No. 638,489.

Patented Dec. 5, 1899.

C. B. ALBREE.

MOTOR FOR TOOLS.

(Application filed June 15, 1899.)

(No Model.)

Fig. 1.

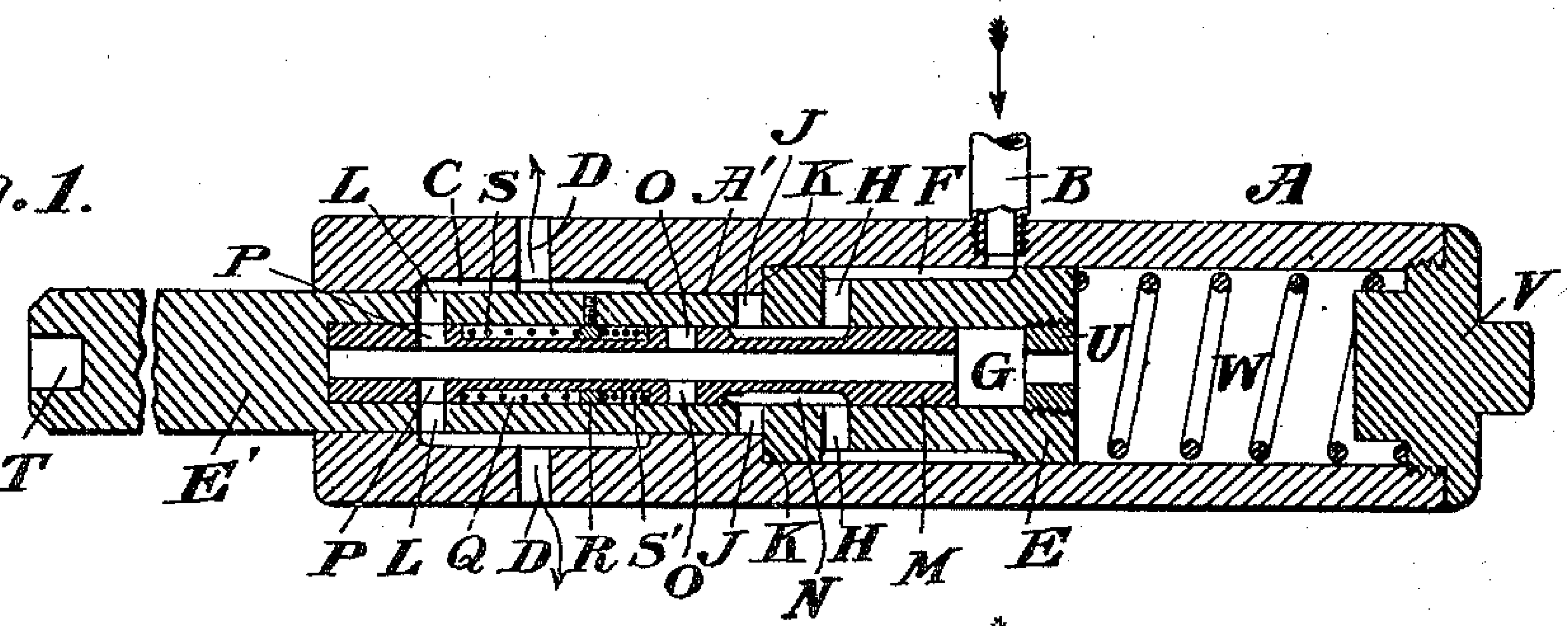


Fig. 2.

