No. 840,668. PATENTED JAN. 8, 1907.

H. B. STOCKS.

POWER HAMMER AND MEANS OF OPERATING SAME

APPLICATION FILED MAR. 26, 1906.

3 SHEETS—SHEET 1.

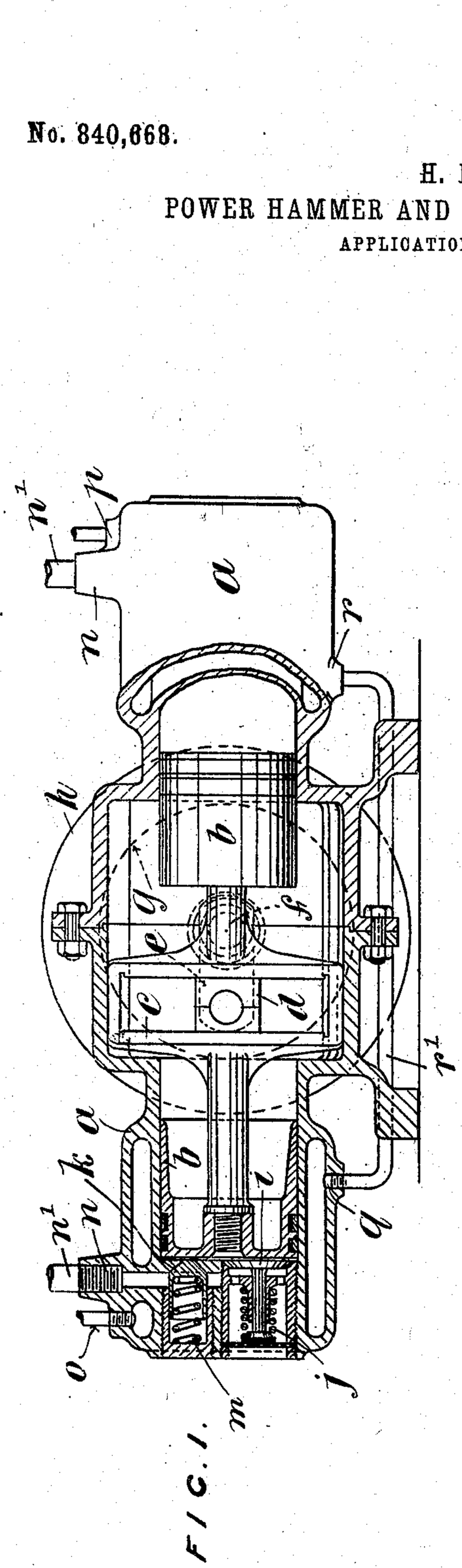

FIG. 1.

