

[72] Inventors Gerhard Widl
 Ditzingen;
 Kurt Groetzner, Stuttgart-rot; Adolf
 Knodler, Fellbach, Germany
[21] Appl. No. 797,583
[22] Filed Feb. 7, 1969
[45] Patented May 4, 1971
[73] Assignee Robert Bosch G.m.b.H.
 Stuttgart, Germany
[32] Priority Feb. 28, 1968
[33] Germany
[31] P 16 39 210.2

[56] References Cited
 UNITED STATES PATENTS
2,370,752 3/1945 Ray 335/281X
2,715,199 8/1955 Bogue et al. 335/251X
3,042,842 7/1962 Cox 335/260X

Primary Examiner—G. Harris
Attorney—Michael S. Striker

[54] AC OPERATED MAGNET
 7 Claims, 9 Drawing Figs.
[52] U.S. Cl..... 335/248,
 335/277, 335/279, 335/281
[51] Int. Cl..... H01f 7/12
[50] Field of Search..... 335/243,
 247, 248, 251, 259, 260, 277, 278, 279, 281

ABSTRACT: A magnet with laminated core and armature arranged for operation with AC current. A plastic casing surrounds the laminated iron in the core and armature members and subdivides the lamination into two identical sections. The intermediate plastic layer which subdivides the lamination serves as an impact surface between the armature and the core member of the magnet. The laminations are reinforced and held together through plastic filled notches, as well as stress take-up rods.

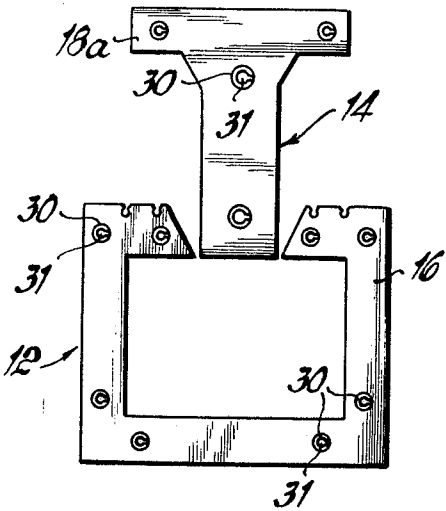


FIG. 1

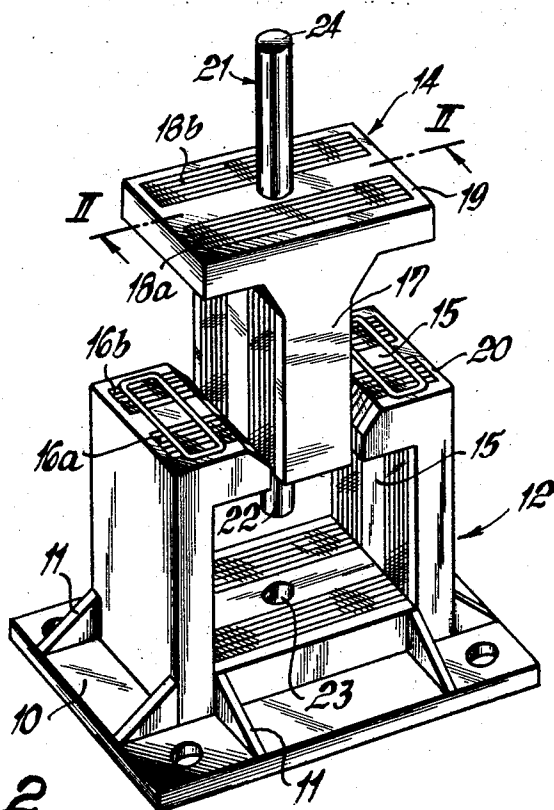


FIG. 2

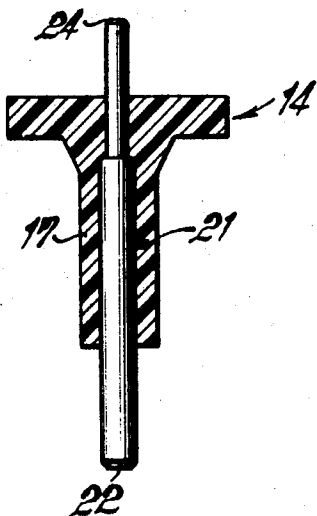
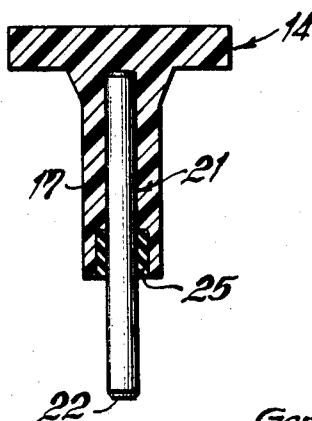


