

June 2, 1942.

H. C. ROTERS ET AL
ELECTRIC RECIPROCATING TOOL

2,285,361

Filed July 6, 1939

2 Sheets-Sheet 1

FIG. 1.

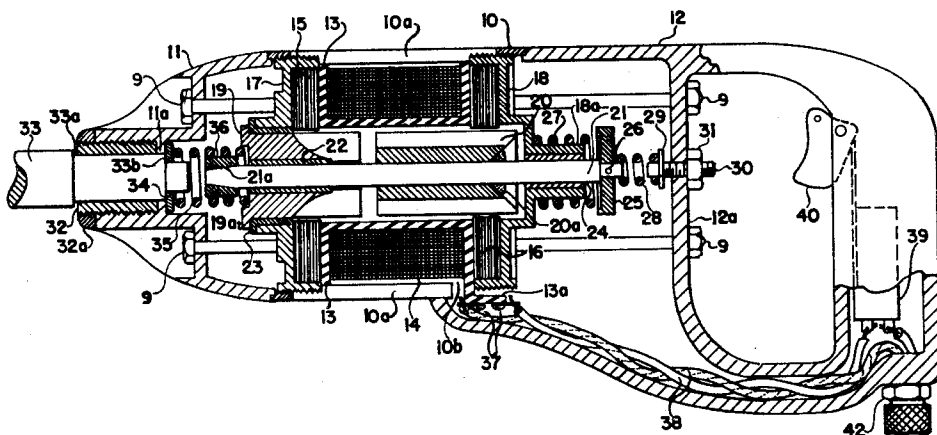


FIG. 2a.

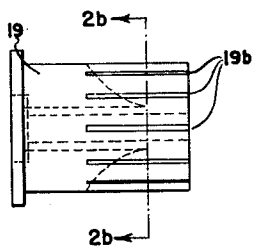


FIG. 2b.

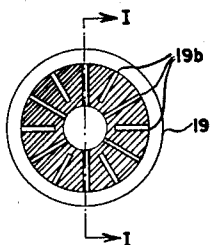


FIG. 3a.

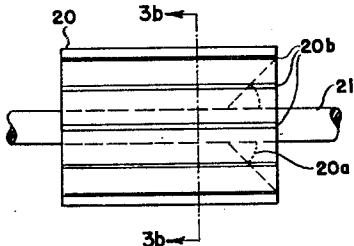


FIG. 3b.

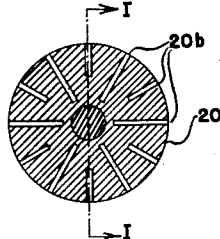


FIG. 4a.

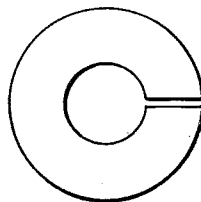


FIG. 4b.



