No. 796,259. PATENTED AUG. 1, 1905.

H. S. SHERMAN.

ELECTROMAGNETICALLY OPERATED RECIPROCATING TOOL.

APPLICATION FILED APR. 22, 1904.

3 SHEETS—SHEET 1.

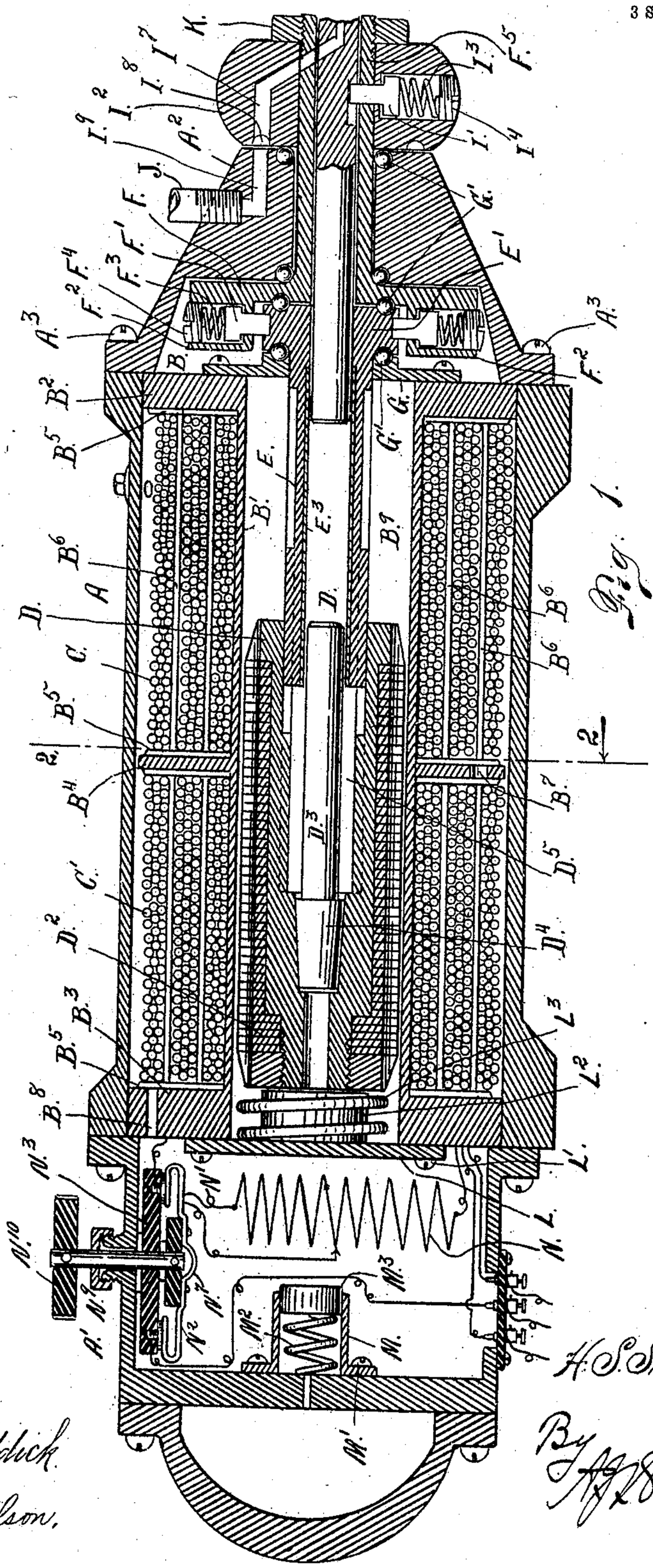


Fig. 1.

Witnesses
Otto E. Hoddick.
Dena Nelson.

H. S. Sherman.
Inventor
By A. F. & D. Mann
Attorney

ANDREW. B. GRAHAM CO., PHOTO-LITHOGRAPHERS, WASHINGTON, D. C.

No. 796,259. PATENTED AUG. 1, 1905.

H. S. SHERMAN.

ELECTROMAGNETICALLY OPERATED RECIPROCATING TOOL.

APPLICATION FILED APR. 22, 1904.

