

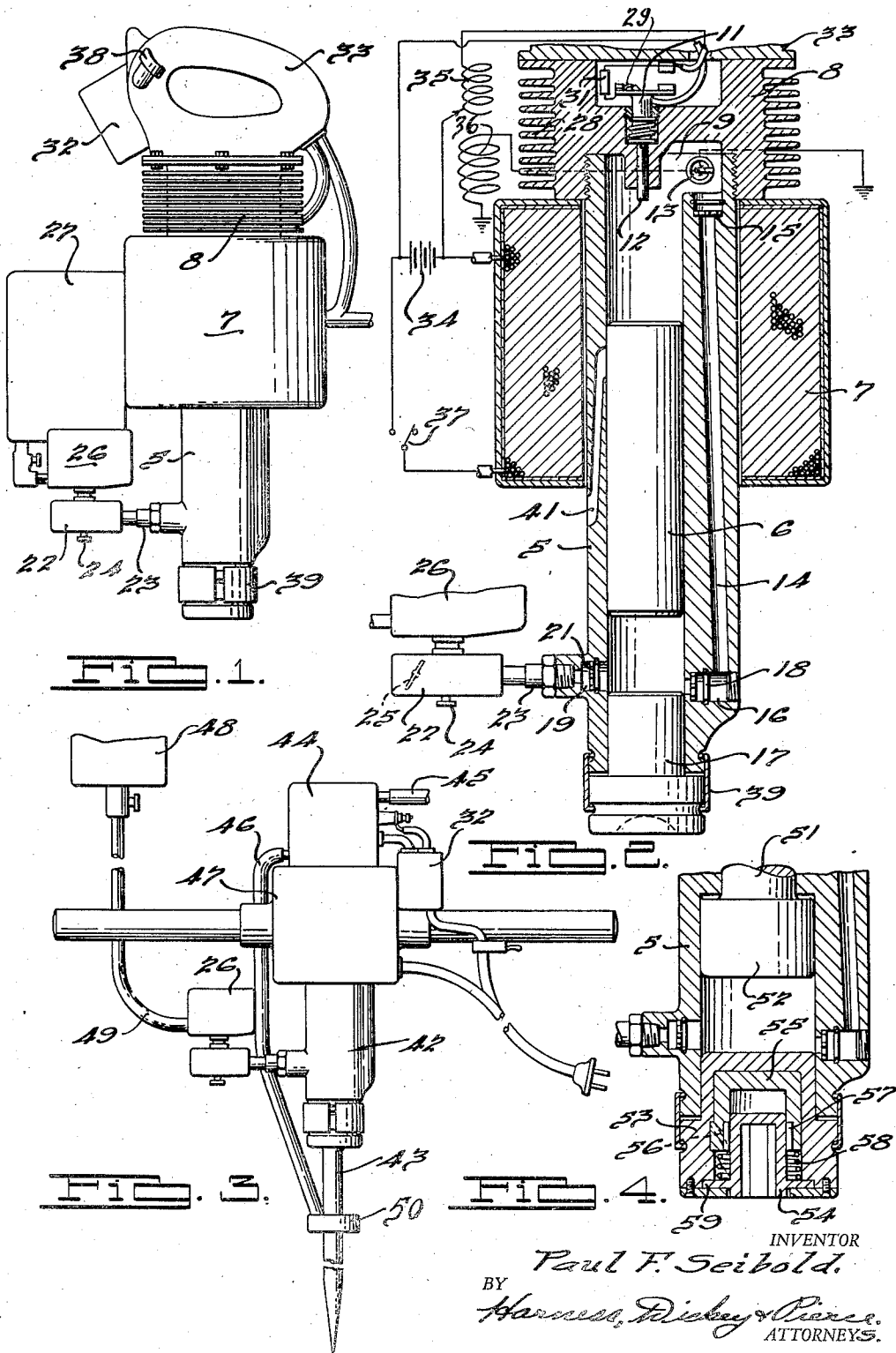
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STRIKING DEVICE

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STRIKING DEVICE

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My invention relates to power-operated devices and particularly to a device having a floating piston which is moved in one direction by explosive pressure and in the opposite direction by a magnetic force.

By way of example, I have illustrated my device as being employed as an air hammer for driving rivets and a jack hammer for breaking concrete and the like. It is understood, however, that I am not to be limited by my illustrated disclosure as the device has many other uses.

A cylinder is provided having a floating piston which has sufficient clearance to permit the free movement of the piston within the cylinder. At one end of the cylinder, intake and exhaust valves and conduits are provided by which gas is drawn into the lower end of the cylinder upon the movement of the piston in one direction and discharged out through the conduit in the opposite direction of movement of the piston. The conduit is connected to the upper end of the cylinder which forms the explosive chamber and into which the gas is forced by the plunger when moving therefrom.