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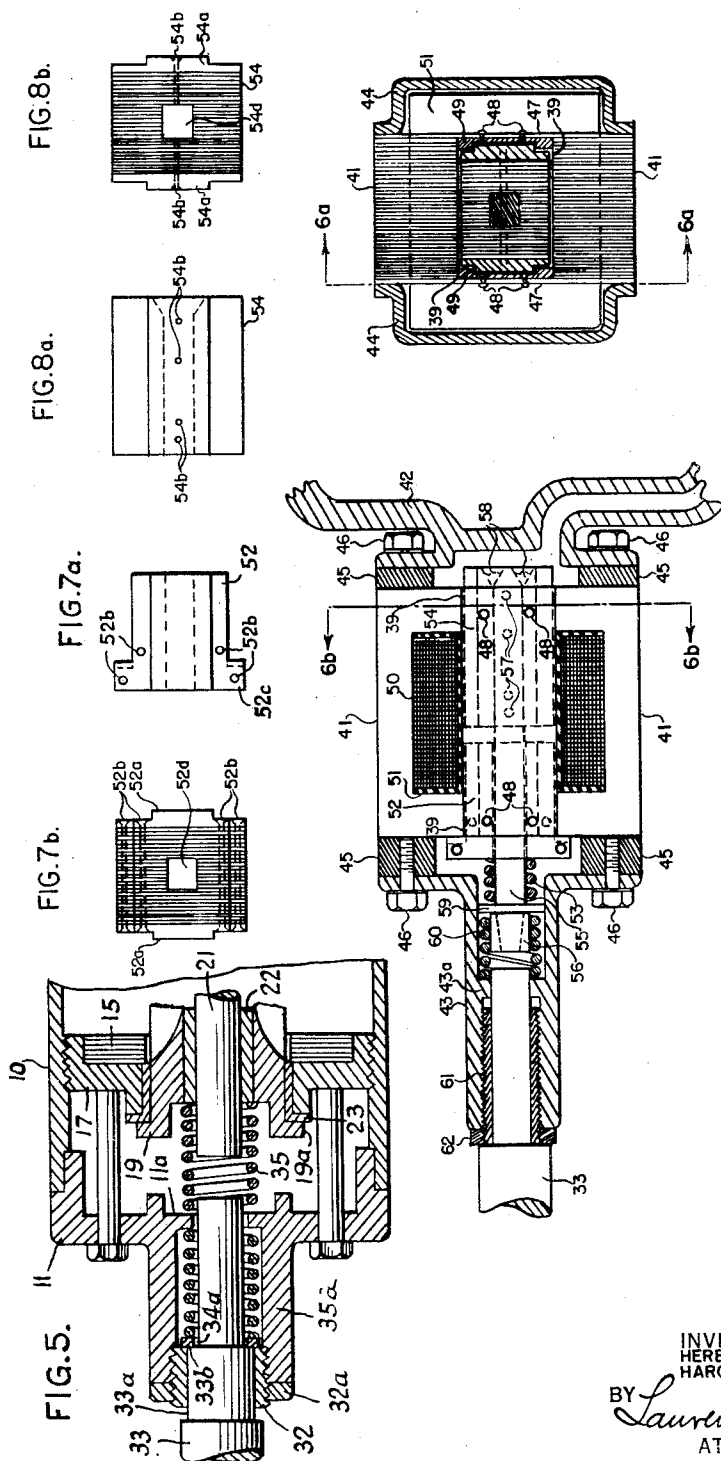
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2,285,361

ELECTRIC RECIPROCATING TOOL

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Application July 6, 1939, Serial No. 282,965

5 Claims. (Cl. 172—126)

This invention relates to electric reciprocating tools and, more particularly, to such tools comprising two relatively reciprocable magnetic cores.

Heretofore there have been devised numerous reciprocating electric tools which may be divided into two general classes: first, that in which the reciprocation is effected by a double-acting electromagnet actuating a single movable magnetic working plunger; second, that in which one direction of motion of the working plunger relative to a cooperating plunger is effected by an electromagnet and the return motion by a spring which is stressed during the working stroke of the electromagnet. The present invention relates to electric tools of the latter type. In electric tools of this type, the working plunger carrying the tool striking member is normally separated from a cooperating plunger, which may be either fixed or reciprocable, by some form of spring device. When the electromagnet is energized, the magnetic force causes the working plunger to move toward the other plunger closing the working air gap and striking the tool. At the same time the spring which acts to maintain the plungers in their normal separated position is stressed so that it is effective to return the working plunger to its normal position when the winding is de-energized. The constants of the spring and the mass of the reciprocating member are so chosen that the natural period of mechanical oscillation is substantially equal to the period at which the electromagnet is intermittently energized. The working plunger is generally mounted for reciprocatory movement in a cylindrical shell or bearing of nonmagnetic material, for example, brass.

However, the electric tools of the prior art, particularly of the type just described, have a number of disadvantages which tend substantially to decrease their efficiency and increase their cost. Among these disadvantages are eddy currents of substantial amplitude set up in the conductive parts of the unit in, or in the vicinity of, the magnetic field; for example, in the brass shell in which the striking plunger is mounted. The losses due to such eddy currents considerably increase the power requirements for a given mechanical power output and also increase the required radiation for dissipating the generated heat.