3 SHEETS—SHEET 2.

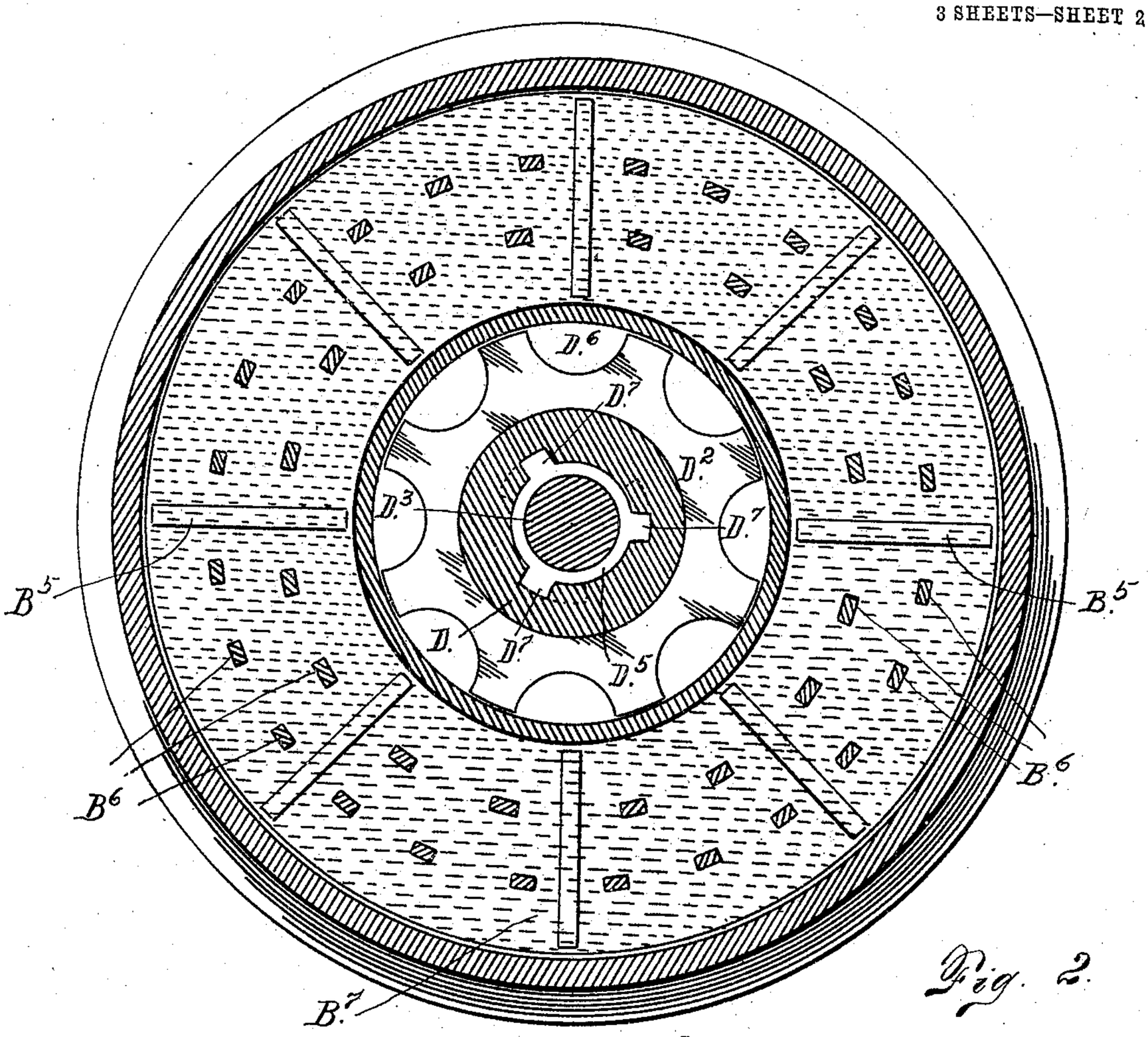


Fig. 2.

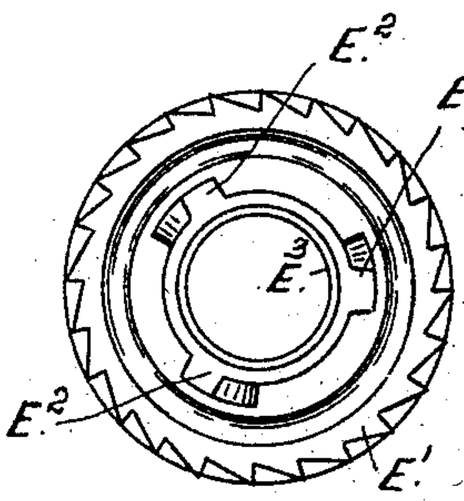


Fig. 4.

