H. SCHWEIM.

PNEUMATIC TOOL.

APPLICATION FILED NOV. 28, 1904.

945,815.

Patented Jan. 11, 1910.

2 SHEETS—SHEET 1.

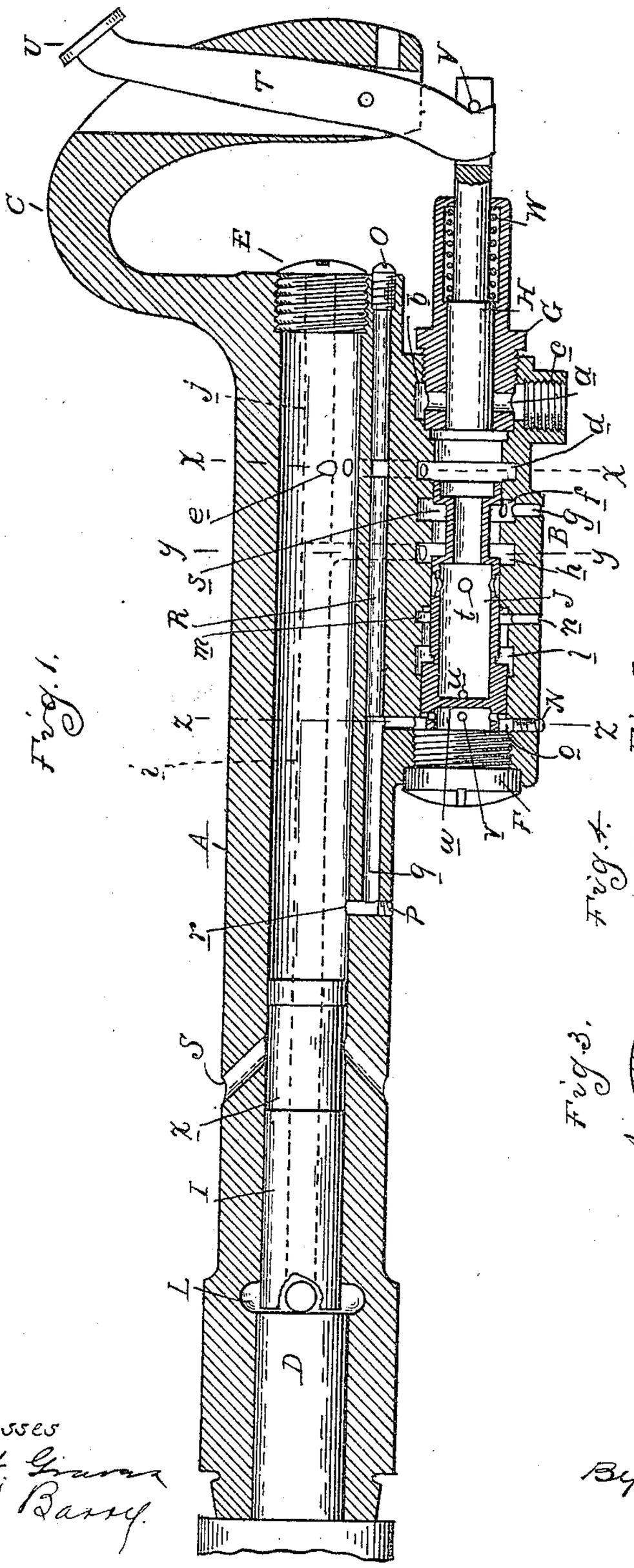

Fig. 1.