Furthermore, the electric tools of the prior art have generally comprised an inefficient magnetic circuit in which a substantial part of the reluctance is distributed outside of the working air

gap between the cooperating plungers while, in the ideal case, all of the reluctance of the magnetic circuit should be concentrated in this air gap. For example, the brass shell in which the plunger is mounted for reciprocation produces an effective air gap where the shell intersects the magnetic circuit and across which appears a substantial part of the total reluctance of the magnetic circuit. The effect of this inefficient design of a magnetic circuit is substantially to increase the required magnetomotive force, that is, the ampere-turns, of the electromagnetic winding for a given power output, which still further increases the requirements of radiation to dissipate the increased losses. Both of the factors described, in addition to increasing the cost and decreasing the efficiency of the unit, cause it to become bulky and unwieldy.

Furthermore, many of the electric reciprocating tools of the prior art have the disadvantage that they tend to be destroyed by excessive vibration if, for any reason, the tool is removed from the unit or the load is removed from the tool. Furthermore, it has not generally been possible to control the intensity of the blow of the striking tool in accordance with the character of the work being performed.

It is an object of the present invention, therefore, to provide an improved electric reciprocating tool which will overcome one or more of the above-mentioned disadvantages of the arrangements of the prior art.

It is another object of the invention to provide an improved electric reciprocating tool of the type described, in which the efficiency is increased by concentrating the reluctance of the magnetic circuit substantially solely in the working air gap between the two plungers.

It is another object of the invention to provide an improved reciprocating electric tool in which the efficiency is improved by substantially removing from the magnetic circuit all elements having substantial conductance for eddy currents, that is, conductive elements which are not readily laminated or slotted to avoid eddy currents.

It is a further object of the invention to provide an improved electric reciprocating tool including provisions for cushioning the blow of the tool striking plunger in the absence of a tool in the unit or upon removal of the load from the tool.

It is still a further object of the invention to provide an improved electric reciprocating tool including provisions for controlling the intensity

of the blow of the striking member in accordance with the character of the work being performed.

In accordance with the invention, a reciprocating electric tool comprises a pair of coaxial relatively reciprocable magnetic cores or plungers together with means for biasing the cores to normal relative positions, when deenergized, in which they are separated by a predetermined working air gap. An exciting winding surrounds the cores and cooperates with transversely or radially extending magnetic members disposed at either end of the winding and cooperating with the cores. The unit is so assembled and proportioned that the clearances between the radial magnetic members and the cores are the minimum required by manufacturing tolerance to avoid actual frictional contact. There is also provided a return magnetic circuit between the transversely extending magnetic members, generally comprising the casing of the unit, so that substantially all of the reluctance of the magnetic circuit of the exciting winding is concentrated in the air gap between the cores when they are in their normal relative positions.

In accordance with another feature of the invention, the reciprocating bearing or guide for the cores is located completely external to the magnetic circuit so that these members do not effectively increase the reluctance of the magnetic circuit or provide a path for the flow of eddy currents.

In accordance with another feature of the invention, one of the cores is resiliently biased to a predetermined position in the path of movement of the working core, so that it constitutes primarily a resilient stop for the working core and is effective to cushion its blow in the absence of a tool in the unit, or upon the removal of the load from the tool.

In accordance with a further feature of the invention, the working plunger is provided with a striking member projecting through the other core, while the working tool is inserted in the unit and biased to such a position that the spacing between the striking member is normally slightly greater than the normal working air gap between the two cores so that the tool is movable by pressure on the unit to a position in which the spacing is slightly less than the normal working air gap. With such an arrangement, when only light pressure is exerted on the working tool, a portion of the energy of the working core is dissipated in striking the cooperating core and absorbed in its biasing spring before the striking member actually contacts the tool. However, for heavier loads on the working tool, the striking member attached to the working core strikes the tool before the working air gap is completely closed so that the full force of the working core is transmitted directly to the working tool for maximum intensity of the blow.