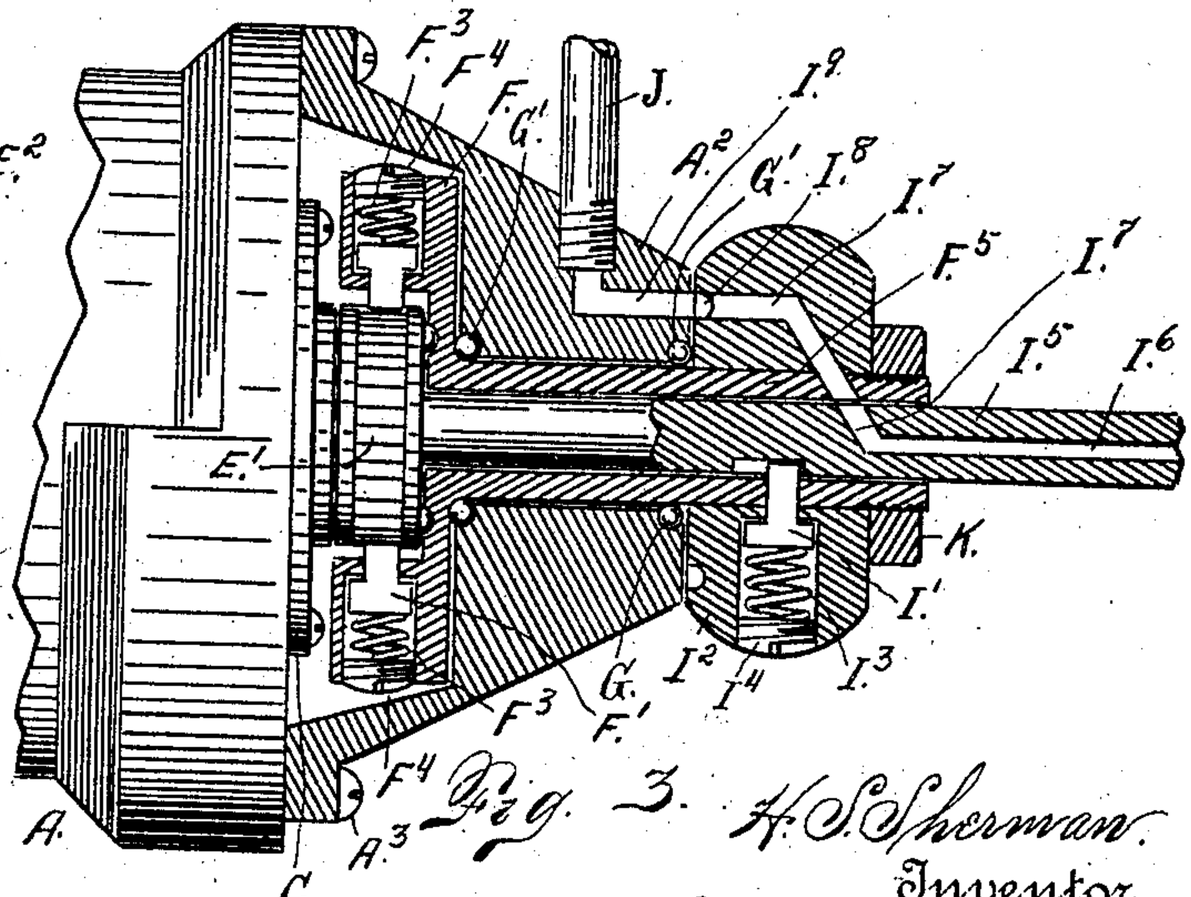


Fig. 3.

Witnesses
Otto E. Hoddick
Dena Nelson.

