R. A. NORLING.

PNEUMATIC HAMMER.

APPLICATION FILED DEC. 17, 1910.

998,919.

Patented July 25, 1911.

4 SHEETS—SHEET 1.

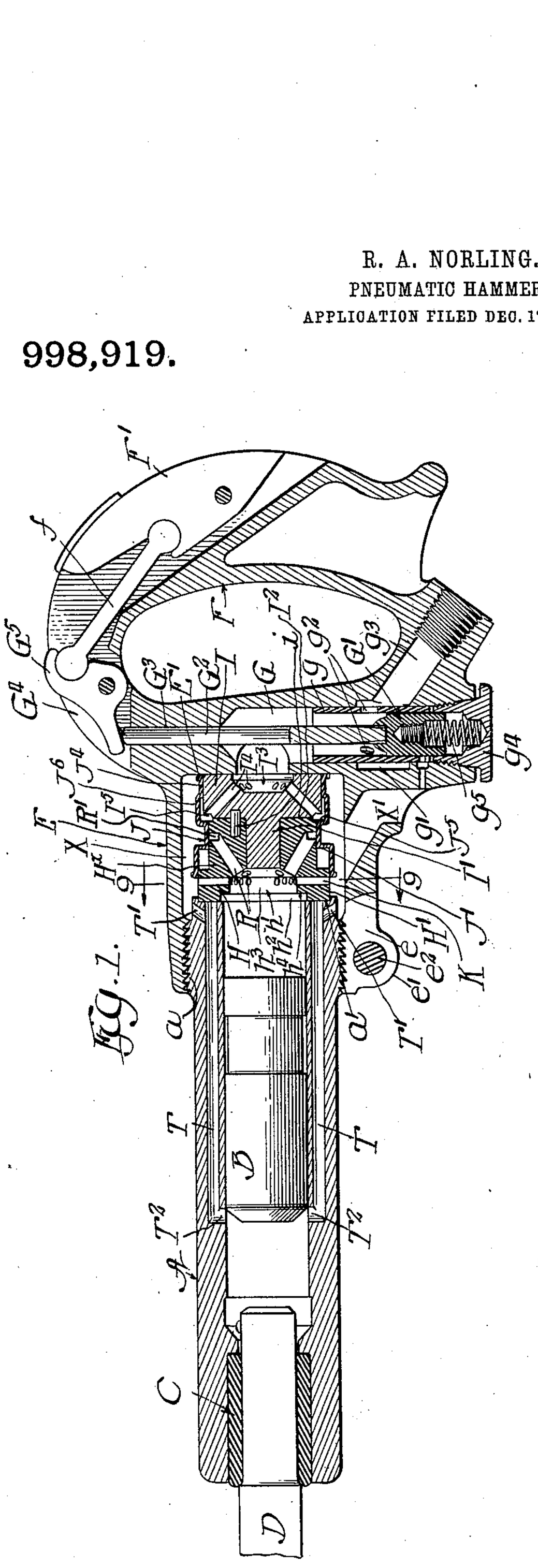

Fig. 1.

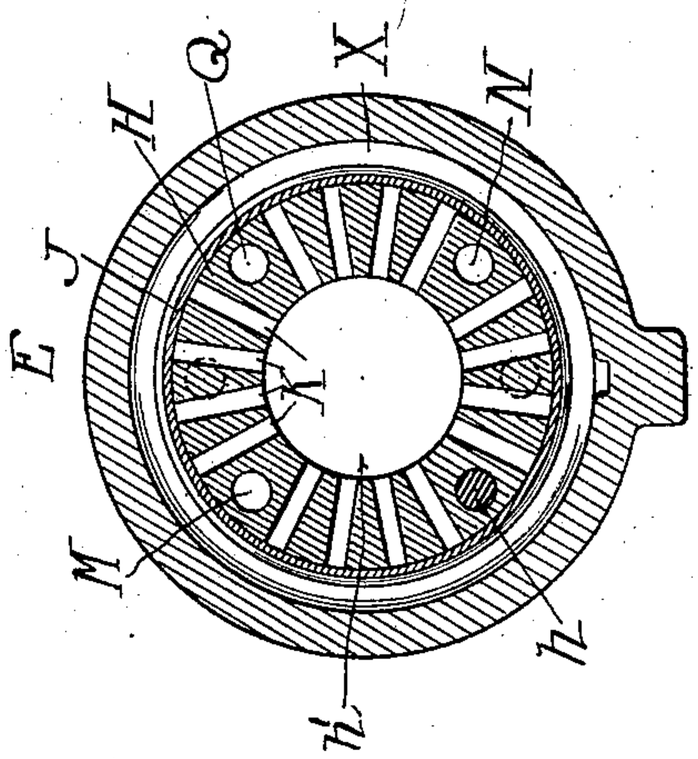

Fig. 9.