For a better understanding of the invention, together with other and further objects thereof, reference is had to the following description taken in connection with the accompanying drawings and its scope will be pointed out in the appended claims.

In the accompanying drawings, Fig. 1 is a longitudinal sectional view of a complete reciprocating electric tool constructed in accordance with the present invention; Fig. 2a is an elevation and Fig. 2b a cross-section of the relatively stationary magnetic core of the unit of Fig. 1; Fig. 3a is an elevation and Fig. 3b a cross-section of the working magnetic core of the unit of

Fig. 1; Figs. 4a and 4b are plan and end views, respectively, of each of the transversely extending magnetic members of the unit of Fig. 1; Fig. 5 is a cross-sectional detail of a modified form of support for the working tool and the relatively stationary core of the unit of Fig. 1; Figs. 6a and 6b are a longitudinal sectional view and a cross-sectional view, respectively, of a modified form of electric tool embodying the invention and utilizing magnetic cores of square cross-section; Fig. 7a is an elevation and Fig. 7b a cross-section of the relatively stationary magnetic core of the unit of Figs. 6a and 6b; and Fig. 8a is an elevation and Fig. 8b a cross-section of the working magnetic core of the unit of Figs. 6a and 6b.

Referring now more particularly to the drawings, the reciprocating electric tool illustrated in cross-section in Fig. 1 comprises a casing formed in three sections, a section 10 comprising the body of the casing and supporting the active elements of the tool, a section 11 comprising a shank or tool supporting member, and a section 12 comprising primarily a handle for the unit and a support for the electric control mechanism of the unit. The section 10 comprises an annular ring of magnetic material provided with a plurality of longitudinal slots 10a for minimizing eddy currents. Supported within and closely fitting into the cylindrical shell 10 is a spool or form 13 of some suitable insulating material, such as Bakelite, on which is wound the actuating or exciting winding 14 of the unit. The winding 14 is provided at either end with transversely or radially extending magnetic members 15 and 16 which are clamped firmly in place by end rings 17 and 18, respectively, threaded into opposite ends of the cylindrical shell 10. For maximum effectiveness in reducing eddy currents, the slots 10a extend between the magnetic members 15 and 16 over substantially the entire length of the magnetic circuit of winding 14. The magnetic members 15 and 16 are closely fitted into extensions or skirts of the end rings 17 and 18, respectively, so that the whole stationary assembly is accurately aligned. The skirts of the end rings 17 and 18 are also preferably slotted radially to aid in reducing eddy currents. The shank section 11 of the casing may be secured to the central section 10 by means of machine screws 9 threaded into the end ring 17; similarly, the handle section 12 may be secured to the central section 10 by means of machine screws 9 threaded into end ring 18.

Supported within the assembly just described, is a pair of relatively reciprocable plungers or cores 19 and 20 maintained in axial alignment by means of a striking member 21 which is rigidly secured to the core 20, as by welding at 20a, and which projects entirely through the core 19 and is supported therein for relative reciprocation by means of a sleeve bearing 22. The core 19, is, in turn, supported within a sleeve bearing 23 mounted in the end ring 17, while the end of the striking member 21, projecting through the opposite end of the core 20, is supported in a sleeve bearing 24 mounted in an annular extension 18a of the end ring 18. The striking member is preferably, but not necessarily, of nonmagnetic material, for example, a high chromium alloy stainless steel, in order to avoid any shunting of the normal air gap between cores 19 and 20.