H. S. Sherman.
Inventor
By A. W. Dean
Attorney

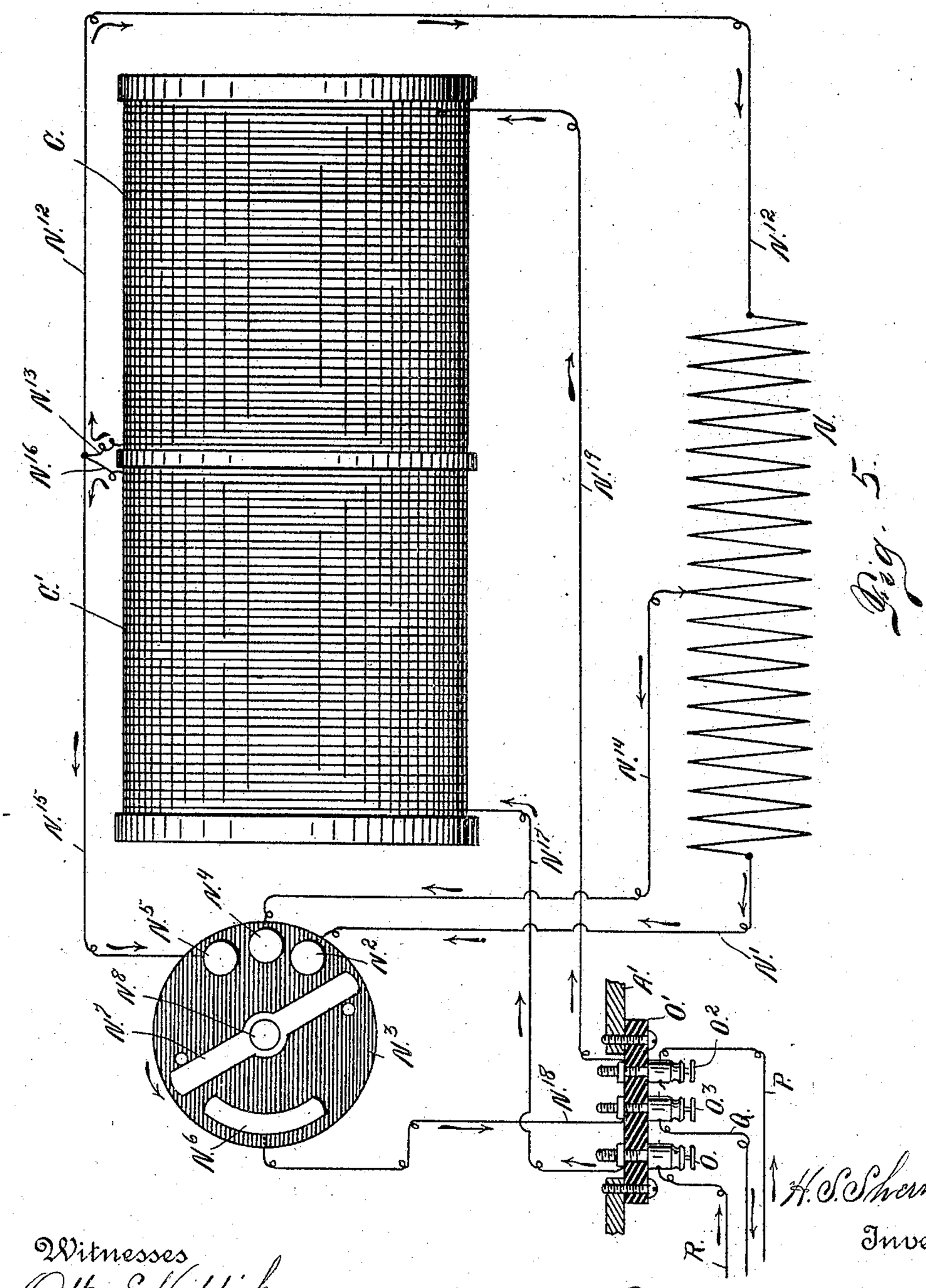
No. 796,259. PATENTED AUG. 1, 1905.

H. S. SHERMAN.

ELECTROMAGNETICALLY OPERATED RECIPROCATING TOOL.

APPLICATION FILED APR. 22, 1904.

3 SHEETS—SHEET 3



Witnesses
Otto E. Hoddick.
Vena Nelson.

UNITED STATES PATENT OFFICE.

HARRY S. SHERMAN, OF DENVER, COLORADO.

ELECTROMAGNETICALLY-OPERATED RECIPROCATING TOOL.

No. 796,259. Specification of Letters Patent. Patented Aug. 1, 1905.

Application filed April 22, 1904. Serial No. 204,490.

To all whom it may concern:

Be it known that I, HARRY S. SHERMAN, a citizen of the United States of America, residing in the city and county of Denver and State of Colorado, have invented certain new and useful Improvements in Electromagnetically-Operated Reciprocating Tools; and I do declare the following to be a full, clear, and exact description of the invention, such as will enable others skilled in the art to which it appertains to make and use the same, reference being had to the accompanying drawings, and to the letters of reference marked thereon, which form a part of this specification.

My invention relates to improvements in reciprocating tools operated by electromagnetism.

In this application what is ordinarily known as a "hammer-drill" will be described, though it must be understood that my improvements may be applied to other classes of reciprocating tools as well as to the particular class herein shown and described.

In my improved tool two solenoids are employed and a two-phase alternating current used in connection with a three-wire circuit. The two phases of the current act alternately upon the solenoids, thus obviating the necessity of a mechanical switch whereby the current is cut off from one solenoid and passed into the other, such as is employed in ordinary reciprocating tools operated by electromagnetism.