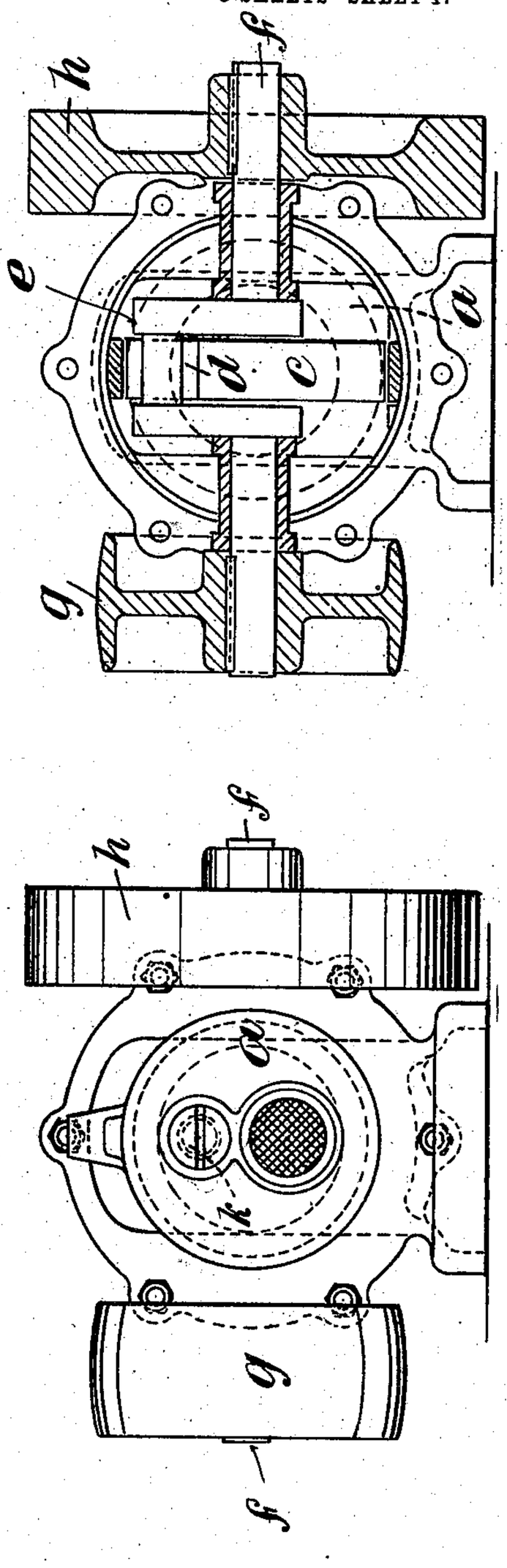

FIG. 3.

FIG. 2.

Witnesses
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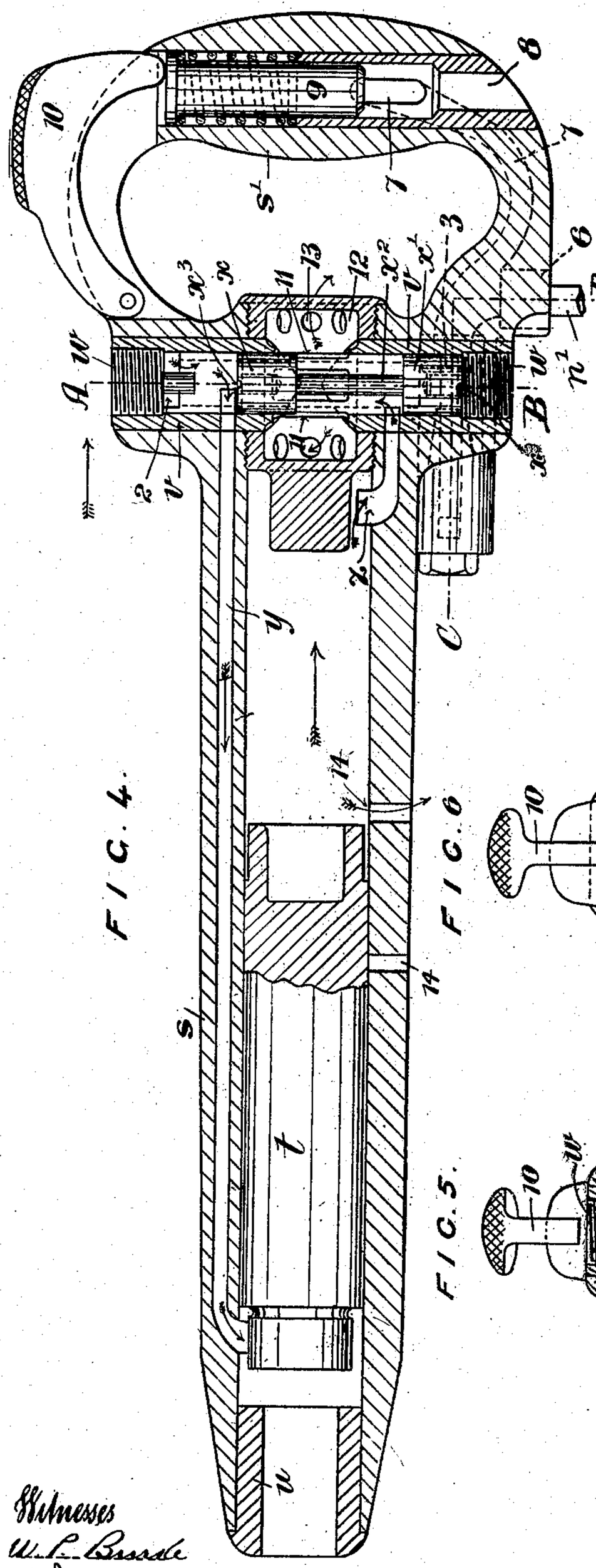

FIG. 4.