As shown more clearly in Figs. 2a and 2b, the core 19 is provided with a large number of longitudinal milled slots, shown as spaced at 30-

degree intervals and extending entirely through the core throughout that portion of its length which normally lies within the magnetic circuit of the winding 14. The longitudinal sectional view of core 19 in Fig. 1 is taken along the line 1—1 of Fig. 2b through two diametrically opposed slots, while the cross-sectional view of Fig. 2b is taken along the line 2b—2b of Fig. 2a. The sleeve bearing 22 supported within core 19 does not extend entirely through the core but is terminated short of the main portion of the magnetic circuit of the winding 14. Similarly, as shown more clearly in Figs. 3a and 3b, the core 20 is provided with a large number of longitudinal milled slots 20b, also shown as spaced at 30-degree intervals and extending nearly to the central bore through which the striking member 21 extends, alternate slots being deeper than the others and leaving only a sufficient amount of material near the central bore to maintain a rigid self-supporting structure. The longitudinal sectional view of core 20 in Fig. 1 is taken along the line 1—1 of Fig. 3b through two diametrically opposed ones of the more shallow slots, while the cross-sectional view of Fig. 3b is taken along the line 3b—3b of Fig. 3a. The cores 19 and 20 are preferably of a high permeability, high resistivity, alloy steel, for example, a high silicon steel, in order to reduce the magnetomotive force required in winding 14 for a given mechanical power output and to aid in reducing eddy-current losses. A detail of each of the radial magnetic members is shown in Figs. 4a and 4b, from which it is seen that each of these members comprises a stock of laminations or punchings arranged to provide a radial slot to minimize eddy currents due to any axial component of magnetic flux flowing through these members.

In the assembly just described, the clearances between the radial magnetic members 15 and 16 and the cooperating magnetic cores 19 and 20, respectively, are the minimum permitted by manufacturing tolerances to avoid actual frictional contact between these members and the reciprocating cores. In practice, it has been found feasible to operate with clearance between these members of 0.005 inch. Furthermore, it is noted that all of the bearing members of the unit, that is, the bearing 23 between the end ring 17 and the core 19, the bearing 24 between the end ring 18 and the projection of the striking member 21, as well as the bearing 22 between the core 19 and the striking member 21, are substantially completely outside of the magnetic circuit of the winding 14. Therefore, these bearings, usually of nonmagnetic materials such as brass, bronze, or the like, do not constitute effective air gaps in the magnetic circuit. Furthermore, since they are outside the magnetic circuit, no eddy currents are induced therein which would otherwise tend to decrease the efficiency of the unit. Since the magnetic reluctance of the casing section 10 and the radial magnetic members 15 and 16 is only an extremely small fraction of the reluctance of the normal air gap between the cores 19 and 20 and since the air gap required by the clearances between the radial magnetic members 15 and 16 and the cores 19 and 20, respectively, is also such an extremely small fraction of the reluctance of the normal air gap between the cores, substantially the entire reluctance of the magnetic circuit of the winding 14 is concentrated in the air gap between the cores 19 and 20, which is substantially the ideal relationship. By this provision the magnetomotive force, that is, the ampere-turns,

of the electromagnetic winding 14 required for any given mechanical power output of the unit is reduced to a minimum.

The core 20 is provided with an end washer or plate 25 secured thereto by a pin 26 and this plate 25 is acted upon by two opposing springs, a spring 27 acting against the extension of the end ring 18 and a spring 28 acting against a washer 29 supported on a bolt 30 threaded into a partition 12a of the casing section 12 and provided with a lock nut 31. By this means the core 20 is effectively "floating" in a deenergized or normal position which may be adjusted by adjustment of the bolt 30. The normal relative positions of the cores 19 and 20 are such as to provide a normal working gap therebetween of substantial value; in a small portable tool a value of the order of $\frac{1}{4}$ inch has been found to be satisfactory. The constants of the springs 27 and 28 are so adjusted relative to the mass of the core 20 and striking member 21 that the natural period of mechanical oscillation of this system is substantially equal to the period of the intermittent current normally supplied to the winding 14 which, it is understood, is generally half-wave rectified 60 cycle alternating current.