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by Poole & Brown Attys

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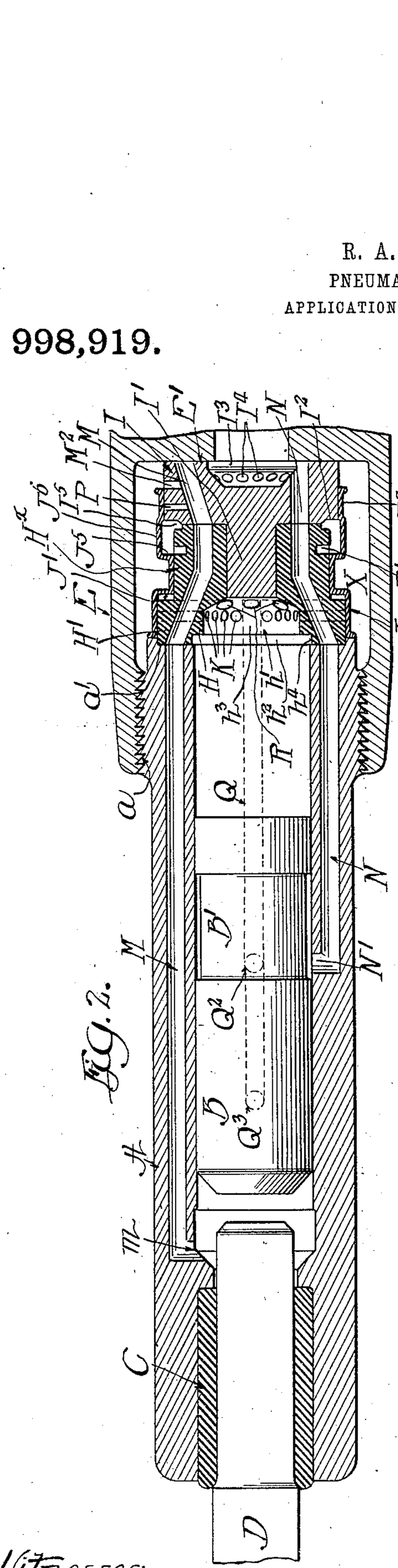

Fig. 2.

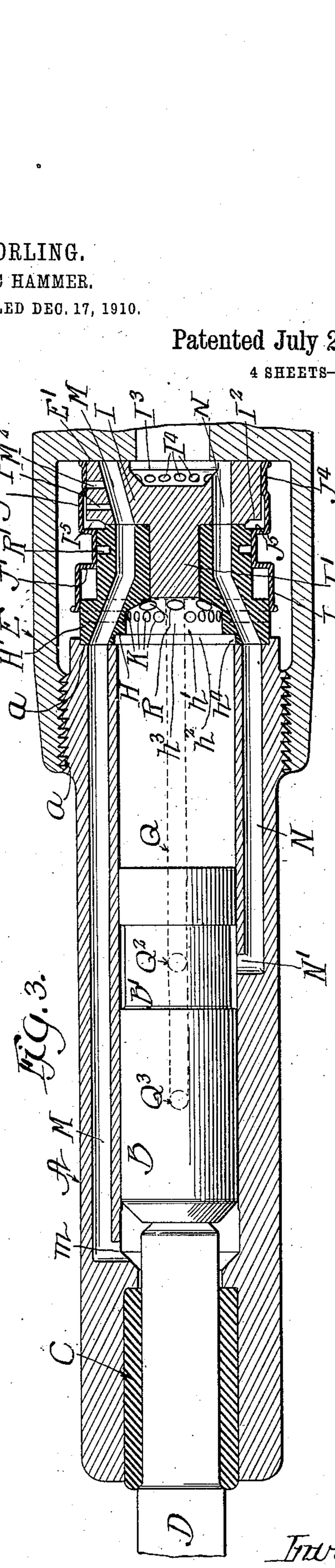

Fig. 3.

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4 SHEETS—SHEET 3.