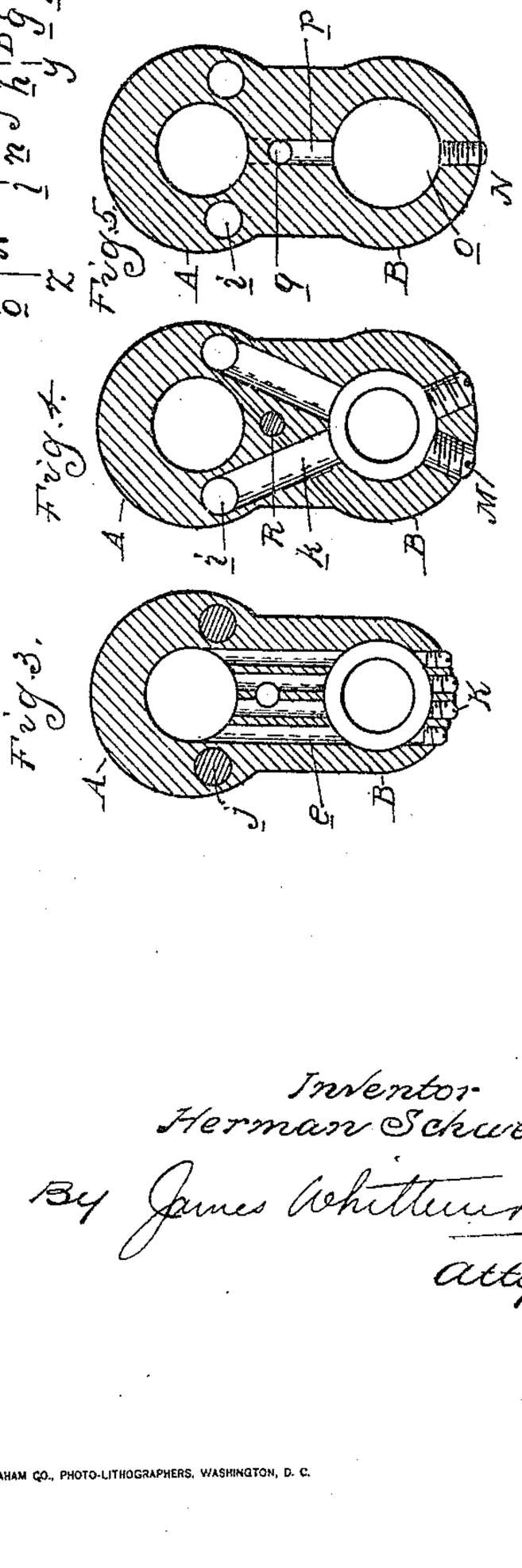

Fig. 5.

Fig. 4.

Fig. 3.

Witnesses
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Jas. P. Barry.

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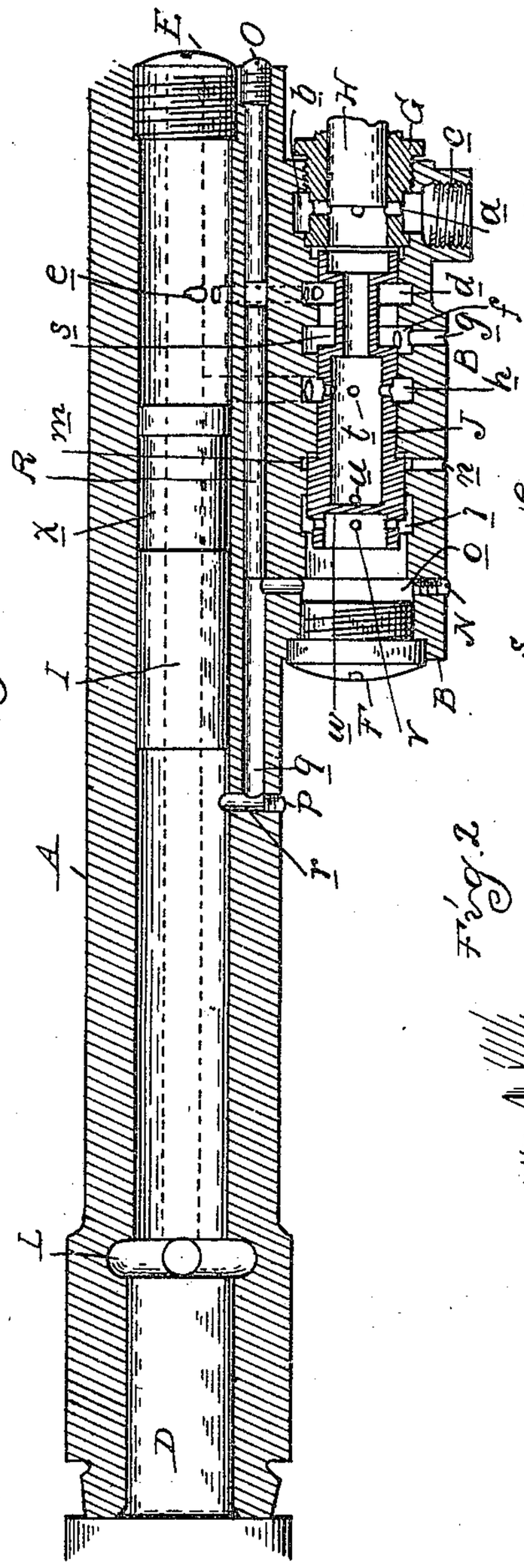

Fig. 2.