An important feature of my invention consists in the manner in which the coils of the solenoids are arranged, whereby the oil with which the case containing the solenoids is filled circulates freely around and through the convolutions of the wire, whereby a perfect insulation is obtained. In my improved construction at suitable intervals the layers of convolutions composing the solenoids are separated by strips of fiber or other suitable insulating material, thus keeping the convolutions of the coil sufficiently separated to permit the circulation of the oil, which forms the best possible insulation.

It is well known that for various reasons the ordinary insulation of the wires from which the solenoids are formed often fails to give complete protection to the wires, thus resulting in short circuits and much trouble by way of repairs. This is particularly the case with tools of the class herein described. However, by the employment of the oil, which completely fills the solenoid-case and circulates freely through the windings or convolutions of the wire, this difficulty is entirely obviated.

Having briefly outlined my improved construction, as well as the function it is intended to perform, I will proceed to describe the same in detail, reference being made to the accompanying drawings, in which is illustrated an embodiment thereof.

In the drawings, Figure 1 is a vertical section taken through my improved tool or electromagnetic hammer. Fig. 2 is a section taken on the line 2 2, Fig. 1, the parts being shown on a larger scale. Fig. 3 is a view of the forward extremity of the tool, partly in section. Fig. 4 is an end view of the ratchet and rifle-bar connected therewith for imparting the rotary motion to the tool-holding chuck. Fig. 5 is a diagrammatic view illustrating the three-wire circuit, preferably employed in connection with my improved device.

The same reference characters indicate the same parts in all the views.

Let A designate the outer case and B the spool, inclosed by the case upon which the solenoids C and C′ are wound. The spindle B′ of this spool is provided intermediate the heads B^2 and B^3 with a partition B^4, separating the two solenoids. The spool is composed of non-magnetic material, as bronze. The heads of the spool on their inner surfaces, as well as the partition B^4 on its opposite surfaces, are provided with radial ribs B^5, which leave sufficient space between the solenoids and the adjacent parts of the spool to permit the free circulation of the oil, which fills the solenoid-case. This oil is indicated by the shading in Fig. 2.

As shown in the drawings, each solenoid is composed of a number of circular layers or convolutions, the said layers being separated by longitudinal strips B^6, composed of fiber or other suitable insulating material, the said strips being located at suitable intervals, as indicated in Fig. 2. These strips further facilitate the circulation of the oil among the coils or convolutions of the solenoids C and C′. The partition B^4 of the spool, as well as the head B^3, is provided with orifices B^7 and B^8. The orifices B^7 permit the free circulation of the oil betweeen the two parts of the case A containing the two solenoids, while the orifice B^8 allows the free circulation of the oil between the solenoid-case and the case A′, attached to the rear extremity of the case A.

Mounted to reciprocate in the hollow B^9 of the spool is the hammer D, composed of a body D′, of non-magnetic material, as bronze, and a series of washers D^2, composed of magnetic material, as steel. These washers are located between the two heads of the body D′, the rear head being threaded on the body of the hammer, whereby it is readily attachable and detachable. By virtue of this construction the washers are locked on the hammer after being slipped into position. This washer portion of the hammer becomes permanently magnetized by virtue of its location in the magnetic field surrounded by the solenoids. In the center of the body of the hammer is located a striking part or hammer proper, (designated D^3,) whose rear extremity D^4 is cone-shaped and adapted to fit into a socket of corresponding shape formed in the body of the hammer, whereby it is held securely in place during use. Surrounding the striking part D^3 of the hammer and between the said striking part and the body thereof is a chamber D^5, adapted to receive the rifle-bar E, which enters the body of the hammer as the latter moves forwardly. By virtue of this rifled construction the rifle-bar, together with the ratchet-head E′, connected with the forward extremity of the rifle-bar, is rotated for the purpose of rotating the tool-holding chuck F. This chuck carries spring-actuated pawls F′, located in cases F^2, mounted on the rear extremity of the chuck, which is disk-shaped. A spring F^3 bears on each pawl, while each pawl-case is closed by a screw-plug F^4. To the forward extremity of the spool is attached a plate G, which surrounds the rifle-bar adjacent its ratchet-head. Ball-bearings G′ are interposed between the plate G and the ratchet-head, between the ratchet-head and the chuck part F′, and between the latter and the forward extremity A^2 of the casing. This extremity A^2 of the casing is cone-shaped and is secured to the body A by screws A^3. The body of the chuck is provided with a reduced forward extension F^5 through which the drill-bit or cutting-tool I passes. This tool is locked to rotate with the chuck by a dog I′, located in a collar I^2 and acted on by a spring I^3. The recess in which the dog I′ is located is closed by a screw-plug I^4, against which the spring bears. The inner extremity of the dog enters a recess I^5, formed in the tool. The collar I^2 is revolubly mounted adjacent the part A^2 of the casing, ball-bearings G′ being interposed between the parts A^2 and I^2. (See Fig. 3.) The cutting-tool or drill-bit is provided with a central passage I^6, registering with an inclined branch I^7, formed in the tool, the reduced part of the chuck, and the collar I^2. This passage I^7 communicates with a circumferential groove I^8, formed in the rear face of the collar I^2. A passage I^9, formed in the part A^2 of the casing, also communicates with the groove I^8. This passage I^9 communicates with a water-supply pipe J, threaded into the part A^2 of the casing, whereby water is thrown through the drill-bit into the hole of the rock for the purpose of washing out the cuttings and keeping the hole clean during the drilling operation. The collar I^2 is held in place on the chuck by a nut K, screwed on the threaded forward extremity of the reduced part of the chuck.