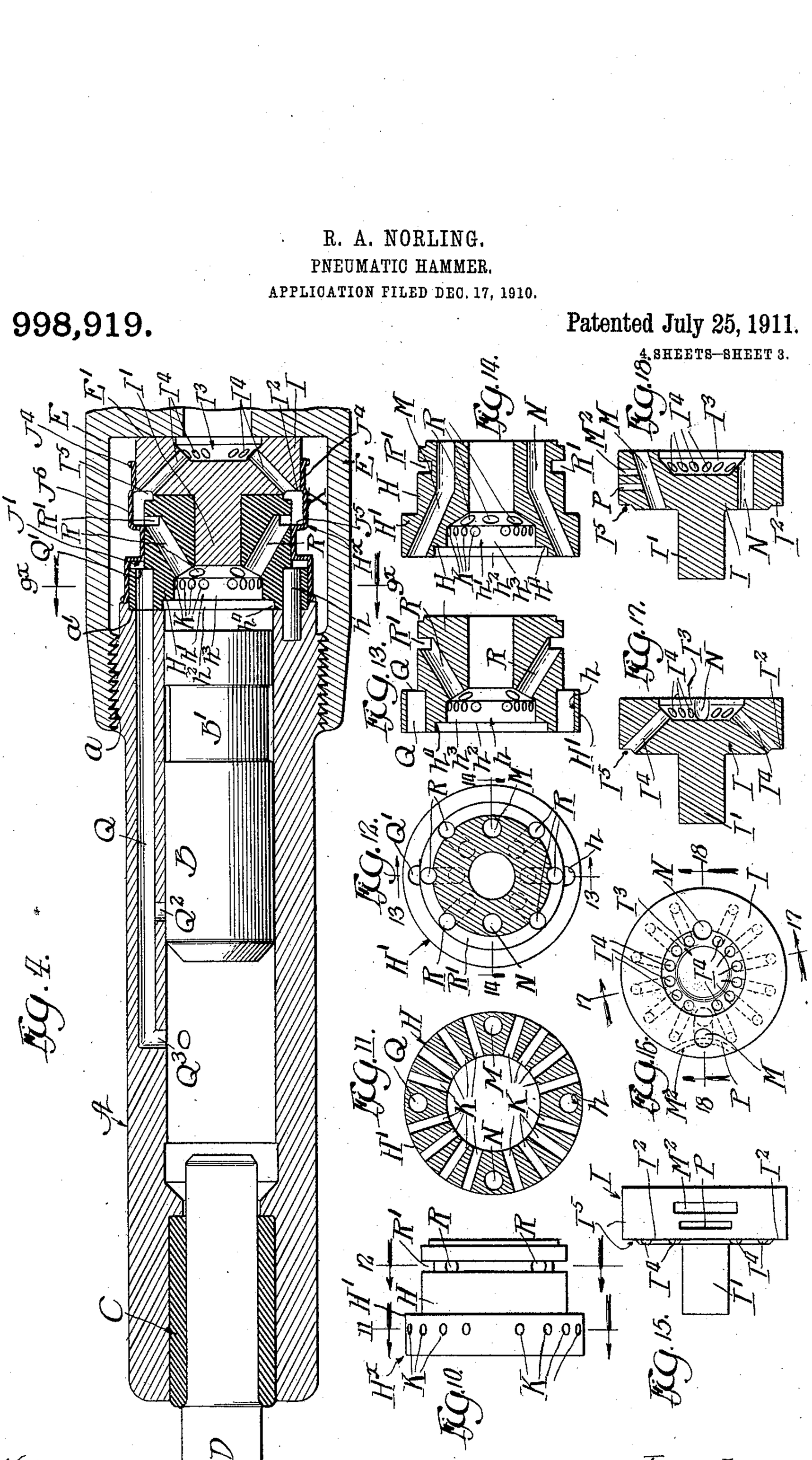

Fig. 4.

Fig. 14.

Fig. 18.

Fig. 13.

Fig. 17.

Fig. 12.

Fig. 16.

Fig. 11.

Fig. 15.

Fig. 10.

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4 SHEETS—SHEET 4.

FIG. 5.

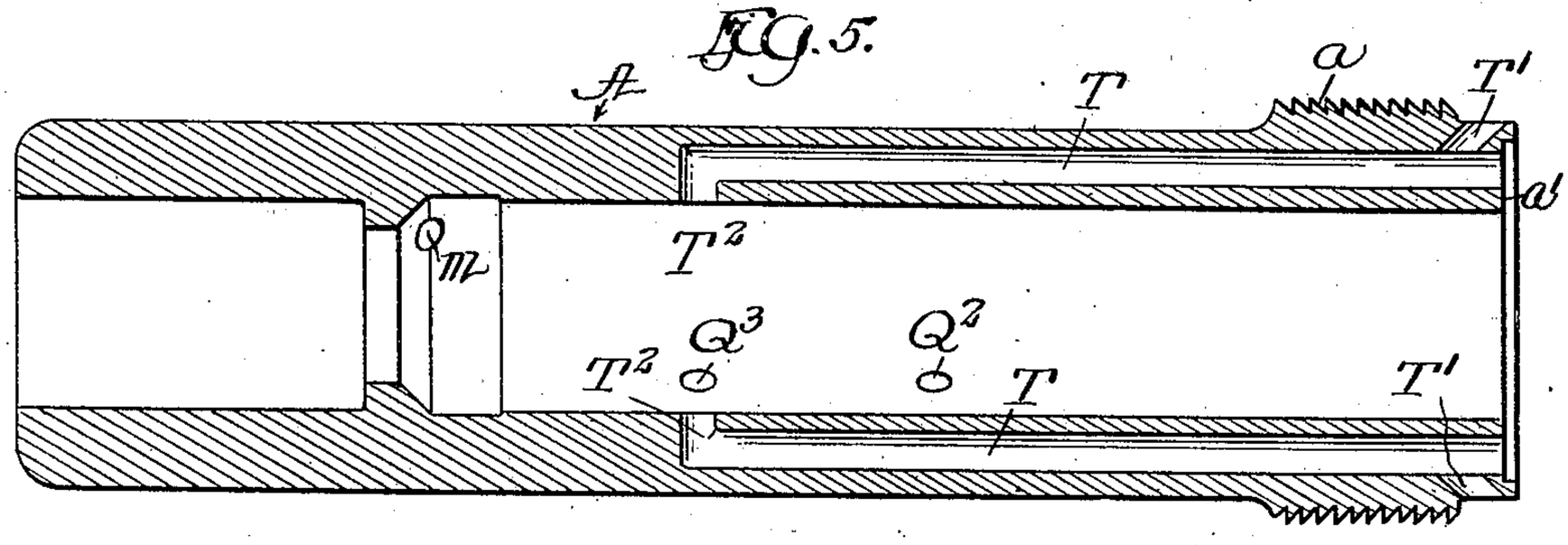


FIG. 6

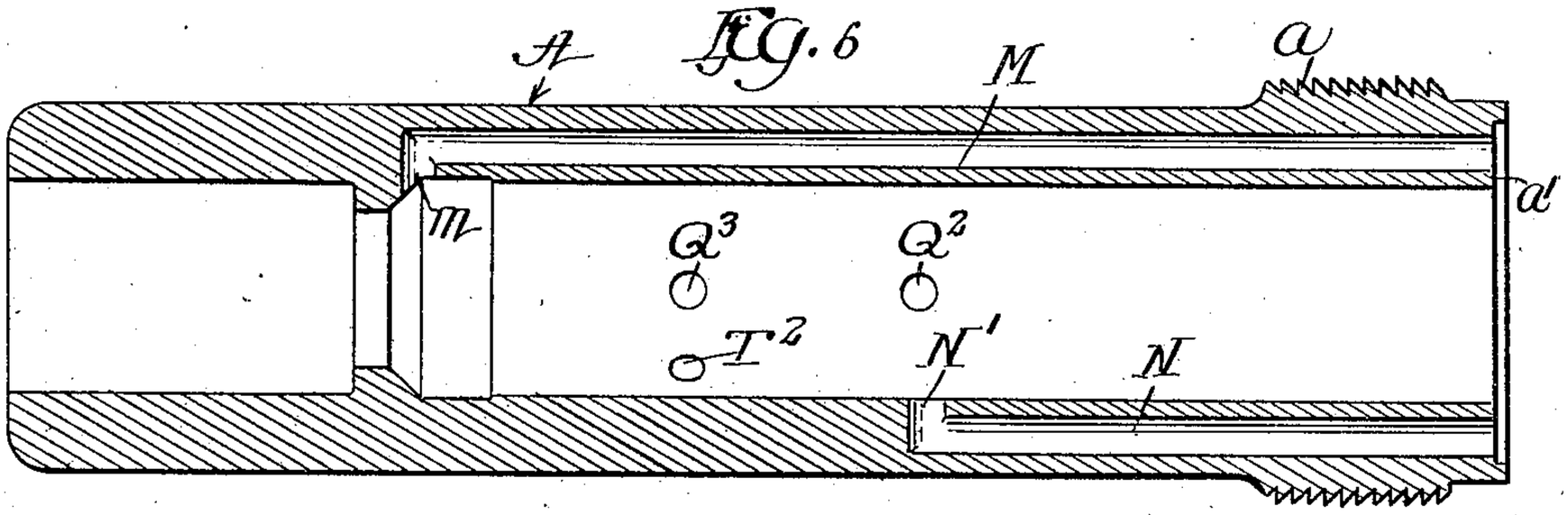


FIG. 7.