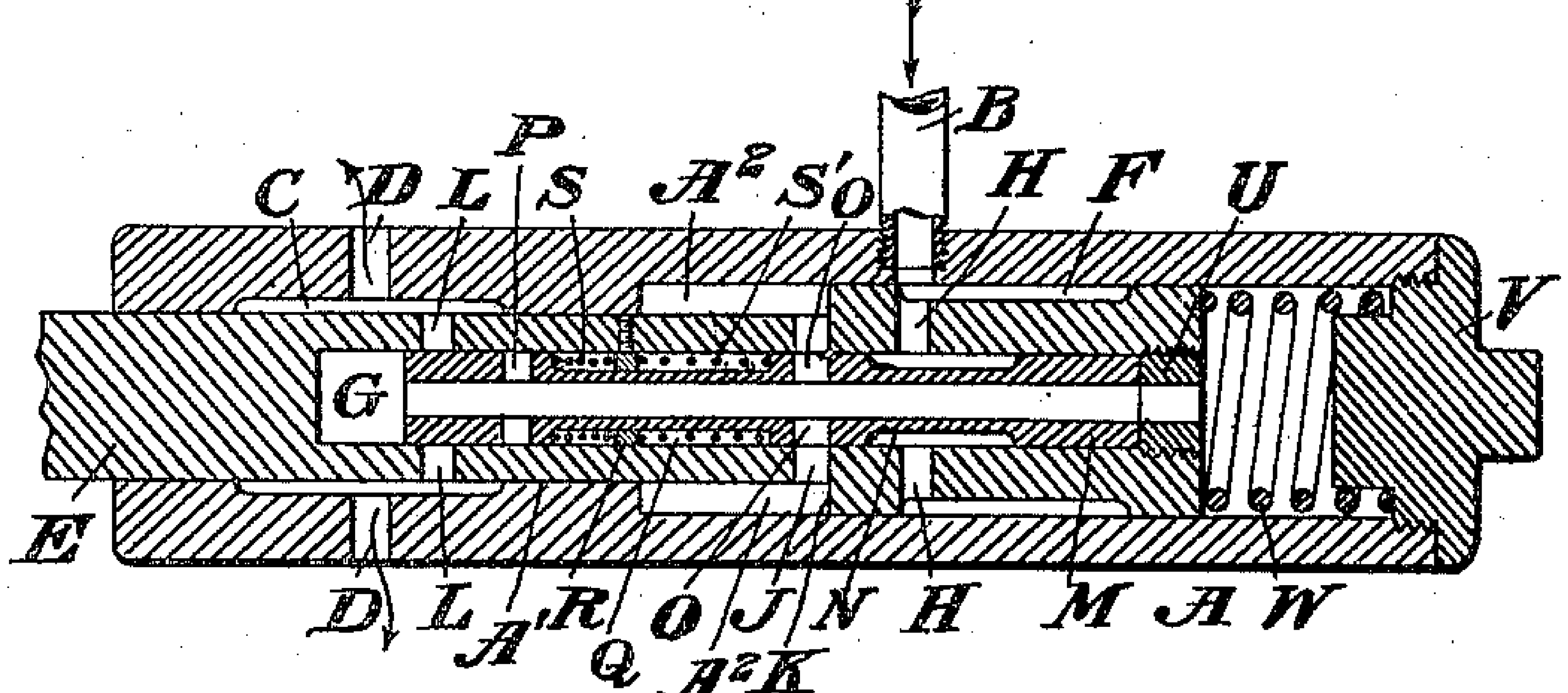


Fig. 3.