The rifle-bar E is provided with spiral ribs E^2, (see Fig. 4,) which engage counterpart grooves formed in the body of the hammer D, whereby the rotary movement is imparted to the drill chuck and tool as the hammer is reciprocated.

The rear extremity of the central chamber B^9 is closed by a plate L, secured to the rear end of the spool by screws L′ or other suitable fastening devices. Upon this plate and projecting into the chamber B^9 is a cushion L^2, preferably composed of rubber. This rubber cushion is surrounded by a coil-spring L^3, the two parts together forming a buffer adapted to receive the rear extremity of the hammer as it reaches its forward limit of movement. The steel washers D^2 of the magnetic hammer are provided with recesses D^6, (see Fig. 2,) which register with each other when the washers are in place, thus forming longitudinally-disposed grooves arranged around the hammer and communicating with the hammer-chamber, whereby the air within the chamber is permitted to circulate freely as the hammer reciprocates.

Located within the rear part of the casing A′ is an auxiliary casing M, secured by screws M′. Within this casing is located a spring M^2, engaged by a piston M^3, adapted to yield to compensate for the expansion of the oil as the latter becomes heated, due to the motion of the hammer and the heat generated in the solenoids. Within this casing A′ is located a resistance-coil N, one extremity of which is connected with a conductor N′, leading to a contact N^2, mounted on an insulating-piece N^3. This insulating-piece is also provided with separated contacts N^4 and N^5 and, further, with an elongated contact N^6. A circuit-closing bar N^7 is made fast to a spindle N^8, journaled in the plate N^3 and also passing through a stuffing-box N^9, mounted on the auxiliary casing part A′. To the outer exposed extremity of the spindle N^8 is made fast an insulating-handle N^{10}, whereby the circuit-closer N^7 may be manipulated at will. Connected with the opposite extremity of the resistance-coil N is a conductor N^{12}, from which leads a branch N^{13} to the solenoid C. From the middle of the resistance-coil leads a conductor N^{14} to the contact N^4, while from the contact N^5 leads a conductor N^{15}, from which leads a branch N^{16} to one terminal of the solenoid C′, while from the opposite terminal of the last-named solenoid a conductor N^{17} leads to a binding-post O, mounted on an insulating-piece O′,

secured to the casing part A′. Upon this insulating-piece O′ are also mounted binding-posts O^2 and O^3. From the binding-post O^3 leads a conductor N^{18} to the contact N^6, and from the binding-post O^2 leads a conductor N^{19} to the terminal of the solenoid C remote from the branch conductor N^{13}. Circuit-wires P, Q, and R lead from the source of electricity to the respective binding-posts O^2, O^3, and O.

Assuming that the circuit-closing bar N^7 is in position to engage the contact N^6 and the contact N^5, the circuit may be described as follows: One phase of the current in this event may be said to pass from the conductor N^{17} to the solenoid C′, from the latter through the conductor N^{16} to the conductor N^{15}, thence to the contact N^5 through the bar N^7, the contact N^6, the conductor N^{18} to the binding-post O^3, and thence out through the conductor Q, while the other phase of the current may be said to pass from the conductor P to the binding-post O^2, from the latter through the conductor N^{19} to one terminal of the solenoid C, thence from the other terminal of the same solenoid through the conductor N^{13} to the conductor N^{15}, from the latter to the contact N^5, thence through the circuit-closing bar N^7, the conductor N^{18}, the binding-post O^3, and the return-wire Q. In this way the two phases of the alternating current act alternately on the two solenoids, whereby the latter are alternately energized and deënergized, thus imparting the reciprocating movement to the hammer D, whereby the latter as it reaches its forward limit of movement acts on the tool I^5. The hammer during its forward movement, together with the rifle-bar E and the ratchet-head E′, makes a partial rotation while the chuck and drill-bit remain stationary. However, during the reverse movement of the hammer the rifle-bar, the ratchet, the chuck, and the drill-bit are given a partial rotation in one direction in a manner that will be readily understood.