A valve is provided on the end of the conduit to cut off the chamber from the conduit when compression is applied to the gases when the piston moves toward the chamber. A spark plug has the firing end projected in the chamber and a switch has a plunger projecting into the chamber preferably on the axis of the piston within its path of travel. The upward movement of the piston compresses the gas and moves the plunger to complete the contact of the switch, which produces a spark across the spark plug which fires the compressed gas and drives the piston to the lower end of the cylinder.

The wall of the cylinder is made up of non-magnetic material such as brass, stainless steel, aluminum and the like, and is surrounded by a solenoid having the proper number of ampere-turns to return the plunger toward the firing chamber to compress the gas and move the plunger of the switch to again fire the charge. The cylinder is in communication with the atmosphere when the piston nears the end of its downward movement to permit the escape of the fired gas. The device functions as a two-cycle engine and work is produced thereby by having the piston strike an element in the nature of a tool when moved by the explosive pressure.

Accordingly, the main objects of my invention are to provide a device having a floating piston which is moved in one direction under explosive pressure and in the opposite direction by a mag-

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netic force; to provide a device which operates as a two-stroke cycle engine, the compression stroke of which is produced by a magnetic force; to provide a hammer made from a cylinder having a floating piston which is driven against the tool end thereof by explosive pressure and which is returned to the position to be exploded under the influence of a magnetic force; to form a hammer from a cylinder having floating pistons surrounded by a coil which moves the piston into firing position relative to a head containing iron which increases the upward pull on the piston to compress the gas which is drawn to the lower end of the cylinder when the piston moves upwardly and is forced into the explosive chamber when the piston moves downwardly and the fired gas is expelled at the end of the downward movement; to provide a device having an explosive chamber in which the upward movement of a piston operates a switch to complete a circuit to a spark plug which explodes a gas to move the piston in the opposite direction and in general to produce a device which is self-contained for producing impulse energy which is simple in construction, positive in operation and economical of manufacture.

Other objects and features of novelty of my invention will be specifically pointed out or will become apparent when referring, for a better understanding of my invention, to the following description taken in conjunction with the accompanying drawing; wherein

Fig. 1 is a view in elevation of an impact device embodying features of my invention;

Fig. 2 is a broken sectional view of the structure illustrated in Fig. 1 with the piston near the end of its downward stroke;

Fig. 3 is a view in elevation of a device similar to that illustrated in Fig. 1, showing a further form which my invention may assume, and

Fig. 4 is a sectional view of a portion of the structure illustrated in Fig. 2 showing a modified form of my invention.

Referring particularly to Figs. 1 and 2, I have illustrated my device as embodying a cylinder 5 which is made of non-magnetic material, such as brass, aluminum, stainless steel, or the like, in which a piston 6 of magnetic material is fitted to be freely movable while maintaining minimum clearance. About the cylinder 5, a coil 7 is provided for the purpose of drawing the piston to the top end of the cylinder. The top end of the cylinder 5 is threaded or otherwise secured to a head 8 having a firing chamber 9. The head is similar to the head on an engine except for the

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switch 11 which is preferably mounted on the axis of the head with an operating plunger 12 projecting into the path of movement of the piston 6. A spark plug 13 is threaded into the wall of the head 8 with the firing ends thereof projecting within the firing chamber.

The wall of the cylinder 5 is provided with an intake passageway 14, the upper end of which contains a valve 15 which closes when the gas is compressed on the upward movement of the piston 6. The lower end of the passageway 14 joins with a passageway 16 which communicates with the inner area of the cylinder below the piston 6, above the riveting dolly 17 which closes the cylinder end. A spring clip 39 is herein illustrated for securing the dolly 17 to the end of the cylinder 5.

A valve 18 is mounted in the passageway 16 which closes the passageway upon the upward movement of the piston 6. An additional passageway 19 is provided through the wall of the cylinder at the lower end thereof, having a valve 21 therein which is open during the time the piston 6 moves upwardly. A gas mixing valve 22 is connected by a conduit 23 to the passageway 19, the flow of gas through which is regulated by the needle valve 24. A throttle valve 25 may also be employed on the valve 22 to control the amount of air flowing therethrough, to control the amount of gas drawn into the cylinder by the piston 6. A float chamber 26 may be employed on the mixing valve 22 communicating with a gas storage tank 27 mounted on the side of the device.

