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H. WALKER
ELECTROMAGNETIC DEVICE
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2,289,227

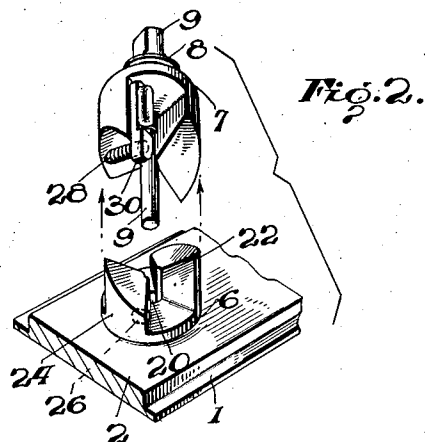
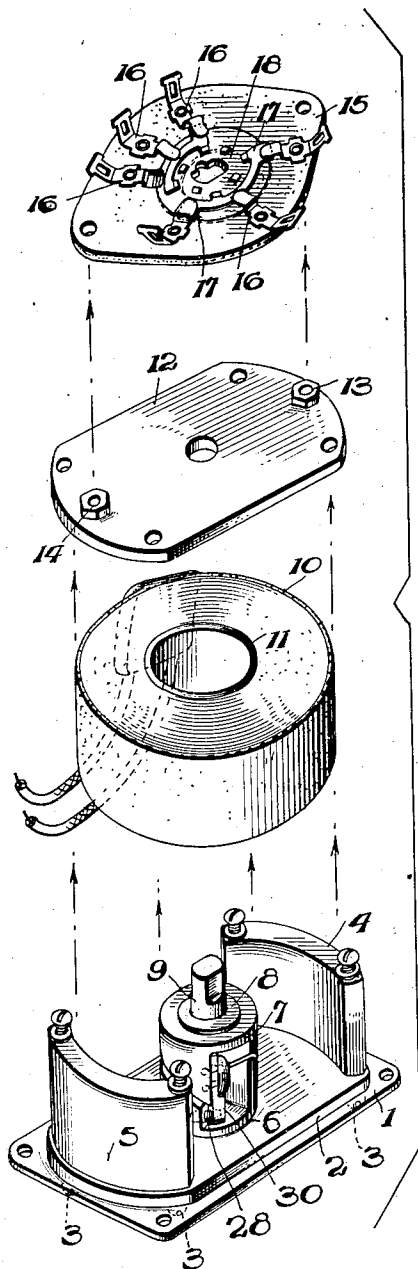


Fig. 3.

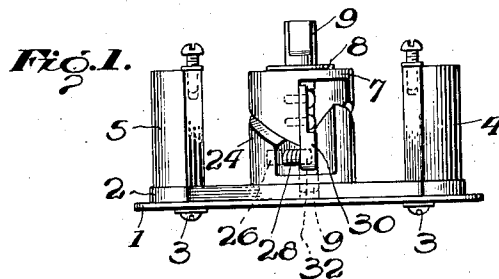


Fig. 4.

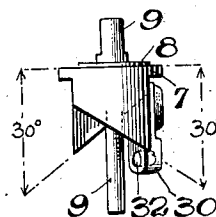
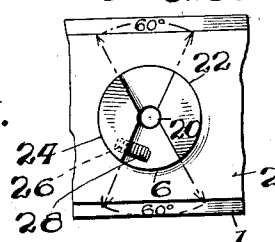


Fig. 5.



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ELECTROMAGNETIC DEVICE

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4 Claims. (Cl. 175—336)

This invention relates to electro-magnetic devices, and more particularly to such a device having an oscillatory armature movable through an arc of rotation.

Such devices are useful in the remote control of switches, rheostats, fluid valves, and indicators of various types, to mention but a few of the many possible uses.

This invention has as one of its primary objects the provision of a novel electro-magnetic device which is not subject to armature chatter under conditions of extreme vibration, such as might be encountered in aircraft.

Another object is to provide an electromagnetic device which may be used in conjunction with electrical switches having a knife action, or switches of the wafer type wherein a non-vibratory rubbing and self cleaning contact is established.