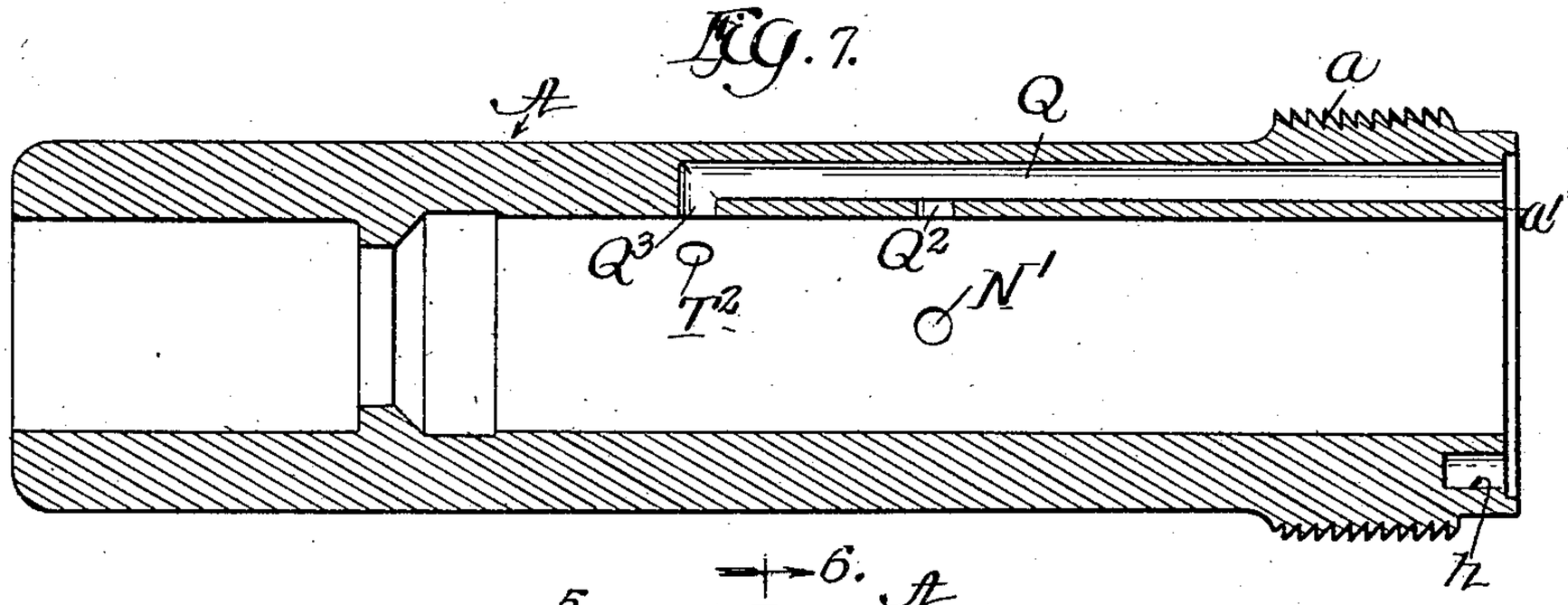
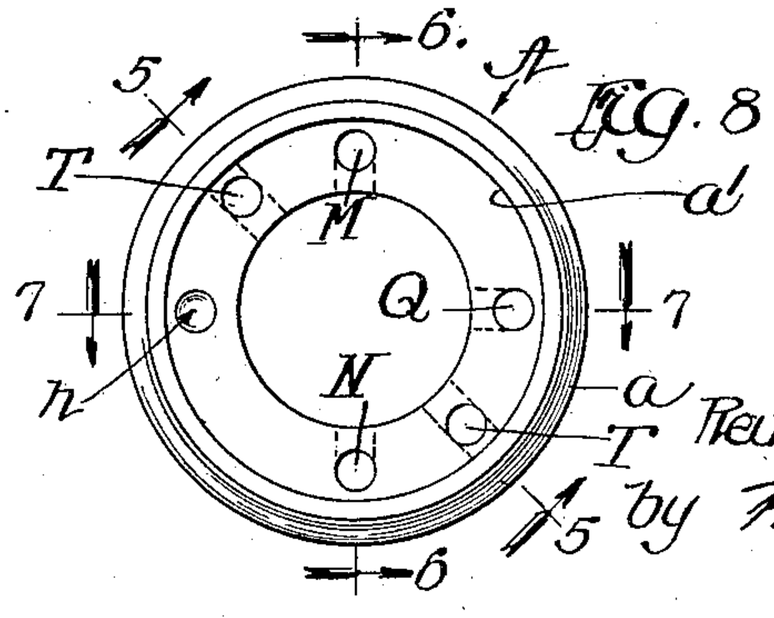


FIG. 8



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UNITED STATES PATENT OFFICE.

REINHOLD A. NORLING, OF AURORA, ILLINOIS, ASSIGNOR TO AURORA AUTOMATIC MACHINERY COMPANY, OF AURORA, ILLINOIS, A CORPORATION OF ILLINOIS.

PNEUMATIC HAMMER.