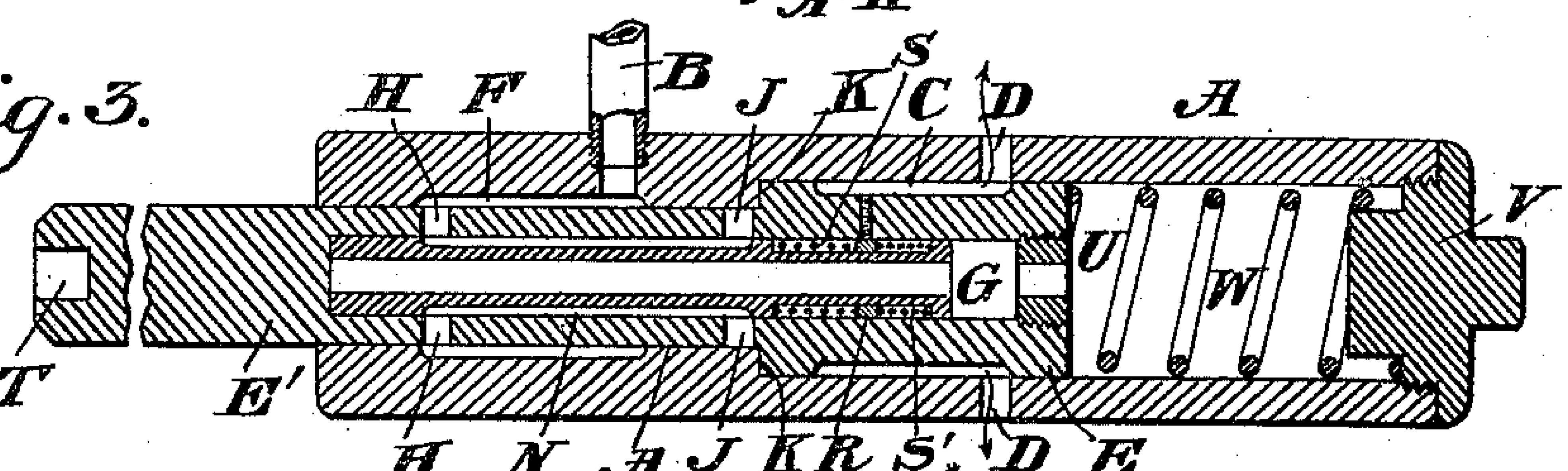


Fig. 4.