A further object is to provide an electro-magnetic device which has a maximum of iron in the flux path under conditions imposing a limitation in size and weight.

Still a further object is to provide an electro-magnet having a larger range of armature motion with a minimum air gap when in released position.

Other objects and advantages will in part be specifically set forth in part be obvious when the following specification is read in connection with the drawing, in which:

Fig. 1 is an exploded view in perspective of the improved electro-magnetic device showing the manner of assembly and the mode of attaching a wafer switch thereto.

Fig. 2 is an exploded perspective view of the armature and abutment assembly.

Fig. 3 is a side elevation showing in more detail the armature and stator assembly.

Fig. 4 is a side elevation showing details of the armature.

Fig. 5 is a top plan view showing the configuration of the armature abutment.

Referring now in more detail to Fig. 1, the numeral 1 indicates a mounting plate to which is secured a base plate 2 by any suitable means such as screws 3 (Fig. 3) or by welding. Frame members 4 and 5 are attached at either end of the base plate 2 and project forwardly to define an intervening cylindrical space. A generally cylindrical armature abutment 6 is mounted on the base plate 2 and extends centrally between the frame members 4 and 5, and rotatably supported thereon is a corresponding armature 7. A detailed explanation of the construction of the ar-

mature abutment and armature will later be set forth in the discussion of the remaining figures of the drawing. A thin brass washer 8 is carried on the armature shaft 9. Receivable in the aperture defined by the frame members 4 and 5 is a coil 10 which is wound on an insulating tubular form 11 of a diameter to fit over the armature 7 and armature abutment 6. Retaining the coil 10 is a cover plate 12 which attaches to the outer ends of the frame members 4 and 5, and which is centrally apertured to receive the armature shaft 9. Mounting studs 13 and 14 are provided at either end of the cover plate 12, to which may be secured a wafer switch 15, now commercially available. The switch is provided with a plurality of stationary contacts 16, and one or more movable contact strips 17, which are mounted on a rotor 18. The flattened end of shaft 9 projects through a central opening in the rotor to establish driving connection.

The construction and mode of assembly of the armature abutment 6 and the armature 7 are shown in greater detail in Figs. 2 and 3, while the individual elements are shown in Figs. 4 and 5. The exact disposition of the inclined faces of these elements is more readily understood by assuming a bar of cylindrical stock in which are milled two oppositely disposed V cuts of 60° each, as best illustrated in Fig. 2. The cuts should be continued past the axis of the bar in order to form a central longitudinal slot connecting both cuts and defining two heavy opposing webs, integral with, and extending between two end plates. One web is divided into two opposite and equal parts by a saw cut taken on a 30° angle from a transverse line. The other web is similarly divided by a 30° saw cut taken on a plane intersecting that of the first cut. Thus the original cylindrical stock is divided into equal halves, each half having two extending arms terminating in oblique plane surfaces. The plane defined by the end surface of one arm intersects that of the other, and each plane lies 30° from the transverse. One of the above described halves is mounted on the base plate 2 to form an armature abutment as shown in Fig. 2. A recess 20 is drilled in the end portion axially between the arms 22 and 24 to form a step bearing for the armature shaft to be later described. A transverse recess 26 is bored in the shorter inner face of the arm 24 to retain one end of the armature restoring spring 23 shown in Figs. 3 and 5.

The armature 7, illustrated in Fig. 4, has two arms with end surfaces complementary to those of the armature abutment 6 just described. A

narrowed portion of the armature shaft 9 extends along the slot formed by the intersecting V cuts and has an end bearing surface which co-operates with the step bearing recess 20 of the armature abutment 6. Fixedly secured as by screws, to the longer face of one of the arms of the armature 7 is an armature stop member 30, having a recess 32 in which is retained the other end of the armature restoring spring 28 as shown in Figs. 2 and 3.