When it is desired to interpose a part or the whole of the resistance-coil N in the circuit, the circuit-closing bar N^7 will be shifted to engage the contacts N^2 or N^4, as the case may be, and the flow of the current may be said to be in the paths hereinafter specified. Assuming first that the circuit-closing switch-bar N^7 is in engagement with the contact N^6 and the contact N^2, one phase of the current may be said to pass from the conductor R through the binding-post O, the conductor N^{17}, the solenoid C′, the branch conductor N^{16}, the conductor N^{12}, the whole resistance-coil N, and the conductor N′ to the contact N^2, through the bar N^7, the contact N^6, the conductor N^{18}, the binding-post O^3, and out through the conductor Q, while the other phase of the circuit may be said to pass from the conductor P, through the binding-post O^2, the conductor N^{19}, the solenoid C, the conductor N^{13}, the conductor N^{12}, the whole of the resistance-coil N, the conductor N′, the contact N^2, the switch-bar N^7, the contact N^6, the conductor N^{18}, the binding-post O, and out through the conductor Q. Now assuming that the switch-bar N^7 is shifted to engage the contact N^4 simultaneously with the contact N^6, one phase of the current may be said to pass from the conductor R, through the binding-post O, to the conductor N^7, the solenoid C′, the conductor N^{16} to the conductor N^{12}, a portion of the resistance N, the conductor N^{14}, the contact N^4, the switch-bar N^7, the contact N^6, the conductor N^{18}, the binding-post N^3, and out through the conductor Q, while the other phase of the current passes from the conductor P through the binding-post O^2, the conductor N^{19}, the solenoid C, the conductor N^{13}, the conductor N^{12}, a portion of the resistance N, the conductor N^{14}, the contact N^4, the switch-bar N^7, the contact N^6, the conductor N^{18}, the binding-post O^3, and out through the return-wire Q. It will thus be seen that the switch mechanism virtually constitutes a rheostat, whereby the current may be controlled by having no resistance at all or more or less resistance, as may be desired.

Attention is called to the fact that the steel body portion E of the rifle-bar is provided with an interiorly-located bushing E^3 of non-magnetic material, thus preventing any tendency of the striking part of the hammer D^3 to stick to the rifle-bar.

Having thus described my invention, what I claim is—

1. In a tool of the class described, the combination with a suitable casing, of two solenoids, a magnetic hammer, a tool to be acted on by the hammer, a two-phase alternating-current circuit, means for connecting the respective current phases with the two solenoids for producing the reciprocating movement of the hammer, a resistance-coil interposed in the two-phase circuit, and a switch whereby both phases of the current may be passed through the whole or a part of the resistance-coil as may be desired.

2. In a reciprocating tool, the combination with a casing, of two solenoids located within the casing, a magnetic hammer surrounded by the solenoids, means for passing an electric current alternately through the solenoids whereby a reciprocating movement is imparted to the hammer, the coils of the solenoids being arranged in layers one outside of another and at varying distances from the longitudinal centers of the solenoids, the solenoid-case being filled with oil to more perfectly insulate the solenoid-coils, and suitable means for separating the convolutions of the coils to permit the circulation of the oil.

3. In a tool of the class described, the combination of a closed casing filled with oil, two solenoids located in the oil-filled casing, the coils of the solenoids being arranged in circular layers, and insulating-strips interposed

between the said layers whereby the convolutions of the coils are held apart to permit circulation of the oil, and a magnetic hammer located in the chamber in the center of the solenoids, and closed against the entrance of the oil in the solenoid-chamber.

4. In a tool of the class described, the combination of a casing, a spool located therein and provided with a central opening, a magnetic hammer located in the spool-opening, the said opening being separated from the outer chamber, two solenoids located in the chamber and wound on the spool, a central partition mounted on the spool and separating the solenoids, the latter being wound in circular layers, strips of suitable material being located at intervals between the layers of the solenoids, and oil filling the solenoid-chamber for the purpose set forth.