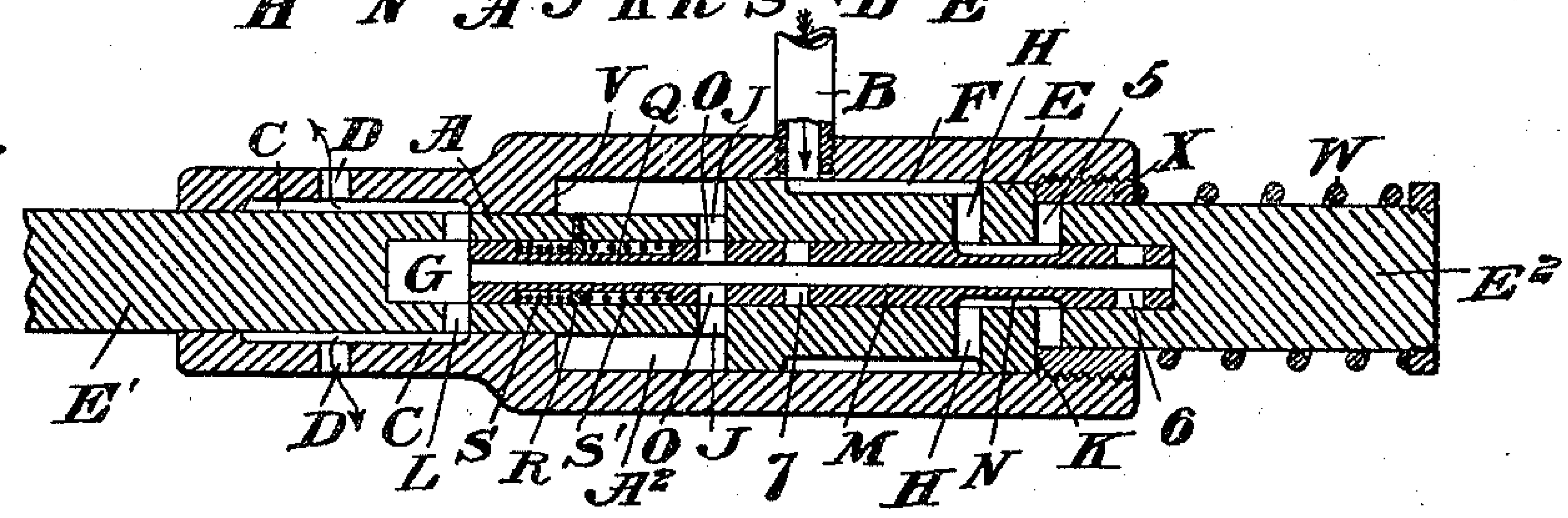
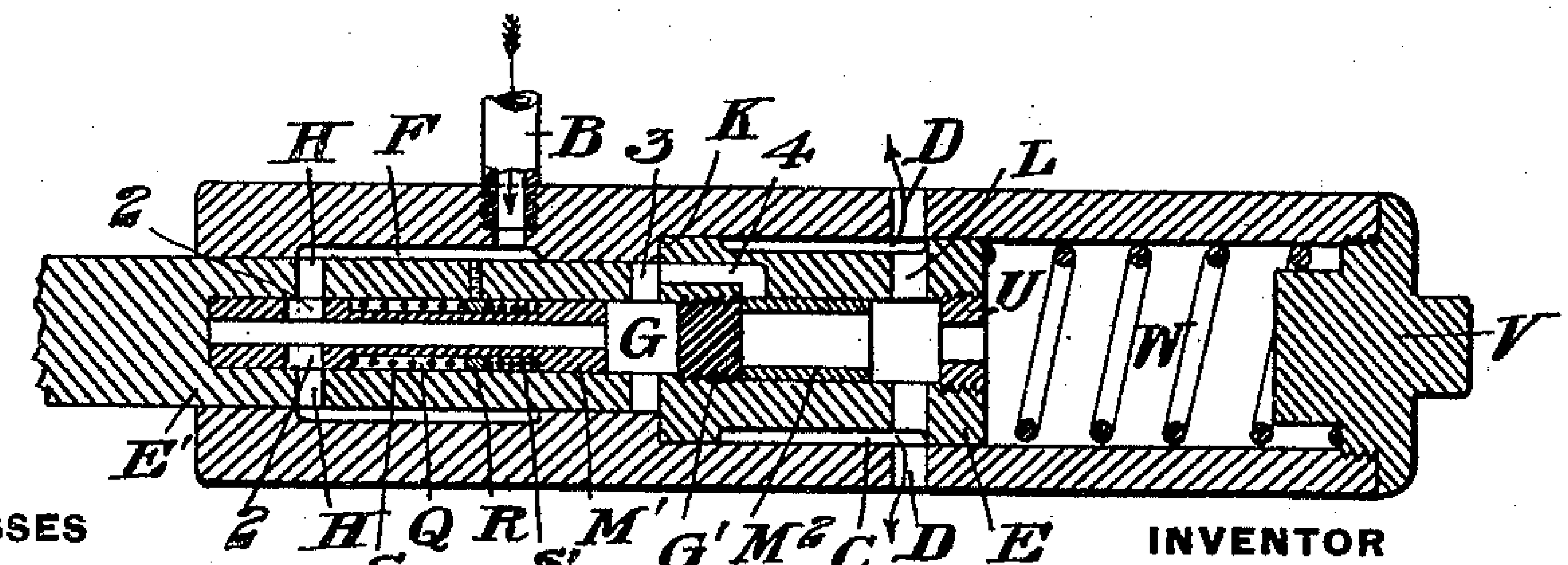


Fig. 5.



WITNESSES

INVENTOR

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UNITED STATES PATENT OFFICE.

CHESTER B. ALBREE, OF ALLEGHENY, PENNSYLVANIA.

MOTOR FOR TOOLS.

SPECIFICATION forming part of Letters Patent No. 638,489, dated December 5, 1899.

Application filed June 15, 1899. Serial No. 720,599. (No model.)