998,919. Specification of Letters Patent. Patented July 25, 1911.

Application filed December 17, 1910. Serial No. 597,865.

To all whom it may concern:

Be it known that I, REINHOLD A. NORLING, a citizen of the United States, and a resident of Aurora, in the county of Kane and State of Illinois, have invented certain new and useful Improvements in Pneumatic Hammers; and I do hereby declare that the following is a full, clear, and exact description thereof, reference being had to the accompanying drawings, and to the letters of reference marked thereon, which form a part of this specification.

This invention relates to a portable pneumatic tool or hammer of that class embracing a barrel or cylinder, a piston or plunger adapted to move therein, and a controlling valve, through which the air or other fluid under pressure is admitted to and permitted to escape from the opposite ends of the cylinder or barrel to give reciprocatory movement to the plunger therein.

The invention is illustrated and described herein as applied to a chipping hammer, otherwise known as a short stroke hammer, and consists of the combination of parts hereinafter described and more particularly pointed out in the appended claims.

In the drawings:—Figure 1 is a longitudinal section through the hammer in a plane containing the central axis of the barrel or cylinder and the central axis of the throttle valve chamber. Fig. 2 is a longitudinal section through the barrel on an enlarged scale in a plane through the central axis thereof at an angle to the plane of Fig. 1. Fig. 3 is a similar section through the barrel in the same plane, showing the piston and movable valve member in different positions to those shown in Fig. 2. Fig. 4 is a longitudinal section through the central axis of the barrel in a plane at a second angle to the plane of the section of Fig. 1. Figs. 5, 6 and 7 are longitudinal sections through the barrel taken respectively on the lines 5—5, 6—6, and 7—7 of Fig. 8. Fig. 8 is a rear end elevation of the body of the barrel. Fig. 9 is a cross-section of the hammer on the line 9—9 of Fig. 1, with the movable valve member in the position indicated in Fig. 4 where the plane of the section is indicated by $9^{\times}$—$9^{\times}$. Fig 10 is a side elevation of the valve block body. Fig. 11 is a transverse section through the same on the line 11—11 of Fig. 10. Fig. 12 is a transverse section through the valve block body on the line 12—12 of Fig. 11. Fig. 13 is a longitudinal section through the valve block body on the line 13—13 of Fig. 12. Fig. 14 is a longitudinal section through the valve block body on the line 14—14 of Fig. 12. Fig. 15 is a side elevation of the valve block cap. Fig. 16 is a rear end elevation of the same. Fig. 17 is a longitudinal section through the central axis of the valve block cap on the line 17—17 of Fig. 16. Fig. 18 is a longitudinal section through the valve block cap through the central axis of the same on the line 18—18 of Fig. 16.

In that embodiment of my invention illustrated in the accompanying drawings, A represents the barrel or cylinder of the hammer; B, the piston or plunger adapted to reciprocate therein; C, the tool carrying nozzle; and D, the tool, in this case a chisel. The rear end of the barrel or cylinder is screw-threaded as at *a*, to receive the forward, internally threaded end of a hollow head E. Said hollow head E is closed at its rear end by an end wall E^1 and has formed integrally with it a handle F. The head E is split at its forward end and provided with a longitudinal recess *e* inclosed by apertured lugs e^1, e^1 which are drawn together by a bolt e^2 so as to rigidly clamp the thread of the head in engagement with the thread of the barrel.

G indicates a transverse passage in the tool head containing a valve bushing *g*. G^1 is a throttle valve piston reciprocably mounted in said bushing, and adapted to be operated by a stem G^2 which projects through an aperture G^3 into a slot G^4 in the handle containing a pivotally mounted lever G^5 which operatively engages the upper end of said stem. Said lever G^5 is actuated by a hand lever or trigger F^1 pivotally mounted in the slot G^4 in position to be engaged by the palm of the hand when the tool handle is grasped and connected to said lever G^5 by a link *f*. An annular chamber g^1 is formed about the bushing *g* and is connected with the interior thereof by supply ports g^2.

g^3 is an air passage leading to the annular chamber g^1. Said passage is enlarged at its outer end and threaded to receive the usual air supply pipe (not shown).

The outer end of the transverse passage G is closed by a threaded cap g^4 and the opposing parts of said cap and of the piston valve

G[1] are provided with recesses to receive the ends of a coiled spring g^5 which normally holds the piston in position to close the supply ports g^2.

The valve mechanism for controlling the admission and exhaust of air into and from the cylinder embraces a valve block H[×] provided with exhaust and admission ports and an annular or cylindric valve ring J surrounding said valve block and arranged to slide endwise thereon to open and close said ports; said valve ring being provided with oppositely facing differential pressure areas. Said valve block is located at the rear end of the barrel and is made in two parts,—a body member H and a cap member I.

The valve block body H rests at its forward end within an annular recess a^1 formed in the rear end of the piston barrel A. It is provided with a recess or chamber h^1 in its forward face, the outer part of which, h^2, is of slightly larger diameter than that of the barrel A, while the inner part, h^3, is of smaller diameter, an annular shoulder h^4 being thus formed. A dowel pin h (see Fig. 4) holds said valve block body against rotative movement relative to the piston barrel. The cap member I is provided at its forward end with an annular projection or stem I[1] of nearly the length of the valve block body, which engages within a longitudinal, central bore in said valve block body, the forward end of said stem forming part of the rear wall of the chamber h^1 in the forward face thereof. The rear end of the valve block cap rests against the end wall E[1] of the plunger barrel head. The valve block H[×] is thus rigidly held in place between the rear end of the cylinder A and the end wall of the hollow head E. A dowel pin i (see Fig. 1) holds the cap I against rotative movement relative to the valve block body H.