5. In a tool of the class described, the combination of a suitable casing, a spool located in said casing, solenoids wound on the spool, strips of suitable material interposed between the windings of the solenoids, oil filling the solenoid-chamber, a central chamber formed in the spool, the said chamber being surrounded by the solenoids, a magnetic hammer located in the central chamber, and a tool suitably mounted and arranged to be acted on by the hammer.

6. In a tool of the class described, the combination of an oil-filled casing, a spool located in said casing and made fast, the said spool being provided with a central partition, solenoids mounted on the spool on opposite sides of the partition, the spool having heads whose inner faces are provided with ribs, the central partition being also provided with ribs on its opposite faces, the convolutions of the coils being arranged in layers, and strips of suitable material interposed between the layers, the ribs and strips permitting a free circulation of the oil through the coils, windings or convolutions of the solenoids.

7. In a tool of the class described, the combination of two solenoids, a reciprocating hammer, and a tool to be acted on by the hammer, the hammer being composed of a non-magnetic body, washers of magnetic material mounted exteriorly on the body, a striking device centrally located in the hammer, and means for alternately passing the electric current through the solenoids whereby the latter are alternately energized to produce a reciprocating movement of the hammer.

8. In a tool of the class described, the combination of a casing, solenoids inclosed thereby, a magnetic hammer surrounded by the solenoids, means for passing the electric current alternately through the solenoids for the purpose of imparting to the hammer a reciprocating movement, a rifle-bar engaged by the hammer which is constructed to coöperate therewith, and a tool-holding chuck attached to the rifle-bar by a ratchet-and-dog connection, the solenoids being located in the chamber within the casing which is closed from the hammer-chamber and filled with oil for insulating purposes.

9. In a tool of the class described, the combination of a main casing, solenoids located within the casing, a central chamber surrounded by the solenoids, a magnetic hammer located in the central chamber, means for passing the electric current alternately through the solenoids whereby a reciprocating movement is imparted to the hammer, an auxiliary casing attached to the rear extremity of the main casing, an electric switch or circuit-closer located in said auxiliary casing and having a protruding part to facilitate manipulation, the solenoid-circuit being made and broken by the use of this switch, and a resistance-coil also located in the auxiliary casing and connected with contacts of the switch, whereby the whole, a part or none of the resistance-coil may be interposed in the circuit according to the will of the operator, the solenoid-chamber together with the auxiliary casing-chamber being filled with oil and communicating with each other for insulating purposes.

10. In a tool of the class described, the combination of a casing, a spool located therein, solenoids mounted on the spool, means for separating the convolutions of the solenoids to permit the circulation of oil therethrough, the solenoid-chamber being filled with oil, a central chamber surrounded by the solenoids and closed from the solenoid-chamber, a magnetic hammer located in the central chamber, a buffer located in the rear of the hammer, and a tool located forward of the hammer and arranged to be acted on thereby during the reciprocating movement of the latter.

11. In a tool of the class described, the combination of a main casing, solenoids located therein, a central chamber closed from the solenoid-chamber, a magnetic hammer located in the central chamber, means for passing an electrical current alternately through the solenoids whereby a reciprocating movement is imparted to the hammer, an auxiliary chamber attached to the main chamber and communicating therewith, a switch located in the auxiliary chamber for controlling the circuit through the solenoids, and a yielding piston located in the auxiliary chamber whereby the said piston is adapted to yield as the liquid in the casing expands, the main and auxiliary chambers being filled with oil and communicating with each other, substantially as described.

12. In a tool of the class described, the combination with a suitable casing, of two solenoids located therein, a magnetic hammer located in the chamber surrounded by the solenoids, the said hammer being composed of a non-magnetic body portion, and magnetic washers mounted thereon and recessed to form longitudinal grooves surrounding the ham-

mer, the said grooves communicating with the hammer-chamber to permit a free circulation of the air, and suitable means for alternately passing the electric current through the solenoids whereby reciprocating movement is imparted to the hammer, substantially as described.

13. In a tool of the class described, the combination of two solenoids, means for passing the current alternately through the solenoids, a hammer located in the chamber surrounded by the solenoids, the interior portion of the hammer being composed of non-magnetic material, the hammer being provided with a central striking steel portion and an interiorly-located steel portion, and a rifle-bar which the hammer engages during its reciprocating movement, the body portion of the said rifle-bar being composed of magnetic material having a lined or interiorly-located bushing of non-magnetic material through which the striking part of the hammer passes, while the non-magnetic portion of the hammer engages the rifle-bar exteriorly and is grooved to engage the spiral ribs of the said bar.

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

HARRY S. SHERMAN.

Witnesses:
DENA NELSON,
A. J. O'BRIEN.