To all whom it may concern:

Be it known that I, CHESTER B. ALBREE, of Allegheny, in the county of Allegheny and State of Pennsylvania, have invented a new and useful Improvement in Motors for Tools, &c., of which the following is a full, clear, and exact description.

Figure 1 is a longitudinal section of a pneumatic tool embodying my invention. Fig. 2 shows the same with the parts in the positions which they occupy when the piston is at the other end of its stroke. Fig. 3 illustrates a modification, and Figs. 4 and 5 are like views of other modifications.

My invention relates to pneumatic tools, rock-drills, hammers, stamps, and other mechanism of the reciprocatory type, and is designed to provide a compound motor of improved construction wherein the motive fluid acts at high pressure to move the piston in one direction and then expansively at a lower pressure to move the piston in the opposite direction, thus imparting great efficiency to the motor and enabling it to be used with economy of motive fluid.

In the drawings, A represents the cylinder, having two portions A A' of different diameters, and B is the inlet-port, opening into the larger portion A of the cylinder.

D is the exhaust-port, communicating with an annular space C in the smaller diameter of the cylinder.

The piston E has two portions E and E' of different diameters, fitting, respectively, within the portions A A' of the cylinder, and around the larger portion E is an annular recess of sufficient length to constitute a port which is always in communication with the inlet-port B in every position of the stroke of the piston.

It will be understood that the shape of the ports B and F may be reversed, the port B being elongated and the port F being a single opening, and the same is true of the relations between the ports C and L, hereinafter described.

G is a passage which is formed lengthwise through the piston, having ports H communicating with the annular port F and ports L communicating with the annular port C, adapted by reason of the length of the port C to be in communication therewith at every portion of the stroke of the piston. Ports J also lead from the passage G to the outer surface of the piston at or near the shoulder K at the junction of the large and small diameters of the piston. The passage G is preferably cylindrical, and it contains a hollow sliding inertia-valve M, which fits neatly therein, but is free to slide back and forth. It has an exterior annular recess N, constituting a port of sufficient length to register with and connect the ports H and J when the valve is at the outer end of the passage G, as shown in Fig. 1. It has also a port O, leading from the interior to the exterior of the valve and adapted to register with the ports J when the valve is at the inner end of the passage G, as illustrated in Fig. 2. The valve has ports P, leading from its interior to its exterior surface and adapted to register with the ports L when the valve is at the outer end of the passage G, as shown in Fig. 1. The valve has also an exterior annular space Q so situate that it does not register with any two of the ports L, J, or H at any position of the valve. Therefore it does not serve as a port; but its purpose is to contain coiled springs S S', the adjacent ends of which bear against a ring R, which is fixed to the interior of the passage G of the piston. The outer ends of the springs bear against the valve at the ends of the annular space Q, and these springs are so related to each other in strength that normally they hold the valve in the position shown in Fig. 1; but they are sufficiently flexible to allow the valve to be moved by inertia to the other end of its stroke in the manner explained below. The piston has a socket or holder T, adapted to the tool which is intended to be used with it, and the cylinder has a suitable head V. At the end of the passage G is a stop U, adapted to limit the motion of the valve, and between the cylinder-head and the piston is a spring W, which is adapted to return the piston automatically to the outer end of the stroke when the cylinder is disconnected from power in order to put the parts in position for starting, as explained below.