The valve member J is in the form of a cylindric sleeve surrounding the valve block H[×] and is arranged to have endwise sliding movement thereon. The valve block H[×] is enlarged in diameter at its forward end to form an annular flange H[1]. The valve ring J is enlarged at its forward end to embrace said flange H[1] and is provided with an annular shoulder J[1] on its inner surface which is opposed to the rear face of the annular flange H[1], and which forms the larger pressure area of the valve ring. The valve block cap I is made of larger diameter than the rear end of the valve block body H so as to form a forwardly facing, annular shoulder I[2] extending around the rear end of the body, and the valve ring J is enlarged at its rear end, as indicated at J[4], to embrace said valve block cap.

J[5] indicates an annular, rearwardly facing shoulder on the inner surface of the valve ring J opposite the forwardly facing annular shoulder I[2] of the valve block. Said shoulder J[5] constitutes the smaller pressure area of the valve ring J. Within the inner, rear, enlarged end of the valve ring is formed an annular groove or channel J[6] which communicates with the space between the shoulder J[5] of the valve ring and the shoulder I[2] of the valve block in all positions of the valve ring, as shown in Figs. 1 to 4, inclusive. The forward movement of the valve ring J is limited by the rear end of the cylinder A, while its rear movement is limited by the end wall E[1] of the hollow head E. The length of the valve ring J is so proportioned to the distance between the end wall E[1] and the rear end of the cylinder A that the shoulders J[1] and J[5] of the valve ring do not strike the shoulders of the valve block to which they are opposed when the valve ring moves to its limits, but leaves a small space between them (see Figs. 2 and 3) so that air may be readily admitted to the pressure area of the valve ring.

K indicates a series of radial exhaust ports which are located at the forward end of the valve block body and which extend through the cylindric walls of the chamber, located in the forward end thereof. Said ports K constitute the main exhaust ports for the inner end of the cylinder and are adapted to permit the exhaust of the air from the inner end of the barrel, when the piston B is making its rearward or return stroke, the valve ring J being then in such position that the ports K are uncovered and open to the space X about the valve, which space is freely open to the outer air through the passage X[1] (see Fig. 1) which opens through the cylindric wall of the head E.

M indicates a passage extending longitudinally through the walls of the main barrel or cylinder and which opens into the interior of the barrel at its forward end through a port m (see Figs. 2, 6 and 9), and which is adapted for the exhaust of air from the outer or forward end of the cylinder during the outward stroke of the piston. Said passage extends through the walls of the valve block body H and through the valve block cap, being closed at its rear end against the end wall E[1] of the head E. The part of said passage M extending through the valve block is bent inwardly intermediate the ends of the valve block so as to make it possible to provide a passage of large diameter without unduly enlarging the diameter of said valve block. Said passage M opens through the cylindric surface of the cap I by means of a port M[2] located near the rear end of said cap. Said part is in the form of a transverse slot in the outer cylindric surface of the cap (see Figs. 2, 15 and 18) and is covered by the valve ring J when the same is at the rearward limit of its movement, but is left uncovered

and open to the exhaust space X when said valve ring is at its forward limit of movement. From the foregoing description it will be apparent that when the valve ring J is at the rear limit of its movement, the exhaust space X is connected with the inner or rear end of the barrel, while, when said valve ring is at the forward limit of its movement, said exhaust space is connected with the outer or forward end of the barrel.

In the rear end of the valve block cap I is formed a central annular recess or chamber I^3 which opens directly into the transverse throttle-valve passage G in the head. A series of annularly arranged ports I^4 are provided in the cap I, said ports extending from the chamber I^3 through the outer surface of said cap and being inclined rearwardly with respect to the longitudinal central axis of the cap so as to open into an annular groove I^5, located immediately forward of the shoulder I^2 in the annular surface of the valve block, and formed partly in the valve block body and partly in the valve block cap. Said groove I^5 opens into the space between the shoulder J^5, the smaller pressure area of the valve ring J, and the shoulder I^2 of the valve block, which space, as above described, is always in communication with the channel J^6 of the valve ring. The space between the shoulder J^5 and the shoulder I^2 and the channel J^6 are thus always supplied with live air when the throttle valve is open.

In the valve block body H are provided a series of annularly arranged ports R, which extend from the chamber h^1 in the forward end thereof to an annular slot R^1 in the outer surface of said valve block body near its rear end. Said ports are inclined rearwardly and outwardly and constitute the main supply ports for admitting live air to the inner or rear end of the cylinder. The slot R^1 is adapted to be uncovered and brought into communication with the annular groove or channel J^6 of the valve ring J for the admission of air to the inner end of the cylinder when the valve ring J is in its forward position. (See Fig. 4).

The longitudinal exhaust passage M which leads from the forward end of the barrel, opens by means of a slot or port P through the outer cylindric surface of the valve block cap I at a point spaced longitudinally to the rear of the exhaust port M^2. The port or slot P opens into the live air space formed by the groove or channel J^6 when the valve ring J is in its rearward position and is closed by said valve ring when the same is in its outer or forward position. The port or slot P, and the longitudinal passages M connected therewith, constitute the supply port for admitting air to the outer or forward end of the cylinder to drive the piston rearward on its return stroke.

N indicates a longitudinal supply passage (see Figs. 3, 6, 16, 17 and 18) formed in the wall of the cylinder A and extending through the valve block body H and into the cap I where it opens at its rear end into the live air chamber I^3 in said cap. Said passage N opens at its forward end into the cylinder A through a port N^1 located intermediate the ends of said cylinder.

Q indicates a longitudinal supply passage formed in the wall of the cylinder A and extending into the valve block body and opening by a port Q^1 into the space between the annular shoulder formed by the flange H^1 of the valve block and the annular shoulder J^1, that is to say, the larger pressure area of the valve ring. The passage Q opens by a port Q^3 into the cylinder at a point intermediate its ends. Said port is spaced circumferentially from but in a transverse plane with the port N^1.