The head 8 may be provided with a plurality of louvers 28 to aid in cooling the device while the switch 11 may have the contacts 29 thereof shunted by a condenser 31 for producing a hot spark. A spark coil 32 is mounted in the handle 33 connected in series with a battery 34 or other source of electric energy for energizing the coil 35. The high tension coil 36 has one end connected to the spark plug which is grounded on the device to which the other end of the coil is also grounded. The same source or a different source of energy is employed for energizing the coil 7 controlled by a switch 37 operated by a thumb button 38 disposed on the side of the handle 33.

While I have illustrated a riveting dolly 17 for closing the end of the cylinder 5, it is to be understood that a sleeve or other tool holder could be employed, having a chisel or other tool disposed therein, which is operated by impact force. The novelty of the device embodies the two stroke cycle engine having the floating pistons, one stroke of which is produced by magnetic force. The use of the solenoid provides a particular advantage over the use of a spring for returning the plunger, as it will be noted that the material of the head is magnetic for exerting a greater force on the plunger when the plunger is at the upper end of its stroke at a time when the piston is doing the greatest amount of work in compressing the gas in the firing chamber. Conversely, when urged by the ignited gases downwardly, the further the piston moves from the head, the less the magnetic force resisting such movement, so that a stronger blow can be struck against the anvil or dolly.

The device so produced functions as a two cycle engine having a floating piston which is moved in one direction by a magnetic force. The wall of the cylinder 5 has one or a plurality of passageways 41, through which the exhaust gas escapes when the piston approaches the end of its downward movement.

In operation, the button 38 is pushed downwardly to close the contacts of the switch 37 to

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complete the circuit to the coil 7. The magnetic force produced by the coil draws the piston 6 upwardly and pressure on the button 38 is released to permit the plunger to again drop to the bottom of the cylinder 5. This up and down movement of the piston 6 draws in a charge of gas through the valve 22 and forces the charge through the passageways 16 and 14, into the firing chamber 9. When the button 38 is again pressed to close the switch 37, the upward movement of the piston 6 compresses the gas and moves the plunger 12 upwardly to close the contacts of the switch 11, to thereby complete the circuit to the spark plug 13, across the gap of which the spark bridges to ignite the compressed fuel in the head. The ignited fuel immediately expands and forces the piston 6 downwardly against the top of the dolly 17 with a driving force. Near the end of the downward movement, the compressed gas is forced upwardly through the passageway 14, forces the burnt gases within the cylinder above the piston out through the passageways 41 which are immediately closed upon the movement of the piston 6 upwardly under the magnetic force produced by the coil 7. In this manner, the device functions as a two cycle engine firing at the end of each up stroke and producing work when striking a tool or anvil, at the end of the downward stroke. When my device is employed as a hammer, as herein illustrated, it may be operated from a battery or from an electric circuit in a much more economical manner than the air guns heretofore employed which were operated on compressed air. My particular device therefore opens a large field for the use of hammers of this type, where heretofore, because of the expense of compressors and their operation, such devices could not be employed.

In Fig. 3 I have shown a further form of my device, that embodying a jack hammer 42, having a pin 43 which is driven by the piston 6 for breaking up concrete and doing other similar work. The cylinder 44 is provided with a water jacket and a conduit 45 is employed for introducing water about the cylinder within the jacket which is conducted through a line 46 to a spray nozzle 50 which sprays the water upon the area about the end of the pin 43 for eliminating dust which may be produced by the use of the hammer. A casing 47 is provided for surrounding the coil 7 which may be made of magnetic material to increase the lines of flux produced by the coil disposed therein. In the present construction, the gas container 48 is herein illustrated as a separate element which may be mounted on an easel or hung on any device, so long as it is higher than the float chamber 26 to which it is connected by a flexible conduit 49.

Referring to Fig. 4, I have illustrated a modified form of my invention wherein the floating piston has a compression end 51 which is smaller than the intake end 52. The advantage of this type of piston resides in its ability to draw in a larger charge of gas than that obtained when the piston ends are of the same diameter. The anvil employed as a closure for the end of the cylinder 5 has a tool supporting sleeve 54 therein which is slightly rotated each time the anvil is struck by the end portion 52 of the piston. This rotation is obtained by a cup-shaped hammer 55 having helical splines 56 which mate with helical splineways disposed in the inner walls of the anvil 53. An over-running clutch is provided by rollers 57, which functions to turn the sleeve when the hammer 55 moves upwardly, and which is

disconnected from the sleeve 54 when the hammer 55 is moved downwardly. A spring 53 moves the hammer 55 upwardly when the force of the blow struck by the piston is relieved from the tool holding sleeve 54.

