

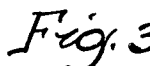
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MAGNETICALLY OPERATED TOOL

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MAGNETICALLY OPERATED TOOL

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This invention relates to a magnetically operated tool, and more particularly to a tool in which the working instrumentality is reciprocated by a magnetically operated driving motor.

One object of this invention is to provide a magnetically operated tool having a reciprocating work-performing instrumentality or tool and magnetic and mechanical driving parts of novel and efficient construction for actuating the tool.

Another object is to energize the actuating magnet by alternating current and store energy during magnetic retraction of the working instrumentality and release during that portion of the reduced current portions of the alternating current cycles.

Another object is to provide a tool of the above character in which the motor housing not only provides an efficient magnetic structure, but firmly and effectively holds the electromagnetic winding in place.

The invention also resides in the novel arrangement of the parts which contributes to low cost of manufacture and effective cooling and facilitates adjustment to provide optimum magnetic efficiency.

Further objects and advantages will become apparent from the following description taken in connection with the accompanying drawings, in which

Figure 1 is a vertical sectional view through a magnetically operated tool which embodies a preferred form of this invention.

Fig. 2 is a side elevational view of a portion of the structure shown in Fig. 1 with a portion cut away to show more clearly the internal structure.

Fig. 3 is a sectional view taken substantially on line 3-3 of Fig. 1 and viewed in the direction indicated by the arrows.

While the invention is susceptible of various modifications and alternative constructions, I have shown in the drawings and will herein describe in detail the preferred embodiment, but it is to be understood that I do not thereby intend to limit the invention by such disclosure but intend to cover all modifications and alternative constructions falling within the spirit and scope of the invention as expressed in the appended claims.

Referring to the drawings, a housing 10 comprehends a pair of opposed cup-like elements 11 and 12 which are preferably cast of magnetic or magnetizable material such as soft iron or silicon steel. The opposed cup-like members 11 and 12 preferably have cooperating flange portions 13

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and 14 which fit together and are secured in place by having cooperating threaded surfaces or by screws such as 15. The members 11 and 12 preferably have central axial bores or openings 17 and 18 and inwardly extending flanges 19 and 20 adjacent these openings and form integral portions of the housing elements 11 and 12 and have tapered outer surfaces radially spaced from the walls of the housing. The inner ends of the flanges 19 and 20 are axially spaced apart.

A stationary core member 22 of magnetic material extends into the housing through the bore 17 and has an end portion 23 threaded into a portion 24 of the element 11. The member 22 is axially adjustable by rotation thereof with respect to the housing and is locked in adjusted position by means such as a lock nut 25. An armature 26 of magnetic material is journaled for axial reciprocating movement in the bore 18 and extends into the housing 10 in opposed relation with respect to the core member 22. The latter and the armature 26 have end portions 28 and 29 of reduced cross section to increase the flux density in the opposed pole faces.

A coil or winding 30 of the solenoid type preferably has inner end surfaces, as at 32 and 33, which are tapered outwardly and fit snugly over the flanges 19 and 20 to support the coil and hold it firmly in position. The outer surface of the coil is preferably spaced from the inner surface of the housing 10 to permit the circulation of cooling air. Leads, such as 34 and 35, are connected to the ends of the coil or winding 30, as at 36, and are adapted to connect the winding to a source of alternating current of predetermined frequency.

The sectional thickness of the housing 10, including that of the flanges 19 and 20, is preferably sufficient to provide a low reluctance flux path for the flux of the winding 30. Since this winding is mounted directly upon the flanges 19 and 20, and the air gaps between the housing and the core member 22 and between the housing and the armature 26 are minimized, the only appreciable high reluctance gap which occurs in the magnetic circuit is the working gap between the pole faces of the stationary core member 22 and the armature 26. To minimize losses due to eddy currents, a radial slot 37 extends outwardly from the center of the stationary core member 22 and along the length of that member. Likewise, a radial slot 38 is provided in the armature 26 which extends outwardly from the center of the armature and along its entire length. Eddy

current losses in the flanges 19 and 20 are reduced by a plurality of slots, such as 39, which divide the flanges into sections, the housing 10 being preferably made from portions which are cast from solid material as distinguished from being built up of laminations. The outer surface of the housing is radially slotted as at 40 to reduce eddy current losses and provide for the circulation of cooling air.

A tubular auxiliary housing member 42, which is preferably made of non-magnetic material such as brass, is threaded into a counterbore 43 which is coaxial with the bore 13 and armature 26. An end of the armature 26 extends into the auxiliary housing 42 and is slidable therein. A stop ring 44 is secured within the auxiliary housing 42 by screws 45. This stop ring limits movement of the armature 26 away from the core member 22. A connecting rod 46 is threaded into the end of the armature 26, as at 47, and extends coaxially away from the armature through an opening 48 in the stop ring 44. The pole face end of the armature 26 is preferably slotted, as at 51, to provide a screw driver slot for holding the armature during the assembly and disassembly of the connecting rod 46. The other end of the connecting rod 46 is threaded into a tool carrier 49, as at 50, the carrier being journaled for sliding movement in the extending end of the auxiliary housing 42. A compression spring 52 is disposed around the rod 46 and between the stop ring 44 and the tool carrier normally to bias the armature away from the stationary magnetic member 22.

A tool or working instrumentality 53 is secured in the end of the carrier 49 beyond the connecting rod 46 as by threading at 54. The tool 53 may be made in any desired shape and of the proper material as may be required for specific uses such as etching metal, plastic or glass surfaces, cutting materials such as metal, glass or stone and the like. An outer covering of insulating material 57 fits over the outer surface of the auxiliary housing member 42 and has an outer surface shaped to provide a handle for the tool.