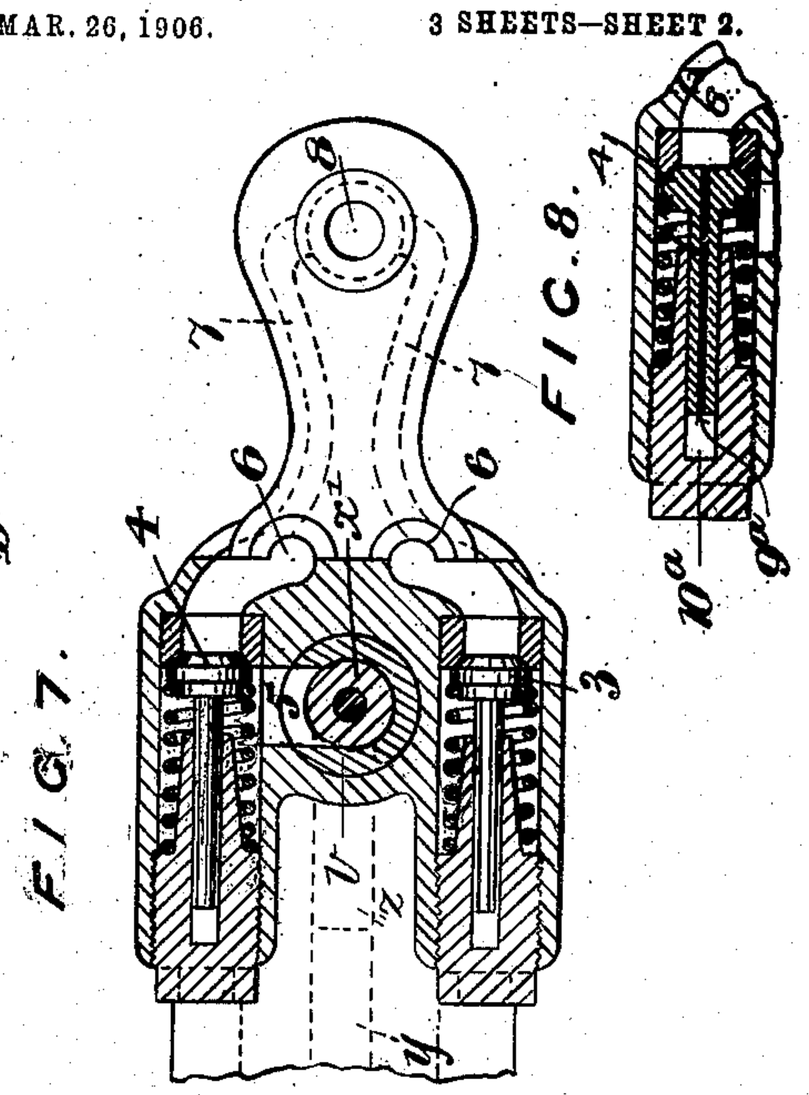

FIG. 7.

FIG. 8.

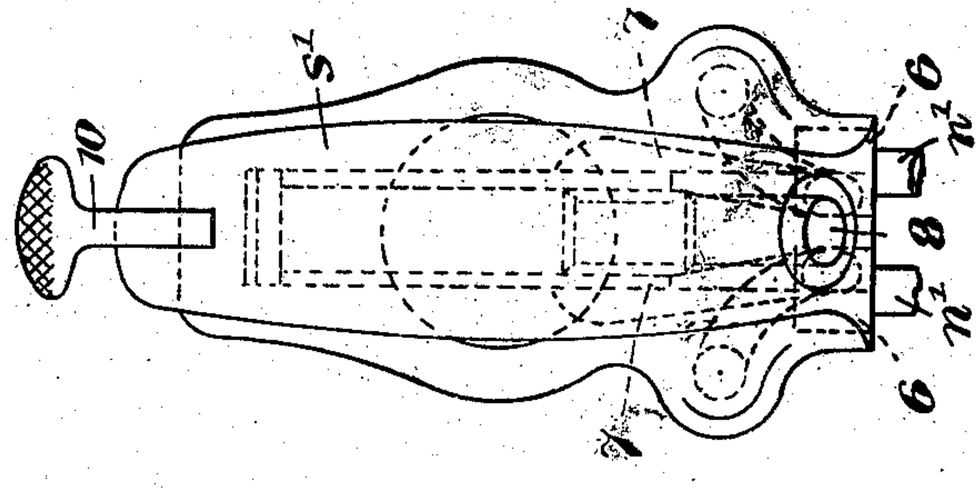

FIG. 6.