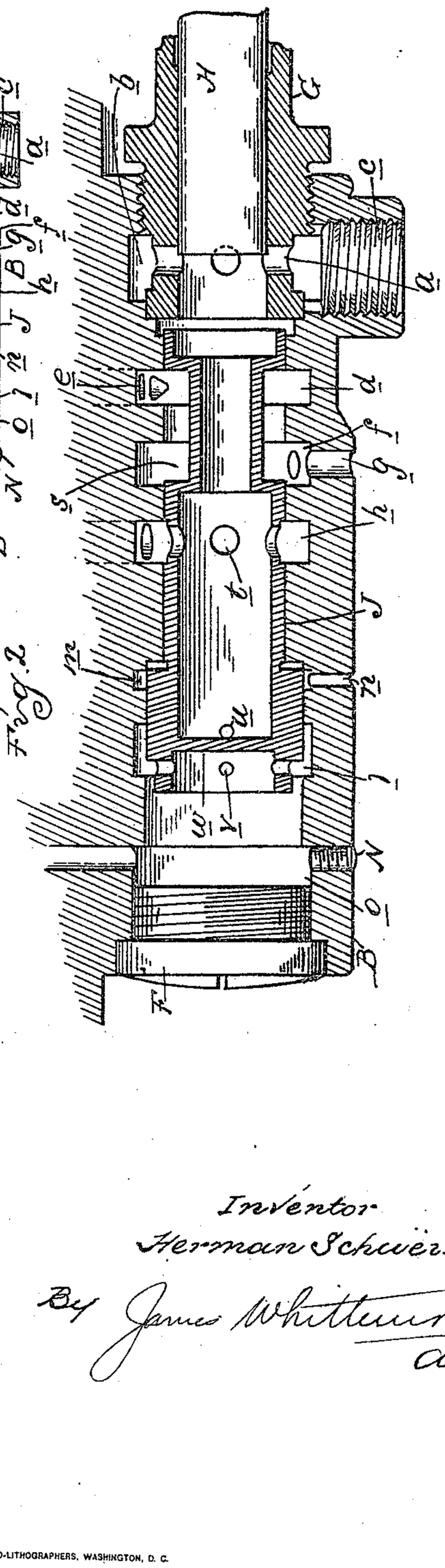

Fig. 3.

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UNITED STATES PATENT OFFICE.

HERMAN SCHWEIM, OF DETROIT, MICHIGAN, ASSIGNOR, BY DIRECT AND MESNE ASSIGNMENTS, TO DETROIT PNEUMATIC TOOL COMPANY, A CORPORATION OF MICHIGAN.

PNEUMATIC TOOL.

945,815. Specification of Letters Patent. Patented Jan. 11, 1910.

Application filed November 28, 1904. Serial No. 234,519.

To all whom it may concern:

Be it known that I, HERMAN SCHWEIM, residing at Detroit, in the county of Wayne and State of Michigan, a citizen of the United States, have invented certain new and useful Improvements in Pneumatic Tools, of which the following is a specification, reference being had therein to the accompanying drawings.

It is the object of the invention to obtain a simple and inexpensive construction of a pneumatic tool and also to overcome certain defects of constructions heretofore used.

In the present state of the art, pneumatic tools generally comprise a large number of parts, which must be accurately fitted and assembled in relation to each other. These separate parts include not only the movable members, but also the stationary portions of the casing and by reason of the numerous ports and passages in the latter, extending from one section to another, the joints between the sections must be air tight. In the use of the tool, it has been found difficult to maintain air tight joints, as the constant vibration tends to separate the sections and also frequently results in breakage of the connecting members.

With my improved construction, these difficulties have been avoided by forming the hammer and valve barrels of the casing integral, the connecting bores and passages being also formed in this single bore, thus avoiding a crossing of a joint. The handle of the tool is also preferably formed integral with the casing.