Threaded into the nose of the shank section 11 of the casing is a bearing 32, held in place by a lock nut 32a, in which a working tool 33 is adapted to reciprocate. The shank 33a of the tool 33 is provided with a shoulder 33b which normally presses against a washer 34 seated on a flange 11a formed in the nose of the shank 11. A spring 35 normally presses the washer 34 against the shoulder 11a and engages the end of the core 19 to bias it to the position shown in Fig. 1 in which its flange 19a seats against the end of the bearing 23. The end of the striking member 21 is tapered at 21a and seated into a hardened annular ring 36 having an internal taper complementary to that of striking member 21, so that the two may be held in position by frictional engagement. The provision of this hardened ring 36 minimizes the up-setting of the end of the striking member 21 in the normal operation of the system.

The cooperating cores 19 and 20 and their associated parts are thus so related that, in the absence of a working tool 33, the active reciprocation of the core 20 by the intermittent excitation of the winding 14 causes it to strike the core 19 and the force of this blow is dissipated in the spring 35, thus preventing destruction of the unit by excessive vibration, as is the tendency in certain of the arrangements of the prior art in which the reciprocating plunger abuts against a rigidly fixed cooperating plunger. Preferably, the bearing 23 may be designed to provide a considerable friction between it and the core 19 so that, under the circumstances described, a portion of the energy of the reciprocating core 20 is dissipated in the bearing 23.

Further, the cores 19 and 20 and their associated parts are so proportioned that the normal separation between the shank of the tool 33 and the striking element 36 of the striking member 21 is slightly greater than the normal separation between the cores 19 and 20 at the working air gap. With this arrangement, if little or no pressure is exerted on the tool 33, the core 20 in reciprocating strikes the cooperating core 19 a slight interval before the striking element 36 engages the shank of the tool so that a portion of the energy of the reciprocating core 20 is dissipated in the blow on the core 19 which, in part,

is dissipated in the spring 35 and in the friction at the bearing 23. However, if the unit is pressed against the work for heavier blows, the shoulder 33b of the tool 33 engages the washer 34 and compresses the spring 35 until the displacement between the shank of the tool 33 and the striking element 36 is less than the normal air gap between the cores 19 and 20. Under these circumstances, the striking element 36 strikes the tool before the core 20 strikes the core 19, so that the full blow of the striking member is imparted directly to the tool. If the depth of movement of the working tool is small, substantially the entire energy of the reciprocating member 20 is transferred to the working tool. However, if the depth of stroke of the tool 23 is substantial, a portion of the energy of the reciprocating member may be transferred to the core 19 and dissipated thereby during the final portion of the working stroke.

Thus, by the provisions just described, the blow of the striking member is cushioned in the absence of a tool in the shank 11 or in case the load is completely removed from the tool, while the intensity of the blow on the tool may be readily controlled by adjusting the manual pressure with which the unit is pressed against the work.

The exciting winding 14 may be energized in any manner well known in the art. To this end the spool 13 is provided with an extension 13a which projects through an aperture 10b provided in the casing section 10 and terminals 37 are mounted on the projection 13a and connect with the terminals of the winding 14, which are preferably in the form of brass strips (not shown) or other equally rigid construction to withstand vibration. The terminals 37 are connected by a pair of conductors 38 and a switch 39 manually operated by a trigger 40 with an external cable 41 projecting into the handle of the casing 12 through a bushing 42. It is understood that the switch 39 and the trigger 40 form no part of the present invention and may be of any suitable well-known construction.

In Fig. 5 there is shown a cross-sectional detail of a modified form of the shank element 11 of the casing. Elements in this figure corresponding to similar elements of Fig. 1 are given the same reference numerals. In this modification the nose of the shank 11 is provided with a cylindrical recess 11b separated by the flange 11a from the central portion of the unit. Within this recess 11b is mounted a spring 35a bearing on the flange 11a and a washer 33b to bias the working tool 33 to the position illustrated in Fig. 1. In this modification, the spring 35 serves only to bias the core 19 so that the flange 19a rests against the bearing 23. As in the arrangement of Fig. 1, in the normal position of the elements, the spacing between the shank of the tool 33 and the striking element 21 is slightly greater than that between the cores 19 and 20 which comprises the working air gap. The principles of operation of the modification of Fig. 2 are in all respects similar to those described above in connection with Fig. 1, but the use of separate springs 35 and 35a for biasing the members 19 and 33, respectively, makes possible the selection of different spring constants, each of which may be selected for optimum operating characteristics of the element biased thereby.