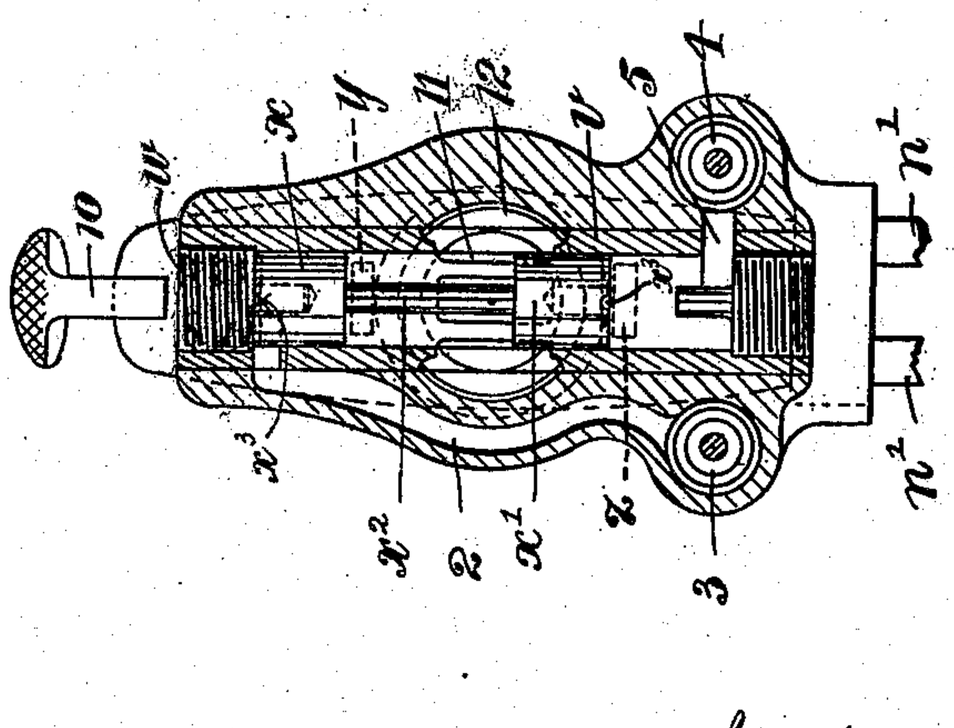

FIG. 5.

Witnesses
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No. 840,668. PATENTED JAN. 8, 1907.

H. B. STOCKS.

POWER HAMMER AND MEANS OF OPERATING SAME.

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3 SHEETS—SHEET 3.