As the end portion 52 of the piston strikes the anvil, the blow is transmitted to the tool through the flange 59 on the tool supporting sleeve 54 and the hammer 55 moves downwardly under the force of the impact. Thereafter, the spring 53 moves the hammer 55 upwardly, engaging the overrunning clutch 57 which produces the turning of the tool sleeve 54 through the operation of the helical splines 56 in the splineways above mentioned. The turning movement is slight, but in view of the rapid operation of the piston the tool is turned at a desirable speed.

While I have illustrated the needle valve as being positioned for operation in a particular plane, it is to be understood that known types of carburetors, valves and the like may be substituted therefor which permit the operation of the gun in any position. Similarly, the gas tank carburetor or mixing valve may be attached to the gun or may be separately mounted. When the gun is to deliver an upward or sideward blow, it is first operated when in a position to strike a downward blow to charge the firing chamber so that the gun thereafter will operate when striking an upward or sideward blow.

It is to be understood that my device, having a floating piston operating in one direction under explosive pressure and in the other direction by magnetic force is not limited to the application of riveting or like hammers, but that such device has a broad use and may be employed in machines or mechanisms in which an impact blow is utilized.

What I claim is:

1. A device having a floating piston which is free at both of its ends, means for moving said piston in one direction embodying explosive pressure produced by the burning of a compressed gas, and magnetic means for moving said piston in the opposite direction for compressing said gas.

2. A device having a solid piston which is free at both of its ends, means for moving said piston in one direction embodying explosive pressure produced by the burning of a compressed gas, and magnetic means for moving said piston in the opposite direction for compressing said gas, and means for continuing the reciprocation of the piston automatically.

3. A device having a solid piston which is free at both of its ends, means for moving said piston in one direction embodying explosive pressure produced by the burning of a compressed gas, and magnetic means for moving said piston in the opposite direction for compressing said gas, means for continuing the reciprocation of the piston automatically, and means for regulating the speed of reciprocation of said piston.

4. A device having a floating piston, a chamber in which said piston reciprocates having intake and exhaust circuits for fuel communicating therewith, firing means in one end of the chamber, a magnetic coil for moving the piston in the direction of the firing chamber to draw in a charge of fuel at the opposite end of the piston, to compress the fuel in the chamber end thereof

and to operate the firing means, resulting in the downward movement of the piston which delivers a working stroke and forces the drawn in fuel into the firing end of the chamber.

5. A device having a floating piston, a chamber in which said piston reciprocates having an intake port for a fuel communicating therewith, firing means in one end of the chamber, a magnetic coil for moving the piston in one direction to draw in a charge of fuel at one end of the piston, to compress the charge at the other end thereof, and to operate the firing means, resulting in the downward movement of the piston under the pressure of the burning charge of fuel which delivers a working stroke and forces the drawn in fuel into the firing end of the chamber, said chamber having exhaust ports which are uncovered by the piston before it reaches the end of its working stroke.

6. In a device having a cylinder, a piston which is free at each of its ends, magnetic means for moving the piston toward one end of the cylinder, a chamber in which a gas is compressed by said piston movement, and means for firing the gas which will expand upon burning for moving the piston in the opposite direction.

7. A device having a piston operating as in a two-cycle engine, one stroke of which is produced by a burning fuel, the opposite stroke which compresses the fuel before burning being produced solely by a magnetic force.

8. In a device having a floating piston, a cylinder in which said piston is reciprocated, means for delivering a gas to one end of the cylinder for moving the piston in one direction, and a magnetic flux acting on said piston as the sole means for moving it in the opposite direction.

9. In a device having a floating piston, a cylinder in which said piston reciprocates, means for delivering an expansible medium to one end of the cylinder for moving the piston in one direction, and a magnetic flux acting on said piston as the sole means for moving it in the opposite direction.

10. In a percussion hammer having a cylinder, a solid piston free at both of its ends disposed in said cylinder for compressing a gas at one end of a stroke and for delivering a blow at the end of its opposite stroke, means for delivering a gas to one end of the cylinder, means for igniting said gas to move the piston to deliver said blow, and magnetic means for moving said piston in the opposite direction to compress a new charge of gas.

11. In a percussion hammer having a cylinder, a solid piston free at both of its ends disposed in said cylinder for compressing a gas at one end of a stroke and for delivering a blow at the end of its opposite stroke, means for delivering a gas to one end of the cylinder, means for igniting said gas to move the piston to deliver said blow, magnetic means for moving said piston in the opposite direction to compress a new charge of gas, and a switch in the circuit of said magnetic means for making and breaking said circuit at the will of the operator to provide the sole means for initiating the reciprocation of said piston and for interrupting its operation.

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