Another feature of the construction is the peculiar arrangement of the valve and hammer barrels in relation to each other and the manner of forming the connecting ports and passages; further, in the peculiar construction of the controlling valves and, further, in the peculiar arrangement, combination and construction of the various parts, as hereinafter set forth.

In the drawings, Figure 1 is a central longitudinal section through the tool. Fig. 2 is a similar view through the valve barrel, showing the valve in a different position. Figs. 3, 4 and 5 are cross sections respectively on lines *x*—*x*, *y*—*y*, and *z*—*z* of Fig. 1. Fig. 6 is a diagrammatic view, illustrating a modification.

As has been stated, the hammer and valve barrels are integral, and these are preferably formed of cast steel. As shown, the barrels A and B are respectively the hammer and valve barrels and C is the handle. The barrels A and B are parallel to each other and are preferably formed by boring completely through the casting, so as to be open at opposite ends. The hammer barrel is closed at its lower end by the shank D of the tool and at its upper end by a screw-threaded plug cap E. The valve barrel is closed at its lower end by a plug cap F and at its upper end by a hollow plug cap G, in which is arranged the throttle valve H. This valve is in the form of a piston slidable within the fitting G and controlling a series of ports *a* therein, which communicate with an annular recess *b* in the barrel B. The recess *b* connects directly to the inlet nipple *c*, to which the flexible supply conduit is attached.

The hammer I is a plain piston, which is fitted to the bore of the barrel A. The valve J which controls the reciprocation of the hammer is in the form of a hollow piston, the upper end of which is open and communicates with the air passing the throttle valve H. Thus, the pneumatic pressure of the motive agent is constantly exerted on the valve J to press it toward the lower end of the valve barrel B.

The valve J controls a number of annular ports formed in the valve barrel B, which are preferably arranged as follows:—The upper port *d* is uncovered in the normal position of the valve J and communicates directly with the upper portion of the hammer barrel A through the passages *e*. These passages, as illustrated in Fig. 3, are preferably formed by boring parallel apertures through the barrel B into the barrel A, the outer ends of these bores being closed by screw plugs K. The next adjacent annular port *f* communicates with the external atmosphere, through bores *g* in the barrel B and constitutes an exhaust port. The third annular port *h* is connected with the lower end of the hammer barrel A by intersecting longitudinal and cross bores, as shown in Fig. 4 and in dotted lines in Fig. 1. The longitudinal bores *i* extend from the upper end of the barrel to an annular recess L at the lower end of the barrel. The upper ends of these bores *i* are, however, closed by plugs *j*, as shown in Fig. 3. The cross-connecting passages are formed by oppositely angling bores

k extending through the barrel B and intersecting respectively with the longitudinal bores *i*, their outer ends being closed by plugs M. Thus, communication is established between the annual port *f* and the annular recess L. The lower portion of the barrel B is counter-bored to increase the diameter and the valve J is provided with a correspondingly enlarged portion fitting this counter-bore. At one point in this counter-bore is an annular recess *l* and at the upper end of the counter-bore is an annular port *m*, which communicates with an exhaust port *n* in the barrel B. *o* is an annular port near the lower end of the counter-bore, which, as shown in Fig. 5, is connected by a cross bore *p* with a longitudinal bore *q*. The port *q* extends to a point intermediate the ends of the barrel A and communicates with a port *r*, opening into said barrel. The bores *p* and *q* are closed at their outer ends by the caps N, O and P and the bore *q* is also closed by an inserted plug R, which stops communication between the ports *r* and *e*.

From the description above given, it will be understood that the movement of the valve J will cause the opening and closing or inter-connection of the various annular ports *d*, *f*, *h* and *o*. In particular, the ports *f* and *h* are normally in communication with each other by reason of the external annular groove *s* in the valve J. This groove connects the said ports, so that an exhaust passage is provided from the annular groove L at the lower end of the barrel A to the port *g*. The valve J is also provided with a series of ports *t*, which, when the valve is moved upward, will come into registration with the annular ports *h* and will permit the passage of the compressed air to the lower end of the hammer barrel. In this position of the valve, the annular groove *s* therein will couple the annular ports *d* and *f* and open an exhaust passage from the upper end of the hammer barrel to the port *g*.