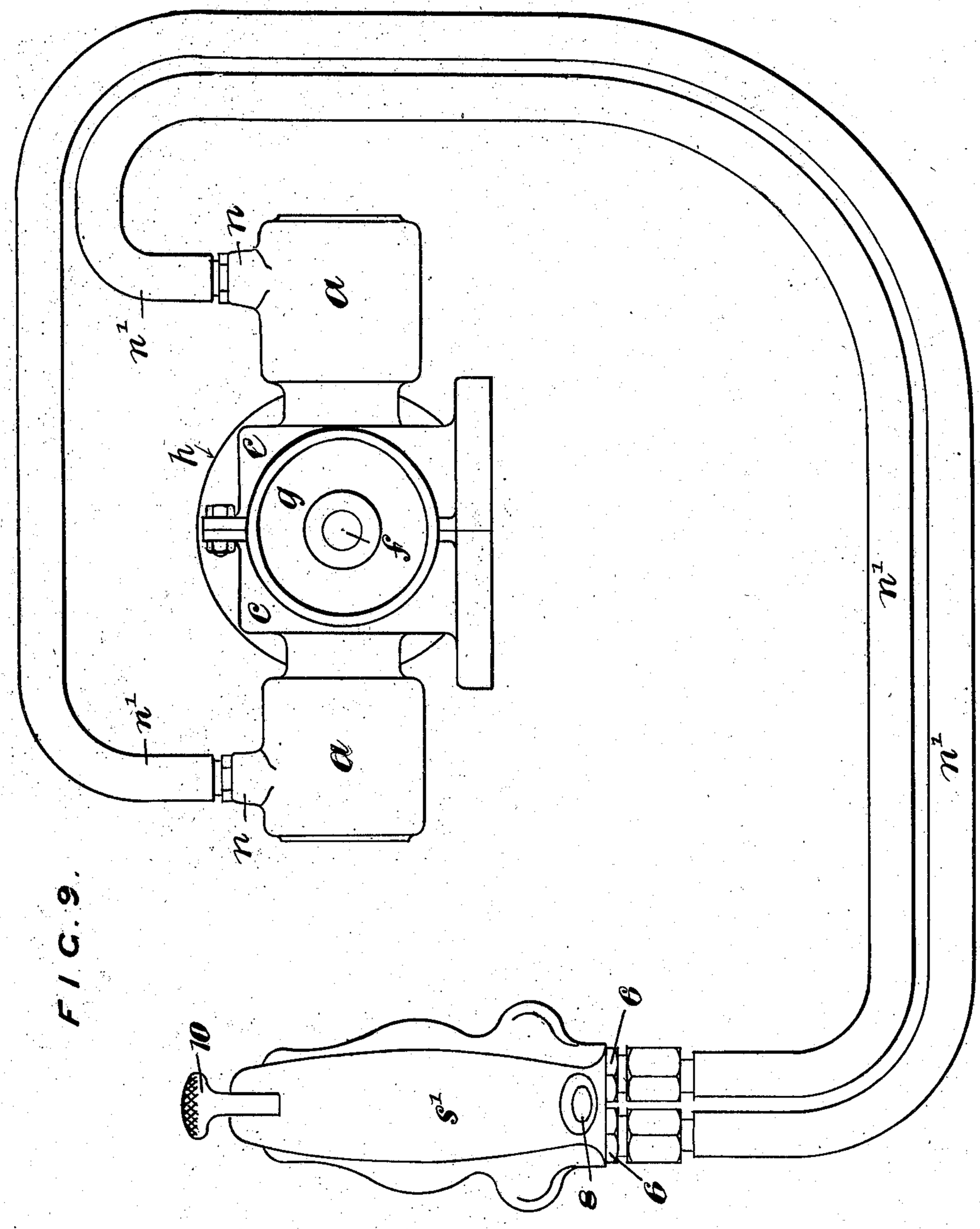

FIG. 9.

Witnesses
H. H. Sieriche
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Inventor
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UNITED STATES PATENT OFFICE.

HARRY BENWELL STOCKS, OF MANCHESTER, ENGLAND, ASSIGNOR TO THE CLIMAX PATENTS LIMITED, OF MANCHESTER, ENGLAND.

POWER-HAMMER AND MEANS OF OPERATING SAME.

No. 840,668. Specification of Letters Patent. Patented Jan. 8, 1907.

Application filed March 26, 1906. Serial No. 308,083.

To all whom it may concern:

Be it known that I, HARRY BENWELL STOCKS, engineer, a subject of the King of Great Britain, residing at 107 Barlow Moor road, Didsbury, Manchester, in the county of Lancaster, England, have invented a new or Improved Power-Hammer and Means of Operating Same, of which the following is a specification.

My invention relates to power-hammers and similar percussive tools actuated by pneumatic pressure and to means for operating the same, such as described in an application filed by me on August 31, 1905. Serial No. 276,000, of which this application is a division.