In Figs. 6a and 6b there is shown a modification of the reciprocating electric tool of Fig. 1, in which the stationary and movable magnetic core members may be made substantially entirely of

laminations of magnetic material, such as silicon steel. Referring to these figures, a central section 41 is made up of two opposed stacks of U-shaped laminations held between a handle section 42, shown in fragmentary section, and a shank section 43 by channel-shaped side plates 44 having end lugs 45 to which the end sections 42, 43 are secured by machine screws 46. Clamped between the stacks of laminations 41 and each of the side plates 44 are plates 47 of somewhat heavier gauge non-magnetic metal to which are secured by means of rivets 48 the channel-shaped bearing guides 49 of nonmagnetic bearing material such as bronze, which extend the entire length of the magnetic circuit. The actuating winding 50 of the device is disposed on a spool 51 of insulating material and having a rectangular cross-section, the winding 50 being mounted in the windows formed by the magnetic core members 41, thus forming a structure somewhat similar to a shell-type transformer. The inner surfaces of the spool 51 are continuous with the inner opposed surfaces of the magnetic core members 41, thus forming a continuous rectangular space between the opposed magnetic core members.

Mounted in the rectangular space between cores members 41 is a relatively stationary magnetic core member 52, shown in more detail in Figs. 7a and 7b, rectangular in cross-section and made up of a stack of high-permeability laminations clamped between a pair of end plates 52a of nonmagnetic bearing material by means of rivets 52b so located as to minimize eddy currents therein. The end plates 52a are formed with guide bearing surfaces complementary to the bearing surfaces of the channel-shaped bearing guides 49. The core member 52 is also provided with a shoulder 52c adapted to be maintained in registry with the ends of the core members 41 by means of a spring 53. Also disposed in the rectangular space between the core members 41 is a relatively reciprocable magnetic core member 54, shown in detail in Figs. 8a and 8b, which also comprises a stack of high-permeability laminations clamped between a pair of end plates 54a of non-magnetic bearing material by means of a series of rivets 57 passing through the holes 54b. The end plates 54a are also provided with slide bearing surfaces complementary to those of the bearing guides 49.

The cross-sectional areas of the relatively stationary core member 52 and the reciprocable core member 54 are such as substantially to fill the space between the magnetic core members 41 and, when suitably mounted in the bearing guides 49, leave an air gap 39 comprising only the minimum clearance required by manufacturing tolerances, which may be only a few thousandths of an inch. Therefore, in this construction, as in that of Fig. 1, substantially the entire reluctance of the magnetic circuit of the device is concentrated in the normal working air gap between the relatively reciprocable cores 52 and 54.

The cores 52 and 54 are provided with longitudinal apertures 52d and 54d, respectively, approximately square in cross-section, through which project a striking member 55 of nonmagnetic material carrying at its striking end a hardened steel collar 56 having a taper fit on the member 55. The striking member 55 may be secured to the relatively reciprocable core 54 by means of the rivets 57 which serve also to clamp the laminations between the end plates 54a and,

additionally, by a fillet welding 58 at the remote end of core member 54.

The spring 53 which retains the core 52 in engagement with the core members 41 bears against an annular disc 59 secured to the striking member 55. There is also provided a spring 60 bearing against an internal flange 43a of the shank 43 which biases the flange 59 to retain the core member 54 in its normal position and to return it to that position after each working stroke. In this construction the spring 53 serves also as a cushion to the return stroke of the core 54 under the action of the spring 60. The shank section 43 is provided with a suitable sleeve bearing 61 for the tool 33 and a lock nut 62 for retaining the bearing 61 in position. As in the arrangement of Fig. 1, the relations of the parts is such that the striking member 55 engages the tool 33 during the working stroke before the core member 54 engages the core member 52.