The operation is as follows: The parts being in the position shown in Fig. 1, to start the motor compressed air is admitted through the port B and thence passes through the passage F and ports H, passage N, and ports J to the shoulder or differential area K on the piston and forces the piston to the rear end of the cylinder, the air contained in the rear portion of the cylinder being displaced through the passage G, hollow valve M, ports P and L, and passage C to the exhaust-port. When the piston strikes the rear end of the cylinder, its motion is checked thereby, and the valve M, by reason of its inertia, moves back in the passage G until it is stopped by the stop U. The parts then are in the position shown in Fig. 2, in which the inlet-ports B and H are cut off from communication with the working space of the cylinder, and the space A^2 of the cylinder at the shoulder K is put into communication with the rear of the cylinder by way of the ports J O and hollow valve-passage M, the exhaust-ports being cut off from communication with the interior of the valve by the disconnection of the ports L and P. Thereupon the air under the pressure which is contained in the space A^2 flows to the rear end of the piston, and by reason of its expansion forces the piston outward, the air-pressure per square inch decreasing as the motion of the piston continues and as the volume of the space in which the motive fluid can expand increases. When the forward motion of the piston is checked, either by striking the end of the cylinder or by the striking of the tool against some object before the end of the stroke is reached, the valve M continues to move by reason of its inertia until it reaches the end of the passage G, whereupon the valve is brought again into the position shown in Fig. 1, another supply of motive fluid is admitted from the inlet B into the space A^2, and any motive fluid remaining under pressure at the back end of the piston exhausts through the ports P, L, and D, the motion of the piston being thus reversed and the operation repeated, as above described.

In order to insure the starting of the piston, it is necessary that the passage N should be in register with the ports J and H and also that the piston should be at the outer end of its stroke. This is not always the position of the parts when the motive fluid is cut off, and if the apparatus should come to rest with the piston at the rear end of its stroke it must be moved to the other end in order to make it possible to start the apparatus. Great convenience is effected by doing this automatically, and although such automatic means are not essential to my invention, broadly considered, the means which I have invented for that purpose are desirable, and I intend to claim the same.

The necessary automatic motion of the valve to its outer position is effected by the springs S S', which may be either in tension or compression, and which, as above explained, normally hold the valve in the position of Fig. 1.

The spring W when the motive fluid is turned off presses the piston automatically to the outer end of its stroke, so that no matter at what portion of the stroke the piston may be stopped it will immediately assume the position required for starting. When the cylinder is vertical, or nearly so, with the piston extending downwardly, this spring is not necessary, for the automatic return of the piston will be effected by gravity.

The arrangement of the ports and passages shown in Figs. 1 and 2 may be varied or more than one inertia-valve may be employed without departure from the scope of my invention. For example, the parts may be arranged so that the motive fluid will act at high pressure to move the piston outwardly and will perform the backward stroke by expansion.

The springs controlling the valve M may be placed inside of the valve or at its ends or may be otherwise arranged to perform the function above explained.

In Fig. 3 I show a motor working on the same principle as in Fig. 1, but with the position of the ports varied. The operation of this form of my invention will be sufficiently apparent from the drawings without further description, the same reference-letters being used as in Fig. 1 to designate the parts.

In Fig. 4 I show a form of my device in which the direct pressure is employed to force the piston outwardly, while the reverse stroke is accomplished by expansion of the motive fluid admitted on the outstroke. In this form the piston has three diameters, the portion E^2 at its rear end extending outwardly through the cylinder and an annular stop X being provided to engage the part E and to limit the instroke of the piston. In the operation of this form of my invention the compressed air passes from the part B, through passage F, port H, passage N, and port 5 into the space between the parts E and E^2 of the piston and propels the piston forward, the air in advance of the part E being displaced through ports J O L and passage C through the exhaust D. When the piston is checked, the valve moves forward by inertia, thus shutting off the exhaust and inlet and connecting the space back of the piston part E with the space in front of said part by way of a port 6, hollow valve-passage, and ports 7 and J. The compressed air in the cylinder then expands into this space in front of the piston and drives the piston back, until at the end of its back stroke the valve is moved by inertia into the position shown in Fig. 4.

