

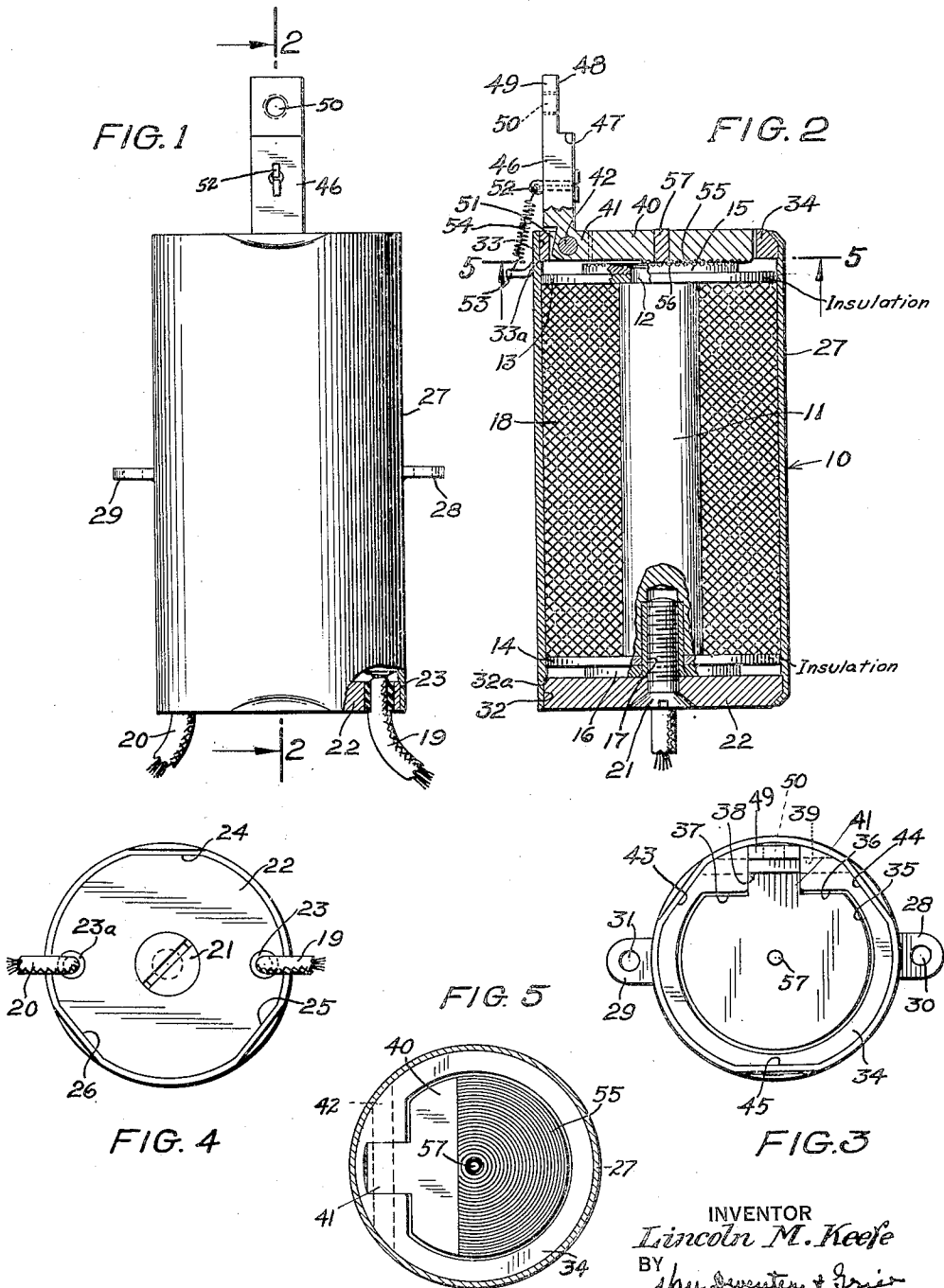
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MAGNET DESIGN

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## UNITED STATES PATENT OFFICE

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## MAGNET DESIGN

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6 Claims. (Cl. 175—336)

This invention relates to improvements in magnet design and has for an object the provision of electro-magnets in which the average air gap between the movable armature and the stationary head when the armature is positioned to be attracted when the electro-magnetic winding is energized, is a minimum as compared to conventional types.

Another object of the invention is the provision, in an electro-magnet, of magnetizable heads which together with a magnetizable tube and the armature completely enclose the electro-magnetic winding and define a path for the lines of force set up in the core of the electro-magnet when its winding is energized.

A further object is to form an opening in one of said magnetizable heads and pivotally mount in this opening an armature of substantially the same thickness as that of the head. The air gap between the outer edges of the armature and the inner edges of the opening is substantially uniform and varies very slightly from the "open" to the "closed" (or attracted) positions.

Yet another object of the invention is the provision of serrations on the inner face of the armature, and in other instances of serrations on the core head adjacent to the armature. These serrations may be circumferential or of any other desired form, and serve as flux intensifiers. When the winding is energized an intense fringe or brush of flux extends from each serration, producing a magnetic field comprised of a series of zones in which the magnetic flux is intensified with zones in which the flux is of less intensity therebetween.