With each power-hammer I use a separate air-compressor and two air-conducting tubes, and as a novel feature of my invention I provide means whereby the pressure obtained at each impulse of the compressor is withheld within the tubes from the tool until a predetermined pressure is attained within the tubes conducting the power to the tool. On the pressure within the tubes being raised above the predetermined degree a system of spring-loaded valves is overcome by such excess pressure and conducts the air to one side or other of the reciprocating piston-hammer within the tool. The piston-hammer of the tool is unaffected unless and until the required predetermined pressure is exceeded, when the spring-loaded valves in the tool are overcome, as explained, and the pressure is utilized with a sudden impulse and at its full intensity at each end of the piston-hammer alternately to actuate the piston-hammer. I thus obtain the most effective stroke without any loss of energy and at great economy in the consumption of power. I also arrange that a far greater pressure shall be delivered behind the piston-hammer on its outward or working stroke than on the return or idle stroke, as will be explained in the course of the following description.

In order that my invention may be fully understood, I will now proceed to describe it in detail with the aid of the accompanying drawings, to which I will refer.

Figure 1 of the drawings illustrates, on a small scale, a sectional side elevation of the air-compressor used under my invention. Fig. 2 is an end elevation thereof. Fig. 3 is a cross-section. Fig. 4 is a power-hammer constructed as a portable hand-tool, on a large scale, made in accordance with my invention and shown in sectional side elevation. Fig. 5 is a cross-section on the line A B, Fig. 4, looking in the direction of the arrow. Fig. 6 is an end elevation from the handle end. Fig. 7 is a sectional plan of the tool turned bottom upward on the line C D. Fig. 8 is a detail view. Fig. 9 shows a side elevation of the compressor and an end view of the tool, the air-compressor and the tool being connected together by the air-tubes.

In the first place I will describe in detail the construction of the air-compressor, although I wish it to be understood that I do not claim such a compressor to be novel *per se*. Such compressor consists of cylinders *a a* in line, in which work trunk-pistons *b b*. All the parts of the compressor at the left hand of Fig. 1 are shown in section, and it will be understood that the internal parts at the right hand, which are shown in the drawings in outside view, are similar and need not be illustrated.

The trunk-pistons *b b* are connected together by a rectangular frame *c*, in which slides a die-block *d*, connected to a crank *e*, which is common to both pistons. On the crank-shaft *f* is mounted a pulley *g*, by means of which the shaft is revolved by a belt from any suitable source of power, and the shaft also carries a fly-wheel *h*. As will be understood, the rotation of the crank-shaft effects the reciprocation of the trunk-pistons *b b*. In conjunction with such piston *b* I provide a suction-valve *i*, which is drawn off its seat against the action of a spring *j* on the forward movement of the piston, admitting air to the cylinder. On the return stroke of the piston the suction-valve *i* is closed, the air is compressed, and finally forces a delivery or non-return valve *k* off its seat against the action of a spring *m*, the air being delivered through the orifice *n*. Each of the delivery-orifices *n n* in practice is connected by flexible tubing *n' n'* to the power-hammer and arranged to conduct the compressed air, one tube leading to the rear of the piston-hammer and the

other to the front thereof, in manner to be hereinafter explained. The heat generated by the compressed air may be dissipated by suitable means. The drawings show water-cooling means, the cylinders being water-jacketed with inlet *o* and outlet *p*, (or vice versa,) the water-jackets of the two cylinders being connected together at *q* and *r* by means of a suitable pipe *r'*.