The movement of the valve J is effected by differential air pressure, the lower end of the valve being of greater area than the upper end thereof. Thus, when the piston I travels downward in the barrel and after it has passed beyond the port *r*, the compressed air will pass through said port and through the passage *p* into the lower end of the barrel B and as the area operated upon is greater than the opposite end of the valve, an upward movement will be effected. This will reverse the connection of the ports, as has been described, opening an exhaust connection to the upper end of the barrel and admitting compressed air through the passages *k* and *i* to the lower end of the barrel A, thereby returning the hammer piston.

Inasmuch as the valve J is constantly acted upon by an air pressure tending to press the valve downward, it is necessary to maintain a preponderating pressure on the lower end of the valve until the piston hammer I has been returned sufficiently as to be ready for another reversal of the valve. At the same time, the opening of the exhaust connection to the upper end of the barrel A will permit the pressure therein to be exhausted, which would neutralize the pressure acting on the lower end of the valve J. Such a result is prevented by providing a restricted connection between the lower end of the barrel B and the compressed air chamber. For this purpose, ports *u* and *v* are formed in the flange on the opposite sides of the head *w* thereof and these ports, when the valve is in its raised position, are in registration with the annular groove *l* in the barrel B. This permits the air within the hollow valve J to pass out through the ports *u* into the groove *l* and thence back through the ports *v* underneath the head *w*. The ports are so proportioned that air is thus admitted beneath the valve in a sufficient quantity to prevent the dropping of the pressure and holding valve up before the port *r* is closed, the latter being effected by an upward movement of the hammer piston I. The ports *u* and *v* are not, however, of sufficient size to maintain air pressure beneath the valve, when a free exhaust passage is in communication with the passages *p* and *q* and such an exhaust connection is formed by ports S in the barrel A arranged between the annular ports L and the port *r*. The arrangement is such that after the piston I has passed upward beyond the port *r*, the air pressure sustaining the valve J will be exhausted through the ports *p*, *q* and *r* and the ports S, thereby permitting a constant pressure operating upon the valve to move the same downwardly into its initial position.

The throttle valve H is preferably controlled by a lever T, arranged in a slot in the handle C having a thumb piece U. This lever T is entered into a slot in the shank of the valve H and engages with a pin V, the construction being such that the pressure upon the thumb piece U will move the lever to lift the valve H and open the ports *a*. To return the valve, a coil spring W is arranged within the cap G and bears against the shoulder upon the valve H.

The construction being as described, in operation whenever the lever T is actuated to lift the valve H, compressed air is admitted into the barrel B, passing directly into the upper end of the barrel A and forcing the piston therein downward. As soon as the piston reaches the lower end of its stroke, the port *r* is opened, admitting the compressed air beneath the valve J and shifting it as has been described. When the valve is thus shifted, the ports *u* and *v* regis-

tering with the annular port *l* maintain the air pressure temporarily beneath the valve during the exhausting of the air in the upper part of the barrel A and during the first portion of the upward movement of the hammer piston I. The port *r* is then uncovered, exhausting the pressure beneath the valve and returning it, as has been described. It will be understood that this operation will continue and automatically impart to the hammer piston I a rapid reciprocating movement, causing it to strike a blow at each downward movement. In the upward movement, the piston is cushioned by arranging the ports *e* below the end of the barrel A, so as to provide an air pocket.

In the construction as thus far described, a certain amount of air is permitted to escape through the ports S during the interval between the uncovering of said ports by the piston and the shifting of the valve J. This loss may be avoided in the construction illustrated diagrammatically in Fig. 6, in which the ports S are omitted, and the ports *t*, through which air is admitted to the lower end of the barrel, are restricted. The restriction of these latter ports is such that the air for returning the hammer piston is permitted to expand and drop in pressure during the movement of said piston and, as a consequence, after the port *r* is uncovered, the sustaining pressure for the valve J will be exhausted into the barrel containing the air at diminished pressure. Such an effect can only be obtained by nicely proportioning the restricted ports *o* and *t* in relation to each other and to the other ports of the tool. The operation is such as to maintain the valve temporarily in its raised position during the initial upward movement of the piston and, nevertheless, to permit the valve to be lowered during the final upward stroke of the piston.

It will be understood that the time of the interval between the opening of the exhaust connection to the upper end of the barrel A and the closing of the port *r* is very brief and it is therefore not necessary to admit the air through the ports *u* and *v* as fast as it is exhausted through *r*, but it is only necessary that the pressure beneath the valve J should not drop enough to permit of movement of said valve before the closure of the port *r*.