Another object of the invention is the provision of an electro-magnet for actuating switching means or for instituting mechanical movement, formed of parts which fit together in accurate relation and may be permanently secured together without the necessity for fastening members, thereby producing a device of the maximum accuracy at a minimum of cost. Devices of this form may be grouped in close order, due to the symmetry thereof, and therefore space is saved in the mechanisms in which these devices are employed.

Other objects will be apparent to those familiar with the art in which electro-magnets, relays and the like fall.

Referring to the drawing:

Figure 1 is an elevation of my new and improved electro-magnet device;

Figure 2 is a sectional elevation of the electro-magnet taken along the line 2—2 of Figure 1;

Figure 3 is a plan view showing details of the armature and the method of mounting it;

Figure 4 is a view of the magnet in Figure 1, as seen from the bottom looking upwardly; and

Figure 5 is a sectional view taken along the line 5—5 of Figure 2, and showing serrations formed in the surface of the armature.

Referring to the drawing, the magnet, generally designated by the numeral 10 includes a core 11 having reduced portions at each end thereof, one of which is designated by the numeral 12, forming shoulders. Heads 13 and 14 formed of insulation material rest upon the shoulders. A disk 15 formed of magnetizable material has a hole formed therein fitting the portion 12 of the core 11. After the head 13 and the disk 15 are placed on the core the end of the core is riveted down to permanently secure the head and the disk thereon.

A similar disk 16 is mounted on the opposite end of the core and said end is riveted down to secure this disk and the head 14 thereon.

The lower end, as viewed in Figure 2 of the core, has a tapped hole 17 formed therein. This hole may be engaged by a threaded stud on the winding machine for applying the windings 18 to the core. The windings are provided with suitable leadout wires 19 and 20.

Secured to the core by means of a screw 21 engaging the threaded hole 17 is a comparatively thick head 22 of iron or other ferrous material. The hole formed in the head 22 for the passage of the screw 21 is countersunk so that the head of the screw is flush with the outer surface of the head. The head 22 also has formed therein holes carrying bushings 23 and 23a through which the leadout wires 19 and 20 pass. The head 22 also has beveled flat portions 24, 25 and 26.

A sleeve member 27 also formed of iron or other ferrous material has struck-out portions forming ears 28 and 29 having holes 30, 31 respectively formed therein to accommodate mounting screws. The shell has a counterbored portion 32 at one end thereof forming a press fit with the head 22 and a counterbored portion 33 forming a press fit with a head 34.

The head 34 is similar to the head 22 in so far as thickness is concerned. However, it has an opening formed therein to accommodate an armature. The opening has a portion 35 which is circular and concentric with the outer diameter of the head 34. The opening has flat portions 36 and 37 and a slotted portion 38. A hole 39 extends through the head at right angles to

and passing through the slot 38 (see Figure 3).

Referring now to Figure 2, an armature 40 has a tongue portion 41 which fits the slot 38, and a pivot pin 42 is mounted in the hole 39 and passes through the corresponding hole in alignment therewith in the tongue 41. The head 34 is also provided with beveled flat portions 43, 44 and 45.

In assembling the electro-magnetic device, the head 22 is secured to the core 11 by means of the screw 21 and this assembly is pushed into the tubular shell 27 until the head 22 is flush with the lower end of the tube. In so doing, the head 22 comes to rest against the shoulder 32a. Then the head 34, the armature 40 having been previously pivotally mounted therein, is pressed into the upper end of the tube until the head 34 comes to rest against the shoulder 33a.

The heads 22 and 34 are then retained in position against the shoulders 32a and 33a respectively by deforming the tubular shell and causing portions thereof to overlie the beveled flat portions 24, 25, 26 and 43, 44, 45 respectively.

The armature 40 may be provided with any suitable type of extension in accordance with the instrumentalities it is desired to control with the device herein shown and described. In one use of the device, for example, a positionable member is to be controlled; an arm 46 is preferably formed integral with the armature 40. This arm may have a portion milled away forming a shoulder 47, and a face 48 on the web 49. The web 49 may have a tapped hole 50 formed therein. Suitable means connecting the arm 46 to the positionable device (not shown) may be provided and may be secured to the web 49 by means of a screw engaging the threads 50 and located by means of the shoulder 47. Suitable spring means may be associated with the positionable member or with the means connecting the same to the arms 46, for urging the armature 40 away from the core 11 and the disk 15. A suitable notch 51 formed in the arm 46 comes to rest against the head 34 and serves as a stop for limiting the upward swing of the armature 40.

In other uses of the device, spring means for urging the armature away from the core may be carried on the head 34 or on the tubular shell 27; for example, a cotter pin 52 may be secured to the arm 46 in the manner shown, and the shell 27 may have an ear 53 extended outwardly in a manner similar to the ears 28 and 29, and the spring 54 may have one end connected to the ear 53 and the other end connected to the cotter pin 52.

