into the upper end of the cylinder and compressed is exploded by the sparking or other igniting device, imparting a quick downward movement to the piston and causing the drill or other tool attached thereto to strike a sharp blow. During the downward movement or active stroke of the piston air is drawn through the passage *e* into the cylinder above the larger part of the piston, the valve *d* being closed while the valve *f* is opened to admit air. Upon the termination of the downward stroke of the piston the weighted arm of the cam *t* is carried by its momentum against the tension of the spring *x* beyond the limit of the movement of the piston and rocker and causes the cam *t* to engage with and trip the latch *o*, thereby releasing the exhaust-valve, which is opened by gravity, or, if necessary or desirable, by a spring. The spent charge in the upper end of the cylinder now escapes through the exhaust-passage *j* and the passage *l* to the atmosphere, and the piston is returned to its initial position by the action of the springs *w* through the rocker-arms *v*. The return stroke of the piston forces the air drawn into the larger part of the cylinder during the downward or working stroke of the piston through the passage *c* into the upper end of the cylinder above the smaller part of the piston. As the piston approaches the upper limit of its movement the pin *z*, moving the plunger *i* upward past the gas or oil supply connection *g*, forces a charge of gas or oil into the passage *c*, through which it is entrained with air into the upper end of the cylinder. The exhaust-valve being closed by the engagement of the cross-bar *y* with the lower end of its stem in the upward movement of the rocker, the charge of gas or oil vapor mingled with the air in the upper end of the cylinder is compressed sufficiently to be ignited and exploded by a spark or other igniting device, whereupon the cycle of operations above explained will be repeated. In the downward or working stroke of the piston the ratchet-wheel 5 is turned to the right by the inclined grooves 4 and the projections in the ratchet-wheel engaging therewith, and in its upward movement the piston itself is turned to the right by the action of said grooves and projections, the ratchet-wheel being held from turning back to the left by the pawl 6. In this way the drill or other tool is turned step by step between its successive blows, according to the usual operation of rock-drills. By partially closing the passage *l* with the cock *m* and throttling the exhaust the upward movement of the piston is retarded, and the tool is thus caused to strike less frequent blows. By increasing the exhaust-opening the motor is caused to work more rapidly.

Various changes in minor details of construction and in the arrangement of parts may be made within the principle and intended scope of the invention.

I claim—

1. The combination of a cylinder, a piston fitted in said cylinder, an exhaust-valve, a latch normally holding said valve closed, a rocker operated by the movement of the piston in one direction, a spring tending to move said rocker in the opposite direction, a weighted cam loosely mounted on the rocker and adapted to be carried by its momentum beyond the limit of the active stroke of the piston sufficiently to trip said latch and release said valve, and a spring tending to hold said cam against a stop on the rocker, substantially as described.

2. The combination of a cylinder, a piston fitted therein, an exhaust-valve adapted to be closed by the return stroke of the piston, a latch for holding said valve closed, a rocker arranged to be moved in one direction by the active stroke of the piston, a spring tending to move said rocker in the reverse direction

and to return the piston to its initial position, a weighted cam pivotally mounted on the rocker, and a spring normally holding said cam against a stop on the rocker, the cam being adapted to be carried by its momentum against the tension of the spring acting thereon beyond the limit of the active stroke of the piston and in its further movement to trip said latch and permit the valve to open, substantially as described.

3. The combination of a differential cylinder having passages leading from an air-inlet opening into corresponding ends of the larger and smaller parts of the cylinder and connecting the same, a differential piston fitted in said cylinder, inwardly-opening check-valves in said passages, a spring-actuated rocker arranged to return the piston to its initial position after each active stroke thereof, a gas or oil supply connection provided with an inwardly-opening check-valve, and means operated by said rocker for forcing gas or oil into the smaller end of the cylinder during each return stroke of the piston, substantially as described.

4. The combination of a differential cylinder having an air-supply passage opening into the larger part of the cylinder next to the smaller part and provided with an inwardly-opening check-valve and a passage connecting the smaller end of the cylinder with the adjacent end of the larger part and provided with a check-valve which opens toward the smaller end of the cylinder, a differential piston fitted in said cylinder, a spring-actuated rocker for returning said piston to its initial position, a gas or oil supply connection, means operated by said rocker for forcing gas or oil through said connection into the smaller end of the cylinder during each return stroke of the piston, an exhaust-passage opening out of the smaller end of the cylinder, a valve normally closing said exhaust-passage, and means operated by said rocker for releasing and closing said valve at the proper times, substantially as described.

5. The combination of a differential cylinder having a passage connecting the smaller end of the cylinder with the adjacent end of the larger part thereof and provided with a check-valve which opens toward said smaller end, and having an air-supply connection opening into the larger part of the cylinder and provided with an inwardly-opening check-valve, a differential piston fitted in said cylinder, a spring-actuated rocker adapted to return said piston to its initial position, means actuated by said piston for injecting gas or oil vapor into the passage connecting the larger part with the smaller end of the cylinder, an exhaust port or passage opening out of the smaller end of the cylinder, a valve normally closing said port or passage, means operated by said rocker for releasing and closing said valve at the proper times, and a cock for throttling the exhaust and regulating the movement of the piston, substantially as described.

6. The combination of a differential cylinder having a valve-controlled passage connecting its smaller end with the adjacent end of the larger part thereof and having a valve-controlled air-supply connection opening into the larger part of the cylinder, a differential piston fitted in said cylinder, an exhaust-port opening out of the smaller end of the cylinder, a valve normally closing said port, a latch for holding said valve closed, a rocker arranged to be moved in one direction by the active stroke of the piston, a weighted cam pivotally mounted on said rocker and adapted to be carried by its momentum beyond the limit of the active stroke of the piston and to trip said latch, a spring normally holding said cam against a stop on the rocker, a spring adapted to return the rocker and piston to their initial positions and means actuated by the return movement of said rocker for injecting gas or oil vapor into the smaller end of the cylinder, substantially as described.

In witness whereof I hereto affix my signature in presence of two witnesses.

CHARLES E. SHADALL.

Witnesses:

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A. F. WEST.