The power-hammer may be of any suitable size and is shown on Sheet 2 of the drawings as a portable hand-tool. The cylinder *s* (which may be formed in one or more parts, as may be convenient when constructing the tool) is bored out for the reciprocating piston-hammer *t*, which on its forward stroke actuates a suitable chisel or tool inserted in the bush *u*, as usual. At the rear end of the tool is inserted a bush or cylinder *v*, closed at each end by plugs *w* and containing a double piston-valve *x x'*, connected together by a stem x^2. A port *y* is formed in the cylinder *s*, leading to the front of the piston-hammer *t*, and a short port *z* leads to the rear of the piston-hammer. On air being admitted to the tool the double piston-valve is arranged to govern these ports to inlet and exhaust. The air-inlet 2 to the port *y* is governed by a spring-loaded valve 3, a spring-loaded valve 4 governing the air-inlet 5 to the port *z*, the valves being arranged, by preference, as close as possible to the ports *y z*. The spring-loaded valves are differentially loaded, the valve 4, which admits the pressure for the forward or working stroke of the piston-hammer *t*, being loaded to admit air only at a high pressure—say, for instance, eighty pounds—to give a high initial velocity and power to the piston-hammer, while the valve 3 may be loaded to admit air at a greatly-reduced pressure—say twenty pounds—sufficient to return the piston-hammer promptly to its initial starting-point for the next stroke, thus economizing power. It will be understood, of course, that these pressures are given by way of example only and may be varied. The flexible tubes n^2, conducting air under pressure to the piston-hammer, are connected at 6 6. The air-ports 2 and 5 also communicate by passages 7 7 to an exhaust or outlet 8, formed in the handle *s'* of the tool and governed by a spring-valve 9, actuated by a pivoted lever 10. The cylinder *v* is formed with apertures 11, leading to a chamber 12, in which are bored holes 13, communicating with the atmosphere. The cylinder *s* is provided with a hole or holes 14, which serve as exhaust-ports for the air at the end of each forward and backward stroke of the hammer.

Having thus indicated in detail the construction of the compressor and the power-hammer, the method of working and operation will be readily gathered from the following description.

The air under pressure is delivered through two flexible tubes *n'* to the tool in alternate impulses on every stroke of the compressor, as described. When the tool is not at work, the valve 9 is in the position shown in Fig. 4 and the air under pressure escapes readily to atmosphere out of the exhaust-aperture 8, so that there is no necessity to stop the compressor when the working of the tool is temporarily suspended. To start work, the lever 10 is depressed by the workman to close the exhaust 8 by means of the valve 9, and this position of the valve 9 is maintained while the tool is at work. The air is now confined within the flexible conducting-tubing by the non-return valves *k* in the compressor and the spring-loaded valves 3 and 4 in the hammer. Assume the parts to be in the position shown in Fig. 4 and the piston-hammer *t* is at the end of its forward stroke. As soon as the predetermined pressure in the conducting-tube *n'*, leading to the valve 3, is exceeded sufficient to force this valve off its seat the air is admitted via the port 2 and the port *y* to the front of the piston-hammer *t*, which is forced backward, expelling the air behind it through the short port *z*, through the apertures 11 in the cylinder *v* into the the chamber 12, and to atmosphere through the holes 13, as clearly indicated by the arrows in Fig. 4. The impulse thus required to return the piston-hammer and which may, as explained, be of comparatively low pressure is practically exhausted in effecting this work, and the front exhaust-port 14 is uncovered in advance of the piston-hammer *t*, allowing any air above atmospheric pressure to escape. On the reverse stroke of the compressor if the pressure attained thereby in the flexible tube *n'*, leading to the spring-loaded valve 4, exceeds the predetermined limit this valve is in turn forced off its seat, the air insinuating itself behind the piston-valve *x'* (the pistons being formed with cross-grooves x^3 to facilitate this) and traversing it, together with the attached piston-valve *x* in the cylinder *v*, to open the port *z* to air under pressure, closing the air-inlet port 2, as shown in Fig. 5, and opening the port *y* to exhaust in the manner already described. Air is thus admitted to the back of the piston-hammer *t* suddenly and at the desired intensity, providing for a high initial and sustained velocity of working stroke or blow, while air in front of the piston-hammer is exhausted via the port *y* through the apertures in the cylinder *v* to the chamber 12, and so to atmosphere, as already described.

It will be understood that on first closing the valve 9 a number of strokes of the compressor may be needed to bring the pressure in the tubes *n'* to the predetermined degree. The number of such strokes will depend entirely on the length and diameter of the flexi-

ble tubes; but as the compressor is worked at a very high speed the time lost in raising the requisite pressure is inappreciable. When it is desired to temporarily suspend the working of the tool, it may be restarted more promptly by throttling the outlet 8 by means of the valve 9 instead of opening it to its full extent. The air under pressure attained at each impulse may thus be allowed to escape through the outlet 8, while maintaining the pressure within the tubes at the predetermined level or a little below, so that when the valve 9 is closed the starting of the tool is practically instantaneous.