It is thus seen that the magnetic circuit of the reciprocating electric tool of Figs. 6a and 6b comprises the essential advantages of that of Fig. 1, in that the magnetic circuit of the device is not interrupted by any bearing members; substantially the entire reluctance of the magnetic circuit is concentrated in the normal air gap between the cooperating core members 52 and 54; and the air gap in the magnetic circuit outside of the working stroke is only that required for manufacturing tolerances to avoid a frictional contact between the relatively movable members, which may be only a few thousandths of an inch. In addition, in the structure just described, the entire magnetic circuit is fully laminated, thus further improving the efficiency of the unit. While the features of the cushioned blow and the controlled blow have not been illustrated in connection with the apparatus of Figs. 6a and 6b, it will be readily understood that this feature may be applied to the apparatus in a manner entirely similar to that of the apparatus of Fig. 1.

While there have been described what are at present considered to be the preferred embodiments of this invention, it will be obvious to those skilled in the art that various changes and modifications may be made therein without departing from the invention, and it is, therefore, aimed in the appended claims to cover all such changes and modifications as fall within the true spirit and scope of the invention.

What is claimed is

1. An electric tool unit comprising a casing, a tool shank disposed at one end of said casing, a pair of coaxial reciprocable magnetic cores normally relatively biased to provide a predetermined air gap therebetween, an exciting winding surrounding said cores, means providing a magnetic circuit for said winding including said cores, a striking member rigidly secured to one of said cores and projecting through the other of said cores into said shank, and means for resiliently biasing a tool inserted in said shank to a given position such that the spacing between said striking member and the tool is normally slightly greater than said air gap, whereby at least a portion of the energy of said striking core is dissipated in striking said other core when the tool is in its normal position.

2. An electric tool unit, comprising a casing,

a tool shank disposed at one end of said casing, a pair of coaxial reciprocable magnetic cores normally relatively biased to provide a predetermined air gap therebetween, an exciting winding surrounding said cores, means providing a magnetic circuit for said winding including said cores, a striking member rigidly secured to one of said cores and projecting through the other of said cores into said shank, and means for resiliently biasing a tool inserted in said shank to a normal position such that the spacing between said striking member and the tool is normally slightly greater than said air gap, said tool being movable by pressure on the unit to a position in which said spacing is slightly less than said air gap, whereby the energy of said striking core is transferred substantially completely to the tool.

3. An electric tool unit comprising a casing, a tool shank disposed at one end of said casing, a pair of coaxial reciprocable magnetic cores normally relatively biased to provide a predetermined air gap therebetween, an exciting winding surrounding said cores, means providing a magnetic circuit for said winding including said cores, a striking member rigidly secured to one of said cores and projecting through the other of said cores into said shank, fixed stops for said other of said cores and for a tool inserted in said shank, and resilient means for biasing said other of said cores and the tool against their respective stops, the spacing between said striking member and the tool being slightly greater than said air gap when the elements are in their respective biased positions.

4. An electric tool unit comprising a casing, a tool shank disposed at one end of said casing, a pair of coaxial reciprocable magnetic cores normally relatively biased to provide a predetermined air gap therebetween, an exciting winding surrounding said cores, means providing a magnetic circuit for said winding including said cores, a striking member rigidly secured to one of said cores and projecting through the other of said cores into said shank, fixed stops for said other of said cores and for a tool inserted in said shank, and a single spring for biasing said other of said cores and the tool against their respective stops, the spacing between said striking member and the tool being slightly greater than said air gap when the elements are in their respective biased positions.

5. An electric tool unit comprising a casing, a tool shank disposed at one end of said casing, a pair of coaxial reciprocable magnetic cores normally relatively biased to provide a predetermined air gap therebetween, an exciting winding surrounding said cores, means providing a magnetic circuit for said winding including said cores, a striking member rigidly secured to one of said cores and projecting through the other of said cores into said shank, fixed stops for said other of said cores and for a tool inserted in said shank, and separate springs for individually biasing said other of said cores and the tool against their respective stops, the spacing between said striking member and the tool being slightly greater than said air gap when the elements are in their respective biased positions.

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