The piston B, near its rear end, is provided with an annular groove B^1, (see Figs. 1 to 4, inclusive,) in its outer, cylindric surface forming an annular space about said piston by means of which the ports Q^2 and N are adapted to be connected when the piston is at or near its outer limit of movement. This connection directs the live air, always present in the passage N on account of its connection with the live air chamber I^3 in the valve block cap; into the supply passage Q whence it passes through the port Q^1 to the larger pressure area of the valve ring J and shifts said valve ring to its rearward position against the constant live air pressure on its smaller pressure area.

The passage Q is extended forwardly beyond the port Q^2 to a point intermediate said port and the forward end of the cylinder where it opens into said cylinder through a second port Q^3 which is closed by the piston when the port Q^2 is uncovered by the groove B^1 to admit live air to shift the valve ring rearwardly, and which is uncovered by the forward end of the piston on its return stroke. Auxiliary, longitudinal exhaust passages T, T are formed in the wall of the cylinder, said passages opening at their ends by ports T^1, T^1, (see Figs. 1 and 5) through said wall near the rear end of said cylinder into the exhaust space X and opening at their forward ends by ports T^2, T^2 into the cylinder at points located in a transverse plane with the port Q^3 and adapted to be uncovered by the forward end of the piston on its return stroke at the same time that it uncovers the port Q^3 (see Figs. 1 and 3). By this construction the passage Q leading to the larger pressure area J^1 of the valve ring is connected to the exhaust space X after the forward end of the piston has passed the ports T^2 on the return stroke, through the port Q^3, the cylinder, the ports T^2, the passages T and the ports T^1. This

relieves the live air pressure on the larger pressure area of the valve ring, so that it may be shifted to its forward position by the constant live air pressure on its smaller pressure area.

The operation of the valve mechanism is as follows:—Starting with the parts in the position indicated in Fig. 4, with the plunger at the inner or rear end of its stroke, and the valve ring J at the outer or forward limit of its movement, the main supply ports R for admitting live air to the rear end of the cylinder are open into the channel or groove J^6 of the valve ring and the exhaust port M^2 through which the exhaust from the forward end of the cylinder passes to the exhaust space X are also open. The supply port P for supplying live air to the forward or outer end of the cylinder, and the exhaust port K for the exhaust of the air from the inner or rear end of the cylinder are at this time closed. The opening of the throttle valve G^1 admits live air to the live air chamber I^3 in the valve block cap I whence it passes through the radial ports I^4 in said cap to the channel or groove J^6 of the valve ring and thence through the ports R to the inner end of the cylinder. A large supply of air is thus admitted to drive the piston with force forwardly on its working or power stroke, and the air at the forward end of the cylinder in advance of the piston is exhausted through the ports *m*, the passage M and the exhaust port M^2. As the piston nears the end of its forward stroke and reaches the position indicated in Fig. 2, its forward end covers the port Q^3 and the annular groove B^1 in the outer cylindric surface of the piston comes in the transverse plane of the ports Q^2 and N^1, thereby connecting the live air passage N which leads from the live air chamber I^3 in the valve block cap, with the supply passage Q, and thus permitting the live air to pass through the passage Q and port Q^1 to the larger pressure area J^1 of the valve ring. This effects a movement of the valve ring J to the rearward limit of its movement against the constant live air pressure on its smaller pressure area J^5 which it receives through the ports I^4 from the live air chamber I^3. This rearward movement of the valve ring uncovers the exhaust ports K^2 for the rear end of the cylinder, opens the supply ports P, adapted to admit live air to the forward end of the cylinder into communication with the channel or groove J^6 of the valve ring which contains live air and closes the exhaust ports M^2 and the main supply ports R, adapted, respectively, for the exhaust from the forward end of the cylinder and for the supply of live air to the rear end of the cylinder. In the meantime the piston has reached the outer or forward limit of its movement and under the pressure of live air passes through the port P and the associated passage and port M, *m* and is driven on its return or rearward stroke. When, on its return stroke, the piston reaches the position indicated in Fig. 1, the ports Q^3 of the passage Q leading to the larger pressure area J^1 of the valve ring and the ports T^2, T^2 of the auxiliary exhaust passages T, T are simultaneously uncovered by the forward end of the piston, thus opening the larger pressure area J^1 of the valve ring to the exhaust space X, through the ports Q^1, the passage Q, the ports Q^3, the cylinder, the port T^2 and the auxiliary exhaust passages and ports T, T^1. This relieves the pressure on the larger pressure area of the valve ring which is then shifted to its forward position by the constant live air pressure on its smaller pressure area J^5. This puts the parts in the first position described with the exhaust ports K for the inner or rear end of the cylinder and the supply port P for the forward end of the cylinder closed and the supply ports R for the inner or rear end of the cylinder, and the exhaust port M^2 for the outer or forward end of the cylinder open. The operation then continues as before.

It will be noted that, by reason of the arrangement of the ports R and I^4 and their outward inclination toward the grooves R^1 and I^5 into which they respectively open and which are adapted to be connected by the channel J^6 in the valve ring when the valve is in its forward position to connect the inner end of the barrel to the live air supply, the valve block is much shortened and at the same time it is possible to provide large ports so as to produce a large admission of air into the rear end of the cylinder to drive the plunger on its working stroke. A powerful tool is thus produced. In addition, by bending those passageways which extend longitudinally through the valve block inwardly intermediate their ends, the diameter of said valve block may be reduced without affecting the cross-sectional area of said passages.