FIG. 3



INVENTORS
Gerhard WIDL
Kurt GROETZNER
Adolf KNÖDLER

BY

Michael S. Steiner

their ATTORNEY

FIG. 4

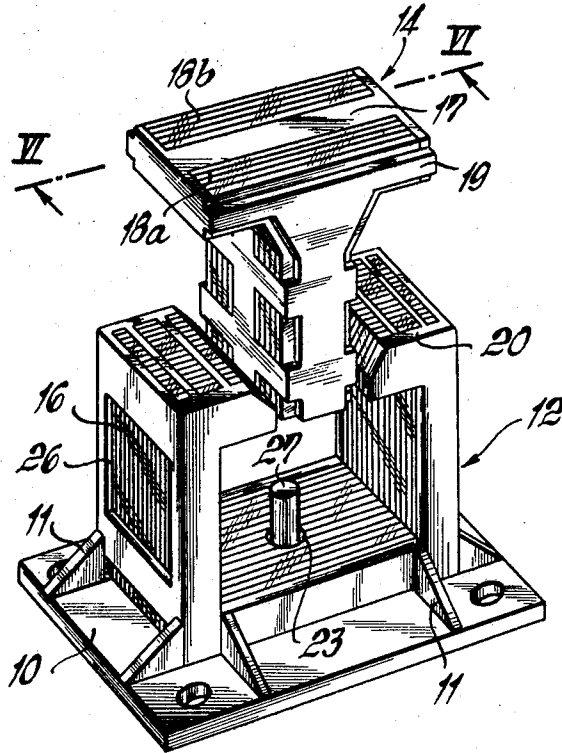
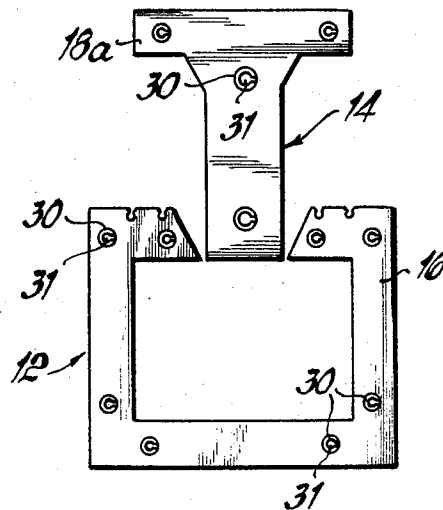


FIG. 5



INVENTORS
Gerhard WIDL
Kurt GROETZNER
Adolf KNÖDLER
BY
Michael S. Strickman
their ATTORNEY