To avoid pressing the piston I against one side of the barrel while opposite the port *e*, said piston is slightly reduced in diameter at *x*, which will permit the air to pass around on all sides thereof.

The annular recess *m* which communicates with the exhaust port *n* in the valve barrel is for the purpose of exhausting any leakage past the valve, which would counterbalance the differential pressure. This annular recess is preferably arranged slightly below the shoulder formed by the counter-bore in the barrel, so as to leave a small pocket in which air is trapped and operates as a cushion for the valve in its upward movement.

What I claim as my invention is:—

1. In a pneumatic tool, the combination with a reciprocatory piston, of a reciprocatory valve therefor, having differential pressure areas for actuating the same in opposite directions, the lesser area being constantly exposed to pneumatic pressure, a barrel in which said piston reciprocates having a pneumatic connection leading from the same to the large area end of said valve, said connection being open when said hammer piston is at one end of its stroke, whereby said valve will be shifted by differential pressure and will open exhaust connection for said barrel, and the large area end of said valve, and means operating to delay the reshifting of said valve after the opening of said exhaust.

2. In a pneumatic tool, the combination with hammer and valve barrels, of a reciprocatory piston, a reciprocatory controlling valve therefor having differential pressure areas for actuating the same in opposite directions, the lesser area being constantly exposed to pneumatic pressure, means operating when said piston is at one end of its stroke for establishing communication between said hammer barrel and valve barrel at the large area end of said valve, whereby the latter will be shifted by a differential pressure, means operating when said valve is thus shifted for opening a restricted, independent connection between the opposite ends of said valve barrel, whereby the pneumatic pressure acting upon said large area is temporarily maintained and the re-shifting of the valve delayed when the pressure in said hammer barrel is exhausted, the capacity of said restricted connection being insufficient to permanently maintain a preponderating pressure, whereby the pressure acting upon the small area will again shift said valve.

3. In a pneumatic tool, the combination with hammer and valve barrels, of a reciprocatory hammer and a reciprocatory controlling valve therefor, the latter having differential pressure areas for actuating the same in opposite directions, the lesser area being exposed to constant pneumatic pressure, a conduit connecting said hammer and valve barrels at the large area end of said valve, and uncovered by said piston when at one end of its stroke, whereby said valve will be shifted by differential pressure, means for establishing a restricted connection between the opposite ends of the valve barrel, when said valve is thus shifted, and means for opening an exhaust connection to said valve barrel at the large area end of said valve, during the return stroke of said piston, said exhaust connection being of greater capac-

ity than said restricted supply connection, whereby said valve is again shifted.

4. A pneumatic tool, comprising an integral casing, containing parallel hammer and valve barrels, having their opposite ends cross-connected, a reciprocatory hammer piston in said hammer barrel, adapted at one end of its stroke to establish communication between said barrels at both ends thereof, a reciprocatory valve in said valve barrel having differential pressure areas for actuating the same in opposite directions, the lesser area being constantly subjected to pneumatic pressure and the larger area only when both ends of said barrels are in communication, whereupon the differential pressure will shift said valves and a restricted connection between opposite ends of said valve barrels through said valve will be opened when said valve is thus shifted and an exhaust port adapted to be opened when said piston is between the opposite end connections to said piston barrel.

5. In a pneumatic tool, comprising a reciprocatory hammer piston and a reciprocatory controlling valve therefor, of means for shifting said valve by differential pressure upon the delivery of the hammer stroke, means for opening a temporary exhaust, and a restricted air feeding passage partially offsetting the same for said differential pressure during a portion of the return of said hammer piston, and a complete exhaust of said differential pressure during the remainder of said return.

6. In a pneumatic tool, the combination with a valve barrel having two portions of different diameters, of a reciprocatory hollow valve fitting said barrel, the smaller end of said valve being open and the larger end closed and a restricted port through the shoulder of said valve adjacent to the closed end thereof, registering with a passage in said barrel in one position of the valve therein, whereby restricted communication is established between the opposite ends of said valve.