In the operation of the device as shown, the extent of the angular displacement of the armature is restricted to about 30° by the rear side of the stop 30 striking against a longer face of the armature abutment 6. However, by regulating the thickness of the stop 30 or by varying the angle of the respective V cuts, a wide range of displacement is available. Due to the bias cut of the end faces of the armature and its abutment the air gap between them decreases in width as the common longitudinal axis is approached and becomes quite small adjacent the narrowed spindle of the armature shaft 9. A highly efficient magnetic circuit results because the air gap reluctance is maintained so small by this described construction. The electrical power consumption of this device is much less than previous types of solenoid relays, while the developed torque and range of armature throw are much greater.

The brass washer 8 is preferably made extremely thin, since its only function is to prevent actual contact between the cover plate 12 and the end of armature 7, with consequent magnetic "freezing" and sticking of the armature.

Although the electro-magnetic device herein described is illustrated in conjunction with an electrical switch, it is apparent that it may be employed to perform many functions other than switching. While the angular inclinations of the various cuts as shown and described are incorporated in the present preferred embodiment of the invention, it is not intended to limit the invention to this exact form. The angles of both bias cuts and of the V cuts may be varied to suit differing requirements of torque and of the distance of armature travel.

Many changes and modifications may be made in the invention by any one skilled in the art without departing from the spirit and scope of the invention as outlined in the following claims.

What I claim is:

1. In an electro-magnetic relay, a stator element of magnetic material comprising a base plate and arcuate frame members extending perpendicularly from said plate, an actuating coil received within said frame members and having a central opening therein, an abutment member having one end fixed to said base plate and a free end projecting into the central opening of said coil, said free end having formed thereon two flat surfaces defining intersecting planes each inclined substantially thirty degrees from the plane of said base plate, a rotatably mounted armature positioned within the central opening of said coil and having on its interior end flat surfaces identical in number and in angular inclination with the said surfaces of said abutment member, said armature surfaces and said

abutment surfaces being engageable upon rotation of said armature, a cover plate retaining said coil within said arcuate frame members and preventing longitudinal motion of said armature, and a washer of non-magnetic material interposed between said armature and said cover plate.

2. In an electro-magnetic relay, a stator element of magnetic material comprising a base plate and arcuate frame members extending perpendicularly from said plate, an actuating coil received within said frame members and having a central opening therein, an abutment member attached to said base plate and having segmental arms projecting into the central opening of said coil, a rotatably mounted armature received within the central opening of said coil and having segmental arms movable by rotation into engagement with said abutment arms, the mating surfaces of the stator and armature segmental arms being transverse to the rotational movement of said armature and inclined in the direction of rotation of said armature, and a cover plate retaining said coil within said arcuate frame members and preventing longitudinal motion of said armature.

3. In an electro-magnetic relay, a stator element of magnetic material comprising a base plate, and arcuate frame members extending perpendicularly from said plate, an actuating coil received within said frame members and having a central opening therein, an abutment member attached to said base plate and having segmental arms projecting into the central opening of said coil, a rotatable armature received within the central opening of said coil and having segmental arms movable by rotation into engagement with said abutment arms, the mating surfaces of the stator and armature segmental arms being transverse to the rotational movement of the armature, and inclined in the direction of rotation of said armature, and support means permitting rotational movement of said armature while retaining said armature at all times in a single position longitudinally of said coil.

4. In an electro-magnetic relay, a stator element of magnetic material comprising a base plate and arcuate frame members extending perpendicularly from said plate, an actuating coil received within said frame members and having a central opening therein, an abutment member having one end fixed to said base plate and a free end projecting into the central opening of said coil, said free end having formed thereon a plurality of surfaces equally inclined with respect to the plane of said base plate, a rotatably mounted armature positioned within the central opening of said coil and having on the interior end thereof inclined surfaces equal in number and inclination with the said abutment surfaces and engaging therewith upon rotation of said armature, the mating surfaces of the abutment and armature being transverse to the rotational movement of the armature and inclined in the direction of rotation of said armature, and a cover plate retaining said coil within said arcuate frame members and preventing longitudinal motion of said armature.

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