FIG. 6

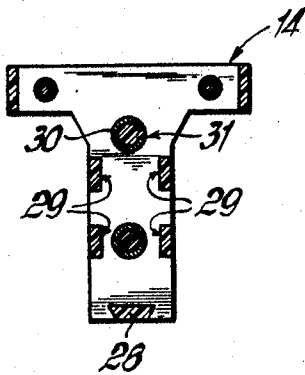


FIG. 7

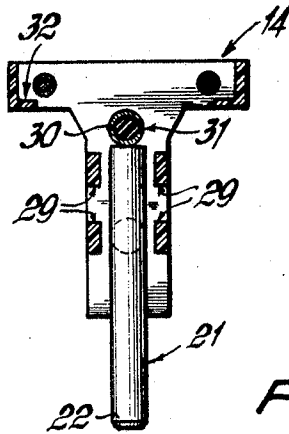


FIG. 7a

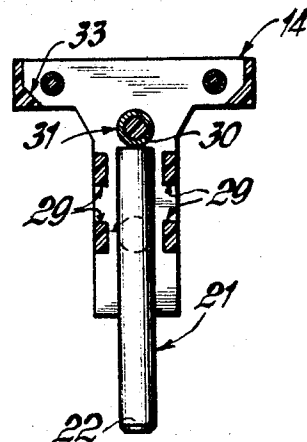
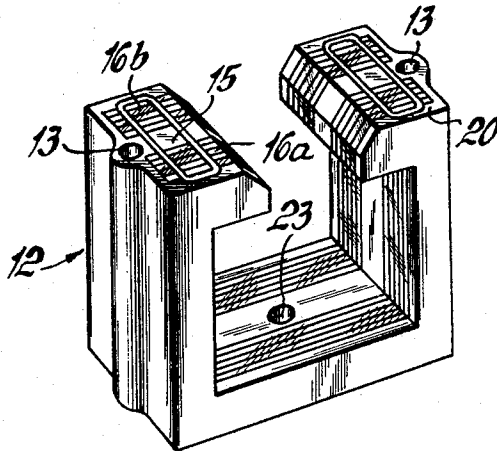


FIG. 8



INVENTORS
Gerhard WIDL
Kurt GROETZNER
Adolf KNÖDLER

BY

Max J. S. S. S. S.

their ATTORNEY

AC OPERATED MAGNET

BACKGROUND OF THE INVENTION

The present invention resides in an AC electromagnet or solenoid applicable particularly for the actuation of hydraulic valves. The AC electromagnet or solenoid has an armature and a core constructed of laminated ferromagnetic material.

Conventional AC electromagnets of the preceding species have soldered laminations or laminated sections. When applied to the operation of hydraulic valves, in which considerable power requirements are involved, the soldered magnetic construction of such magnets are subjected to severe shear forces. As a result of this condition, such conventional magnets have a relatively limited lifespan.

Accordingly, it is an object of the present invention to provide an AC operated electromagnet or solenoid with increased lifespan or operating life. It is also an object of the present invention to produce such an electromagnet of the aforementioned properties, in an economical manner.

The preceding objects of the present invention are achieved by surrounding at least partially the armature and/or core of the magnet with plastic material.

A particular advantageous embodiment of the present invention results when the laminated section or unit is subdivided into at least two adjacent and identical laminated sections. A plastic intermediate layer or layer of synthetic material separates the two identical sections. This construction diminishes the required pressure to be applied for holding together the laminations of the armature and/or the core.

The plastic intermediate layer of the armature and/or core is designed so that the surface of impact between the armature and the core has damping characteristics.

In the design of the present invention, the laminated elements are furthermore particularly well held together through the provision of at least one bore running vertical to the planes of the laminated elements of the armature and/or core. An elastic metallic member, preferably of rolled spring steel, and in the form of a stress resisting rod is inserted into the bore and covered or molded over with plastic material.

SUMMARY OF THE INVENTION

An AC operated magnet in which the core member and the armature are both of laminated iron. A plastic casing or covering surrounds at least partially either or both the core and the armature which is movable relative to the core. A plastic intermediate layer subdivides the armature and/or the core into at least two identical sections, and may be approximately twice as thick as the jacket or casing surrounding the outer rim of the armature or core. Elastic deformable plastic elements are inserted into the impact surfaces of the armature and/or the core to decrease the impact effects when the armature is actuated.

The novel features which are considered as characteristic for the invention are set forth in particular in the appended claims. The invention itself, however, both as to its construction and its method of operation, together with additional objects and advantages thereof, will be best understood from the following description of specific embodiments when read in connection with the accompanying drawing.

BRIEF DESCRIPTION OF THE DRAWING

FIG. 1 is an isometric view of an actuating magnet or solenoid which is subdivided into laminated sections through an intermediate plastic layer, in accordance with the present invention;

FIG. 2 is a sectional view taken along line II-II to the armature in the actuating magnet of FIG. 1;

FIG. 3 is a sectional longitudinal view of the armature of FIG. 1, and shows another embodiment of the actuating rod;

FIG. 4 is an isometric view of a magnetic actuator or solenoid without plastic intermediate layer in the laminated structure of the core;

FIG. 5 is a side view of a laminate armature and core with inserted stress takeup rods;

FIG. 6 is a sectional view of the armature taken along lines VI-VI in FIG. 4;

FIG. 7 is a sectional view of an embodiment of the armature, in accordance with the present invention, and shows the design in which only one stress takeup or supporting rod abutting an injection molded actuating rod;