The mass of the moving parts including the armature 26, connecting rod 46, tool carrier 49, and the tool 53 is correlated with the strength of the spring 52 as well as to the alternating current frequency of the power source in such a way that moving parts vibrate or reciprocate at a frequency which is dependent upon the frequency of the power source. This cooperative relation is also preferably such that the magnetic force exerted upon the armature by the current flow through the winding 30 during a portion of the alternating current cycle is absorbed in the spring 52 for release during a working stroke at another portion of the cycle. The stationary core member 22 is preferably adjusted to a position such that the armature closely approaches the pole face thereof without actual engagement. Thus, the spring 52 absorbs the full energy delivered by the magnet, and this energy is released during the working stroke to project the tool against the work.

It will be observed that the cross sectional area of the various portions of the housing and the stationary core member 22 not only provides flux paths of the desired low reluctance, but is sufficient to provide a mass greater than that of the moving parts and thereby stabilize the tool and minimize vibration of the supporting structure. The novel construction of the magnetic housing

is simple and inexpensive, assembled readily, and enables the parts to be adjusted conveniently in service use. The magnet is utilized most efficiently in actuating the tool because all of the energy developed by the magnet during attraction of the armature is stored in the spring, and the full effect of this energy is applied to the tool to project the latter against the work.

I claim as my invention:

1. A magnetically operated tool having, in combination, a generally cylindrical coil having an axial opening therethrough and adapted to be energized by alternating current, a housing of magnetic material enclosing said coil and having axially aligned flanges turned into opposite ends of said opening and supporting said coil, a core member projecting axially through one of said flanges beyond the inner end thereof and mounted for adjustment axially of its supporting flange, a tube rigid with and projecting from the other end of said housing in alignment with said other flange, an armature slidable axially of the latter flange and said tube for movement of its inner end toward and away from the end of said core member, a carrier slidably guided in the outer end of said tube, a stop limiting the outward movement of said armature, a rod connecting said armature and said carrier, and a compression spring coiled about said rod and acting between said stop member and said carrier to urge the latter outwardly and to be compressed when said armature is attracted to said core member.

2. A magnetically operated tool comprising, in combination, a housing including a pair of oppositely disposed cup-like elements of magnetic material having axial bottom openings and inwardly extending flanges around the openings, a coil coaxial with the housing and surrounding said openings, said coil being wedged onto said flanges, a stationary core member of magnetic material adjustably secured in one of said cup-like housing elements and extending axially into the coil, an armature of magnetic material movably journaled in the opening in the other of said cup-like housing elements and extending into the coil toward the end of the stationary core member, a connecting rod secured at one end to the armature and extending coaxially therewith away from the coil, stop means limiting movement of the armature away from the stationary core member, a tool carrier on the end of said rod, a compression spring encircling said rod between said stop means and the tool carrier tip and normally biasing the armature away from the stationary core member and into contact with the stop means, and a tube enclosing said spring and guiding said carrier.

3. In a magnetically operated tool, the combination comprising a housing of magnetic material having end walls and substantially cylindrical side walls, said housing having an opening in one end thereof and inwardly extending projections having tapered outer walls spaced from said side walls and converging axially toward each other, said projections being axially aligned and spaced apart, a coil having opposite ends fitting snugly over and wedged onto said tapered walls, an armature journaled for axial movement in said opening and extending into the coil beyond the end of one of said projections, the other projection constituting a core to which said armature is attracted when the coil is energized, and resilient means biasing said armature away from said core.

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4. In a magnetically operated tool, the combination of, a housing of magnetic material comprising cup-like halves disposed in opposed relation and having side and end walls, means securing the lips of said cups together in abutting relation, axial inwardly extending projections on said end walls and spaced from the side walls, said projections having tapered outer surfaces, and a solenoid type coil having tapered inner end surfaces fitting snugly over said projections.

5. In a magnetically operated tool, the combination of, a housing of magnetic material comprising cup-like halves disposed in opposed relation and having side and end walls, axial inwardly extending projections on the end walls and spaced from the side walls, said projections having tapered outer surfaces, and a solenoid type coil having tapered inner end surfaces fitting snugly over said projections, the side walls of said housing being allotted to limit eddy current losses and said flanges being axially slotted.

6. A magnetically operated tool having, in combination, two cups of magnetic material arranged with their lips overlapping and secured to each other, the bottoms of the cups having aligned axial openings and flanges around the latter projecting into the cups, a coil within the cups encircling and supported on said flanges, a magnetic plug mounted in one of said flanges and projecting from the inner end thereof, a tube having one end projecting into the bottom opening of the other cup and secured rigidly to the latter, a magnetic cylinder slidable in said tube and the adjacent cup flange toward and from said plug, a stop within said tube limiting the outward movement of said cylinder, a rod within said tube

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secured to said cylinder, and a spring coiled around the rod within said tube and urging said rod and cylinder outwardly.

7. A magnetically operated tool having, in combination, a generally cylindrical coil having an axial opening therethrough, a housing of magnetic material surrounding the coil and having axially aligned flanges integral therewith and turned into opposite ends of the coil, said flanges projecting into opposite ends of said coil and wedged into the latter whereby to provide a firm support for the coil, a magnetic core member fitted in and projecting axially through one of said flanges and adapted for adjustment axially thereof, a tube having one end projecting into and rigidly secured to the other flange, an armature slidable in the latter flange and said tube, a tool carrier slidable in the opposite end of the tube, a rod connecting said armature and carrier, and a spring coiled around the rod and urging said carrier and armature in one direction.

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