In Fig. 5 I show an arrangement which is similar to Fig. 1, except that two inertia-valves M' M^2 are employed. A plug G' separates these valves and forms the rearward stop for the valve M'. Air enters the inlet-port B, traverses the passage F, port H, port 2 into the interior of the hollow inertia-valve M', and thence through said valve and through a port 3 to the space back of the shoulder K between the two diameters of the piston, thus moving the piston rearwardly. When the piston reaches the end of its stroke, the valves M′ M^2 are moved back by inertia, thus closing the port H and cutting off the air-supply and putting the space A^2 of the cylinder into communication with the space back of the piston by way of a port 4, which is uncovered by backward motion of the valve M^2, the exhaust-ports L and D being cut off from communication with the space back of the piston by the same rearward motion of this valve. The piston is then propelled forwardly, and when its motion is checked the inertia-valves are again brought into the position shown in Fig. 5, and the operations above described are repeated.

The efficiency of the apparatus will be appreciated by those skilled in the art. The operation of the valves is automatic, the construction is simple, and by reason of the compound action of the motor the motive fluid received at high pressure can be exhausted at very low pressure, and great economy thus obtained.

I claim—

1. A compound motor having a piston with differential areas, a valve or valves carried thereby and adapted to move by inertia when the motion of the piston is checked, and a port or ports affording communication between the space at the small area of the piston and the space at the larger area thereof, said valve or valves being arranged to open said communication at the time when the said port is cut off from the source of motive fluid, substantially as described, whereby a high-pressure motive fluid is admitted to press on the smaller area of the piston at one end of the travel of the valve, and whereby the same motive fluid is admitted to press on the larger area of the piston when the piston and valve are checked in their travel at or near the opposite end; substantially as described.

2. A motor having a piston, a valve carried thereby and adapted to move by inertia to control the ports, and a spring bearing on the valve and adapted to restore it to starting position when the motor is stopped; substantially as described.

3. A compound motor having a piston with differential areas, a valve or valves carried thereby and adapted to move by inertia when the motion of the piston is checked, and ports controlled by said valves, whereby a high-pressure motive fluid is admitted to press on the smaller area of the piston at one end of the travel of the valve, and whereby the same fluid is admitted to press on the larger area of the piston when the piston and valve are checked in their travel at or near the opposite end, said valve having a spring adapted to hold it at or near the middle portion of its travel in position to admit motive fluid to the smaller piston area when the piston is at rest; substantially as described.

4. A motor, comprising a cylinder having portions of different diameters, a piston within the cylinder and having corresponding portions of different diameter, a valve carried by the piston and arranged to move by inertia when the piston is checked, and a spring acting upon the piston and adapted to move toward the smaller portion of the cylinder when the motor is stopped, to restore the parts to starting position; substantially as described.

5. A motor having a reciprocating piston with differential areas upon which the motive fluid acts in opposite directions respectively, one of said areas adapted to receive such fluid at high pressure and the other to receive the same expansively, a valve adapted to be moved by inertia when the motion of the piston is checked, ports controlled by the motion of the valve and adapted to successively admit fluid at high pressure to one of said areas and afterward to admit the same fluid to act expansively on the other piston area, and an inlet-port for such fluid adapted to be opened by said valve when it moves to admit the fluid at high pressure and to be closed thereby when it moves to admit the fluid expansively to the other piston area, and an exhaust-port also controlled by such valve and adapted to be opened thereby during direct action of the motive fluid and to be closed during its expansion; substantially as described.

6. A motor having a reciprocating piston with differential areas upon which the motive fluid acts in opposite directions respectively, one of said areas adapted to receive such fluid at high pressure and the other to receive the same expansively, a valve adapted to be moved by inertia when the motion of the piston is checked, and ports controlled by the motion of the valve and adapted to successively admit fluid at high pressure to one of said areas and afterward to admit the same fluid to act expansively on the other piston area, said valve being hollow and having ports formed in and through its side; substantially as described.

In testimony whereof I have hereunto set my hand.

CHESTER B. ALBREE.

Witnesses:

H. M. CORWIN,

F. E. GAITHER.