FIG. 7a is a sectional view of another embodiment of the armature; and

FIG. 8 is an isometric view of a core of a magnet, and shows an embodiment for admitting two through-bolts into openings provided in the core.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

Referring to the drawing, the AC electromagnets have laminated iron members which are covered at their exterior with a coating of plastic or similar synthetic material. The laminated members are centrally located upon a baseplate 10 made of plastics or synthetic material. The laminated members are secured to the baseplate 10 by means of injection molded portions 11. The securing of the laminated members to the baseplate can also be accomplished with screws or bolts. A core member 12 consists of laminated sheet metal embedded in plastic material. Bores 13 on both sides of the core run along the legs of the core, as shown in FIG. 8. These bores are symmetrically located with respect to the central axis of the magnet. The bores lie outside of the striking or actuating region of the armature 14. The movable armature 14 functions in conjunction with the core 12. The bores 13 are directed along the axial direction of the magnet, and lie within an intermediate plastic portion 15 which subdivides the laminated structure 16 of the core 12 into two neighboring sections 16a and 16b. The two laminated sections 16a and 16b are of identical design and construction. The laminated construction of the armature 14 is separated into two identical laminated sections 18a and 18b, through a plastic intermediate layer or portion 17.

The intermediate portions 15 and 17 of the armature and the core have a thickness substantially equal to either one of the two respective laminated sections in the armature and the core. Thus, the intermediate portion 15, for example, is as thick as either the section 16a and 16b, while the intermediate plastic portion 17 is as thick as either the section 18a or 18b. These intermediate plastic portions 15 and 17 connect with the neighboring surfaces of the armature and the core with their associated laminated sections, similar to the bordering portions 19 and 20, also made of plastic material. The intermediate portions 15 and 17, in this manner, form striking or abutting surfaces which lie in the same plane as the pole surfaces of the magnetic system.

An actuating rod 21 is inserted in the plastic intermediate layers 17 of the armature 14. This actuating rod projects with a portion 22 out of the armature and in the direction for attracting the armature by the core. This portion 22 of the actuating rod 21 extends into an opening 23 provided within the intermediate plastic layer 15 of the core 12. It is the purpose of this extending portion 22 to actuate a hydraulic valve, not shown. With its opposite end or portion 24, the actuating rod 21 passes through the housing of the magnetic system, not shown, so that the valve may also be manually actuated in the event that this becomes necessary. This construction is shown in FIGS. 1 and 2.

FIG. 3 shows an armature with an actuating rod 21 which has only a projecting end portion 22 for extending into the core and the baseplate. A rubber ring 25 lies around the actuating rod 21 in the region where the rod exits from the armature. This rubber ring prevents fracture of the plastic material as a result of small deflections of the rod or inclinations of the rod in this particular region.

FIG. 4 illustrates an embodiment of an actuating magnet or solenoid in which the laminated section 16 of the core 12 is not subdivided or separated through a plastic intermediate layer. For the purpose of providing more complete cooling of the laminations, recesses 26 are provided about the outer side

surfaces. An actuating rod 27 is held within the baseplate 10 and mounted therein so that it is longitudinally slidable. The armature 14 has a dovetailed plastic insert 28 which strikes or comes into contact with the actuating rod 27. The armature has notches 29 in its longitudinal portion for the purpose of increasing the cohesion of the laminations. These notches 29 run along the sides of the longitudinal portion of the armature 14, so that they are perpendicular to the planes of the laminations. The notches 29 are filled with plastic material. For further increasing the cohesion of the laminated unit, shear supporting rods 30 are provided in bores 31 perpendicular to the layer planes of the laminations. These shear supporting rods 30 are inserted into bores and are covered with plastic material. When the armature strikes the core, the resulting shear stresses or shear forces that arise from this action, are largely taken up by these shear supporting rods 30. The locations and designs of these rods are shown in FIGS. 5 and 6.

FIG. 7 shows an armature design in which recesses 32 and 33 are provided in the striking portion or impact portion of the armature which strikes or contacts the core. These recesses 32 and 33 are filled with plastic material for the purpose of increasing the elastic properties of this contact portion of the armature, and to prevent damage to the relatively thin rim 19, when the armature comes into contact with the core. Thus, the plastic inserts 32 and 33 serve to protect the surface of the armature when striking the core, after becoming actuated.