7. In a pneumatic tool, a casing comprising a hammer barrel, an integral lateral projection from one side thereof forming a parallel valve barrel, the latter being provided with an exhaust port and a series of annular recesses, a cross bore connecting one of said annular recesses directly with said hammer barrel, a longitudinal bore in the wall of said hammer barrel extending to the opposite end thereof, and passing at one side of the cross-bore, and an oblique bore connecting a second annular recess of said valve barrel with said longitudinal bore, forming the connection for returning the piston, and means for connecting said annular recesses alternately with said exhaust port.

8. In a pneumatic tool, a casing comprising a hammer barrel, an integral lateral projection from one side thereof, forming a parallel valve barrel, a plurality of longitudinal bores in the wall of said hammer barrel, and cross bores arranged at different angles, connecting said longitudinal bores with said valve barrel.

9. A pneumatic tool comprising a casing formed of a hammer barrel, an integral lateral projection of lesser length forming a parallel valve barrel having an exhaust port, a cross bore forming a direct connection between said valve and hammer barrels, an annular recess at the opposite end of said hammer barrel and means for connecting said cross bore and said annular recess alternately with said exhaust port.

10. In a pneumatic tool, a casing comprising a hammer barrel, an integral lateral projection forming a parallel valve barrel, a cross bore directly connecting said hammer and valve barrels, an annular recess at the opposite end of said hammer barrel, longitudinal bores in the walls of said hammer barrel on opposite sides thereof, intersecting with said annular recess, a longitudinal bore in the wall between said hammer and valve barrels, a cross bore connecting said valve barrel with the last-mentioned longitudinal bore, and oppositely angling oblique cross bores connecting said valve barrel with the first-mentioned longitudinal bore, and avoiding intersection with the last-mentioned longitudinal bore.

11. In a pneumatic tool, a casing comprising a hammer barrel, an integral lateral projection forming a parallel valve barrel, longitudinal bores extending in the wall of said hammer barrel, respectively between the latter and the valve barrel and upon opposite sides of said hammer barrel, a cross bore directly connecting said valve barrel with said hammer barrel, and intersecting the longitudinal bore between the same, plugs filling said longitudinal bore on opposite sides of the inter-section with said cross passages, a second cross bore intersecting said longitudinal bore and connecting the valve barrel therewith, and oblique cross bores connecting said valve barrel with the longitudinal bores on opposite sides of said hammer barrel, and avoiding intersection with the longitudinal passage between said barrels.

12. In a pneumatic hammer, a casing comprising a hammer barrel, an integral lateral projection forming a parallel valve barrel, a plurality of annular recesses in said valve barrel, a direct connection between said hammer barrel and one of said annular recesses, formed by the cross bores, intersecting longitudinal and oblique cross bores connecting another annular recess of said valve barrel with the opposite end of said hammer barrel, an exhaust connection with the annular recess between the last-mentioned annu-

lar recesses in said valve barrel, intersecting longitudinal and cross bores connecting another annular recess of said valve barrel with said hammer barrel, at a point intermediate the ends of the latter, a counter bore enlarging the diameter of said valve barrel at one end, a piston valve having portions thereof fitting the bore and counter-bore of said valve barrel, to form differential pressure areas at opposite ends of the valve, and an annular exhaust passage adjacent to the point of change in diameter of said valve, for preventing leakage between the annular pressure channels on opposite sides thereof.

13. In a pneumatic tool comprising a reciprocatory hammer piston and a reciprocatory controlling valve therefor, means for shifting said valve upon the delivery of the hammer stroke of the piston by differential pressure, means for opening an exhaust for said differential pressure by the shifting of said valve, and means for delaying the reshifting of the valve after the opening of said exhaust.

14. In a pneumatic tool comprising a reciprocatory hammer piston and a reciprocatory controlling valve therefor, differential pressure means for shifting said valve when said hammer piston is near one end of its stroke, exhaust connections for said differential pressure opened by the shifting of said valve, and means for delaying the reshifting of said valve after the opening of said exhaust, for the purpose described.

15. In a pneumatic tool comprising a reciprocatory hammer piston, a reciprocatory controlling valve therefor, and barrels for said piston and valve respectively, differential pressure means for shifting said valve when said hammer piston is near one end of its stroke, means for opening exhaust connections through said valve barrel for said differential pressure, and means for delaying the reshifting of said valve after the opening of said exhaust connections, for the purpose described.

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

HERMAN SCHWEIM.

Witnesses:
ED. D. AULT,
JAS. P. BARRY.