The armature 40 may be provided with a non-ferrous rivet 57 to prevent the armature from coming in metallic contact with the disk 15 and the end of the core 11 and "sticking."

The surface of the armature 40 facing the core 11 may be provided with serrations 55 which may be disposed in the surface in any desired form. For example, the serrations 55 may be comprised of a plurality of concentric grooves.

In the embodiment herein shown and described, the surfaces of the grooves or serrations are at an angle of 60° with the horizontal. There are eighty serrations per inch and the depth of each groove is .008".

The disk 15 may also have its surface facing the armature 40 provided with serrations 56. In the embodiment illustrated this disk may have 60° serrations, eighty to the inch and .008" deep.

By providing the magnet with a serrated area 56 and the armature with the serrated area 55, the action of the device when the winding is en-

ergized is facilitated due to the fact that the magnetic flux forms concentrated fringes on the peaks of these serrations and thereby provides a series of concentrated annuli with areas less concentrated therebetween.

From tests made with this new and improved magnetic device, it has been found that the device will operate unfailingly on electrical impulses of very short duration passing through the windings, therefore it is fast acting. Furthermore, it will operate under the influence of longer lived impulses of greatly reduced current value and is therefore believed to be very efficient.

Although a single embodiment of the new and improved electro-magnetic device is herein shown and described, it is obvious that many changes may be made in the device without departing from the spirit of the invention as set forth in the annexed claims.

What is claimed is:

1. In an electro-magnetic device, a permeable magnetic core, a winding on said core, permeable magnetic heads at each end of said core, one of said heads having an opening formed therein, an armature mounted in said opening, a pin passing through said last head and pivotally engaging said armature, a permeable magnetic sleeve joining said heads embracing said winding and forming a return path for the magnetic flux generated in said core, said sleeve covering the ends of said pin and confining the same in said last head, and means on said armature and movable therewith for controlling a positionable device.

2. In an electro-magnetic device, a core, a winding carried on said core, permeable magnetic members carried on each end of said core, said members being larger in diameter than the diameter of the core, permeable magnetic heads at each end of said core, said heads being adjacent to said members and one of said heads having an opening formed therein, an armature mounted in said opening and adapted to be attracted by flux distributed over the surface of one of said members, a pin positioned in said head and forming a pivotal support for said armature, a permeable magnetic sleeve forming with said heads a housing for said core and said winding and forming a return path for the magnetic flux in said core, said sleeve also serving to retain said pin in said last head, and means carried on said armature and movable therewith.

3. In an electro-magnetic device, a core having insulating heads at each end thereof, a winding on said core between said insulating heads, permeable magnetic members carried on each end of said core and adjacent to said insulating heads, said members being larger in diameter than the diameter of said core, a permeable magnetic head in contact with one of said members at one end of said core, a second permeable magnetic head adjacent to the other of said members and having an opening formed therein of an area larger than the area of said last mentioned member, an armature positioned in said opening in said last mentioned head, said armature being adapted to be attracted by flux distributed over the surface of said last mentioned member, a pivot pin in said last head forming a pivotal support for said armature, a permeable magnetic tube forming with said heads a housing for said core and said winding, forming a return path for the magnetic flux generated in said core and serving as a retainer for retaining said pin in said head, and means carried on said

armature for connection to movable means outside said device.

4. An electro-magnetic device according to claim 3 in which said sleeve has integral portions of its wall remote from the ends of said sleeve extending outwardly and forming lugs for mounting said device.

5. In an electro-magnetic device, a permeable magnetic core, a winding on said core, permeable magnetic heads at each end of said core, one of said heads having an opening formed therein, an armature mounted in said opening, a pin passing through said last head and pivotally engaging said armature, a permeable magnetic sleeve joining said heads together and embracing said winding, said sleeve being adapted to form a return path for the magnetic flux generated in said core and also covering the ends of said pin and confining the same in said last head, said core having a free end spaced apart from said armature and the surface of said free end of said core being serrated to present a plurality of magnetic fringes toward said armature, and means on said armature and movable therewith for controlling a positionable device.

6. In an electro-magnetic device, a core, insulating heads on each end thereof, a winding on said core, permeable magnetic members carried

on each end of said core, said members being larger in diameter than the diameter of said core and backing up said insulating heads, permeable magnetic heads at each end of said core, one of said heads being in contact with one end of said core, and the other of said heads having an opening formed therein, said opening being generally circular in form and terminating in an inwardly directed slot formed therein, an armature mounted in said opening similar in shape to the shape of said opening and having a tongue portion lying in said slot, a pin in said head extending through said tongue portion and said slot for pivotally supporting said armature in said last head, a permeable magnetic tube forming with said heads a housing for the core and its winding and forming a return path for the magnetic flux, said tube also serving to retain said pin in said last head, the other end of said core being slightly spaced apart from said armature and forming a free pole, a plurality of serrations formed in the surface of said pole, a plurality of other serrations formed in the surface of said armature facing said pole, and means on said armature and movable therewith controlling a positionable member external to said device.

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