The armature 14, shown in FIG. 7a, is exactly like the armature shown in FIG. 7, except that the recesses 33, filled with a synthetic plastic material, have a shape that is different from the recesses 32.

The plastic material used in the design of the aforementioned embodiments are formed through injection molding techniques, and are of nylon reinforced with glass fibers, known in the art as Nylafil G 10/40.

When the armature 14 becomes actuated and is attracted to the core, in this AC magnet arrangement, the armature becomes rapidly accelerated as a result of the varying inductance of the magnetic system, and then strikes with high velocity upon the core 12.

It has been found in practice that magnets in which the laminated elements are held in place through elastic deformable plastic covering, have more resistance to shear forces than magnets with soldered iron cores. This applies even to the condition when the plastic surrounding the laminated sections and elements are of relatively small quantity or mass. In plastic covered iron cores, furthermore, the cohesion of the laminations is further improved, since the plastic penetrates through bores 31 in the laminations or laminated sections. The lifespan of the AC magnets, in accordance with the present invention, is also considerably increased through the presence of the elastic and flexible shear supporting rods or stress rods inserted into the bores 31 and covered or molded over with plastic. These stress takeup rods take up the shear forces which arise in the operation of the magnet. Through subdividing the laminated unit into two or more thin laminated sections, furthermore, the required pressure for packaging the laminated sections becomes diminished. The plastic intermediate layer as well as the plastic surrounding covering, in addition, provides damping effects of the armature impact in striking the core.

It will be understood that each of the elements described above, or two or more together, may also find a useful application in other types of constructions differing from the types described above.

While the invention has been illustrated and described as embodied in AC magnets, it is not intended to be limited to

the details shown, since various modifications and structural changes may be made without departing in any way from the spirit of the present writing.

What is claimed as new and desired to be protected by Letters Patent is set forth in the appended claims.

I claim:

1. An AC operated magnet comprising, in combination, a core member of laminated iron; an armature member of laminated iron and movable relative to said core member; a plastic casing covering at least partially one of said members; and plastic means filled in recesses of said armature member and exposed to the impact surface between said armature and said core member, said impact surface being a surface along which said armature member strikes said core member when said magnet is actuated.

2. An AC operated magnet comprising, in combination, a core member of laminated iron; an armature member of laminated iron and movable relative to said core member; a plastic casing means covering at least partially one of said members; a plastic intermediate layer for subdividing the laminated iron in at least one of said members into at least two identical sections; and actuating rod means projecting from said intermediate layer means of said armature member and passing through an opening in said core member, said opening being through a plastic intermediate layer in said core member subdividing said laminated iron into at least two sections in said core member.

3. An AC operated magnet comprising, in combination, a core member of laminated iron; an armature member of laminated iron and movable relative to said core member; a plastic casing covering at least partially one of said members; at least one stress takeup member in an opening perpendicular to the planar surfaces of said laminated iron of at least one of said members, said stress takeup member being of elastic metallic substance.

4. An AC operated magnet comprising, in combination, a core member of laminated iron; an armature member of laminated iron and moveable relative to said core member; a plastic casing covering at least partially one of said members; at least one stress takeup member in an opening perpendicular to the planar surfaces of said laminated iron of at least one of said members; and plastic means covering said stress takeup means.

5. The AC operated magnet as defined in claim 3 wherein said elastic metallic substance comprises spring steel.

6. An AC operated magnet, comprising, in combination, a core member of laminated iron; an armature member of laminated iron and movable relative to said core member; plastic casing means covering said members for holding the laminations of said laminated iron in assembled position; elastic deformable plastic layers on said armature member and said core member between the surfaces of impact of said armature member and of said core member; and plastic means in at least one recess perpendicular to the planar surfaces of said laminated iron of at least one of said members.

7. An AC operated magnet, comprising, in combination, a core member of laminated iron; an armature member of laminated iron and movable relative to said core member; plastic casing means covering said members for holding the laminations of said laminated iron in assembled position; elastic deformable plastic layers on said armature member and said core member between the surfaces of impact of said armature member and of said core member; and at least one stress takeup member in an opening perpendicular to the planar surfaces of said laminated iron of at least one of said members.