In order to obviate the use of very strong springs to maintain the valves 3 4 closed until the predetermined pressure is exceeded, which strong springs would be difficult to compress when the valves are to be opened to pass air, I may form the valves and their spindles with a small bore 9^a, which will permit air from the compressor to pass from the ports 6 into the chamber 10^a behind the valve-stem, as illustrated in the detail view, Fig. 8. The pressure thus obtained upon the valve-spindle in the chamber 10^a will assist in holding the valve on its seat, and the spring may be correspondingly weakened, so that when the valve is opened the spring will more readily collapse to the pressure and permit the valve to remain open until the pressure again falls to the normal.

The capacity of the compressor-cylinders is such as will maintain sufficient pressure of air on every stroke of the piston to displace the spring-loaded valves 3 and 4 to drive the piston-hammer *t* back and forth with the required velocity when the predetermined pressure has been once attained. Therefore the number of blows per minute of the tool is determined by the number of revolutions made by the crank of the compressor. As the spring-loaded valves in the tool and the back-pressure valves in the air-compressor hold up the air within the conveying-tubes until the predetermined pressure is exceeded, it is not possible for the piston-hammer to begin its stroke ineffectively as soon as the generation of air-pressure is commenced by the piston of the compressor as would happen were there no such valves.

One of the advantages of my invention is that I am enabled to utilize the air-pressure expansively. For instance, I arrange that the cubic capacity of the cylinder of the piston-hammer shall be greater than the volume of air displaced by each stroke of the compressor when the predetermined pressure is attained in the tubes, so that when the piston-hammer has traversed a portion only of its stroke the air to the tool is cut off, being reduced in the conducting-pipe to the normal pressure at which the valve closes, the rest of the stroke being completed without further admission of air, allowing the air admitted to expand, and thus increase the velocity of the piston. I can thus reduce the number of blows per minute to decrease vibration and obtain a piston-hammer with a high-velocity stroke.

I may, if desired, use equal air-pressures for the blow and return stroke; but the use of high-pressure air is not so economical and is liable to set up objectionable recoil.

I prefer that the tubes conducting the pressure to the tool shall be as short in length and as small in diameter as possible, so that the tool will start work promptly on the valve 9 being closed. It must be understood, further, that the design of the tool and the details of construction may be varied to some extent so long as the gist of my invention is preserved.

The invention may also be adapted to larger percussive tools, such as rock-drills.

I declare that what I claim is—

1. In power-hammers and like percussive tools worked in conjunction with an air-compressor, a piston-hammer in the tool two tubes for conducting the air-pressure to the tool means for retaining the air-pressure generated at each stroke of the compressor within the tubes until a predetermined pressure is obtained in the tubes and means for utilizing the excess of such pressure at each stroke of the air-compressor to drive the piston-hammer of the tool back and forth substantially as described.

2. In power-hammers and like percussive tools, the combination of a separate air-compressor to each tool, two tubes connecting the compressor to each tool, back-pressure valves in the compressor and loaded valves in the tool for holding up the air-pressure generated at each stroke of the compressor until a predetermined pressure is attained in the two tubes and means for conducting the excess of such pressure on each stroke of the air-compressor to the piston-hammer of the tool substantially as described.

3. A power-hammer comprising a cylinder, a reciprocating piston-hammer therein, said cylinder having inlet and exhaust ports therein, spring-loaded valves governing said ports and a piston-valve actuated by the air under pressure to alternately open one port to admit air under pressure and the other to exhaust.

4. A power-hammer consisting of a cylinder, a reciprocating piston-hammer therein, said cylinder having exhaust-ports arranged therein to exhaust the air at the end of each stroke of the piston-hammer, said cylinder also having ports to conduct air to the front and back of the piston-hammer, spring-loaded valves for governing such ports, a double piston-valve actuated by the air under pressure to alternately open one port to

admit air under pressure and the other to exhaust and means for conducting the exhaust to atmosphere from the port not under pressure, said cylinder also having an exhaust-port and a valve actuated by the operator to govern said exhaust-port to start and stay the tool, substantially as described.

In testimony whereof I have signed my name to this specification in the presence of two subscribing witnesses.

HARRY BENWELL STOCKS.

Witnesses:

JOSHUA ENTWISLE,

ALFRED YATES.