I claim as my invention:—

1. The combination with a cylinder and a reciprocating plunger therein, of a controlling valve for controlling the admission and exhaust of air into and from the cylinder embracing a valve block member and a valve ring member, said valve ring member having oppositely facing differential pressure areas and being adapted to move endwise on said valve block, said valve block member having shoulders of different areas opposing the pressure areas of said valve ring and having a recess formed in each end, a circumferentially extending channel in said valve ring located at the rear of the smaller pressure area thereof, a plurality of annularly arranged supply ports in said valve block, said supply ports being inclined

forwardly and outwardly and extending from the recess in the rear end of said valve block to the space between the smaller pressure area of said valve ring and the associated shoulder of said valve block, and a plurality of annularly arranged admission ports opening through said valve block intermediate said valve block shoulders, said admission ports being inclined forwardly and inwardly and opening at their inner ends into the recess at the forward end of said valve block, said valve ring channel being constructed to connect the outer ends of said supply and admission ports in one position of the valve ring.

2. The combination with a cylinder and a reciprocating plunger therein, of a controlling valve for controlling the admission and exhaust of air into and from the cylinder embracing a valve block member and a valve ring member, said valve ring member having oppositely facing differential pressure areas and being adapted to move endwise on said valve block, said valve block member having shoulders of different areas opposing the pressure areas of said valve ring and having a centrally located recess formed in each end, an annular slot in the outer surface of the valve block adjacent its shoulder of smaller area, a circumferentially extending channel in said valve ring located at the rear of the smaller pressure area thereof, said channel being in communication with said valve block slot in all positions of the valve ring, a plurality of circularly arranged supply ports in said valve block, said supply ports being inclined forwardly and outwardly and extending from the recess in the rear end of said valve block to the said slot in the outer surface of the valve block, a second annular slot formed in the outer surface of said valve block forward of said first named slot, and a plurality of annularly arranged admission ports in said valve block, said admission ports connecting said second named slot with the recess at the forward end of said valve block and being inclined forwardly and inwardly, said valve ring channel being constructed to connect the slots in said valve block in one position of said valve ring.

3. The combination with a cylinder and a reciprocating plunger therein, of a controlling valve for controlling the admission and exhaust of air into and from the cylinder embracing a valve block member and a valve ring member, said valve ring member having oppositely facing differential pressure areas and being adapted to move endwise on said valve block, said valve block member having shoulders of different areas opposing the pressure areas of said ring and having a centrally located annular recess formed in its forward end, said valve block also being provided with longitudinally spaced annular slots in its outer surface, a supply slot located adjacent the shoulder of smaller pressure area and an admission slot located forward of said supply slot, a plurality of radial, annularly arranged exhaust ports extending through the annular walls of said recess, a circumferentially extending channel in said valve ring located at the rear of the smaller pressure area thereof, said channel being in communication with said supply slot of the valve block in all positions of said valve ring, and being constructed to connect the two slots in one position of said valve ring, a plurality of circularly arranged supply ports in said valve block extending from the rear end of the block and opening into said supply slot, and a plurality of annularly arranged admission ports connecting said admission slot with the said recess in the forward end of the valve block, said admission ports being inclined forwardly and inwardly and opening at their inner ends through the end wall of said recess.

4. The combination with a cylinder and a reciprocating plunger therein, of a controlling valve for controlling the admission and exhaust of air into and from the cylinder embracing a valve block member and a valve ring member, said valve ring member having closely approached, oppositely facing differential pressure areas and being adapted to move endwise on said valve block, said valve block member having shoulders of differential areas opposing the pressure areas of said ring and having a centrally located, annular recess formed in each end, a plurality of exhaust ports and a plurality of admission ports for the rear end of the cylinder, said exhaust ports extending through the annular wall of the recess in the forward end of the valve block, and said admission ports opening through the end wall of said recess, a plurality of supply ports leading from said recess at the rear end of said valve block and opening through the annular surface of the valve block adjacent its shoulder of smaller area, and a circumferentially extending channel in said valve ring located at the rear of the smaller pressure area thereof, said channel being in communication with said valve ring in all positions thereof and being constructed to connect said supply and admission ports when said valve ring is in its forward position.

5. The combination with a cylinder and a reciprocating plunger therein, of a controlling valve for controlling the admission and exhaust of air into and from the cylinder embracing a valve block member and a valve ring member, said valve ring member having closely approached, oppositely facing differential pressure areas and being adapted to move endwise on

said valve block, said valve block comprising a body having a central bore and a cap having a stem fitting within said bore, and said valve block member having shoulders of differential areas opposing the pressure areas of said ring and having a centrally located, annular recess formed in each end, a plurality of exhaust ports and a plurality of admission ports for the rear end of the cylinder, said exhaust ports extending through the annular wall of the recess in the forward end of the valve block, and said admission ports opening through the end wall of said recess, a plurality of supply ports leading from said recess at the rear end of said valve block and opening through the annular surface of the valve block adjacent its shoulder of smaller area, and a circumferentially extending channel in said valve ring located at the rear of the smaller pressure area thereof, said channel being in communication with said valve ring in all positions thereof and being constructed to connect said supply and admission ports when said valve ring is in its forward position.

6. The combination with a cylinder and a reciprocating plunger therein, of a controlling valve for controlling the admission and exhaust of air into and from the cylinder embracing a valve block provided with an annular recess at its forward rear end and a valve ring having closely approached, oppositely facing differential pressure areas, said valve block being provided with a plurality of radial exhaust ports through the annular wall of said recess, and a plurality of annularly arranged admission ports opening at their inner ends through the end wall of said recess and at their outer ends through the outer surface of said valve block, said valve ring having a channel at the rear of its smaller pressure area adapted to communicate with the outer ends of said admission ports in the forward position of said valve ring, means providing a constant supply of live air to said channel, an exhaust passage extending through said valve block, said exhaust passage being inclined inwardly intermediate its ends, and an admission and exhaust port in said valve block communicating with said exhaust passage, said last named admission port communicating with said valve ring channel when the valve ring is in its rearward position.

In testimony, that I claim the foregoing as my invention I affix my signature in the presence of two witnesses, this 5th day of December A. D. 1910.

REINHOLD A. NORLING.

Witnesses:

IVER A. HANSSEN,

LESTER J. YOUNG.