C. R. BEALL.

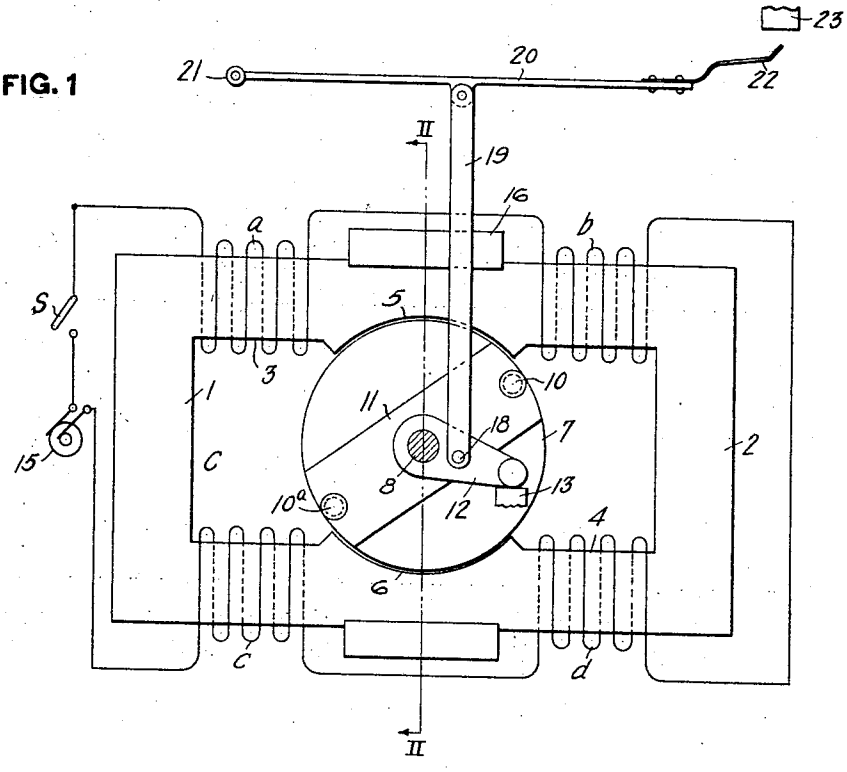
ELECTROMAGNETIC DEVICE.

APPLICATION FILED FEB. 2, 1916.

1,302,284.

Patented Apr. 29, 1919.

FIG. 1



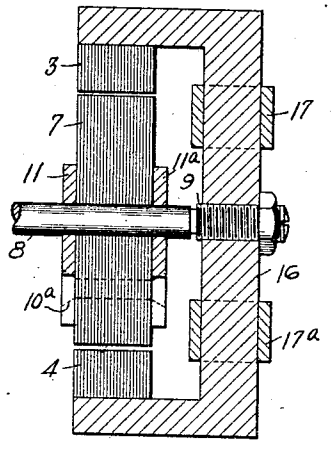


FIG. 2

WITNESSES

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ELECTROMAGNETIC DEVICE.

1,302,284. Specification of Letters Patent. Patented Apr. 29, 1919.

Application filed February 2, 1916. Serial No. 75,770.

To all whom it may concern:

Be it known that I, CHARLES R. BEALL, a citizen of the United States, residing at Swissvale, in the county of Allegheny and State of Pennsylvania, have invented certain new and useful Improvements in Electromagnetic Devices, of which the following is a specification.

My invention relates to electromagnetic devices. One object of my invention is the provision of a device which is operable by alternating current but immune to operation by direct current.

I shall describe one form of apparatus embodying my invention and then point out the novel features thereof in claims.

In the accompanying drawing, Figure 1 is a view, partly diagrammatic showing one form of apparatus embodying my invention. Fig. 2 is a view showing a section of Fig. 1 on line II—II looking in the direction of the arrows.

Similar reference characters refer to similar parts in each of the views.

With reference first to Fig. 1, letter C designates a laminated core substantially rectangular in shape, comprising two vertical legs 1 and 2 connected by two horizontal members 3 and 4. Adjacent their middle, horizontal members 3 and 4 are shaped to form poles 5 and 6, which are adapted to receive between them a cylindrical armature 7. This armature is laminated as shown in Fig. 2 and is mounted on a rotatable shaft 8, which revolves in a rear bearing 9 and a front bearing which is omitted from the drawing for the sake of clearness. This armature is wound with a circuit of low resistance, which as here shown comprises bars 10 and 10^a which extend through slots which are partially open at the surface of the armature, so that the bars are almost completely embedded in the armature laminations. The ends of bars 10 and 10^a extend through corresponding holes in plates 11 and 11^a of electro-conductive material on the front and back of the armature respectively. The bars and the plates are firmly riveted together so that they form a circuit of very low resistance.

An alternating field for actuating the armature is set up in the core C by windings *a*, *b*, *c*, and *d*. All four windings are as here shown connected into one series circuit, which is adapted to be energized by a source of alternating current 15 connected to the circuit by a switch S. The polarities of windings *a* and *b* are at every instant opposite to the polarities of windings *c* and *d*, so that these windings when energized cause flux to flow through the core C and armature 7 in two parallel paths. One of these paths comprises leg 1 of core C, the left half of member 3, armature 7 and the left half of member 4, and the other path comprises leg 2 of core C, the right half of member 3, armature 8 and the right half of member 4. As is well known to those versed in the art, the particular arrangement of the windings and core which I have herein shown and described is only one of many means by which an alternating flux may be sent through the armature and it is understood that I do not wish to be limited to the particular construction shown. I believe, however, that the arrangement which I have shown is preferable because of its symmetry with respect to the armature for reasons which I will describe hereinafter.

The armature is biased by gravity, so that a crank arm 12 fixed to shaft 8 normally engages a stop 13. In this position of the armature, bars 10 and 10^a are a short distance beyond the surfaces of poles 5 and 6 as shown on the drawing so that the flux flowing through the armature passes through the closed circuit comprising bars 10 and 10^a and plates 11 and 11^a. It is well known that if alternating flux is passed through a closed circuit, it causes the flow of currents in the circuit which create magnetic forces under the influence of which the circuit tends to assume a position wherein it is threaded by the smallest number of lines of force. In other words, the closed circuit tends to assume such a position that its plane is parallel to the lines of force, which means in this case that the circuit tends to rotate the armature counter clockwise until bars 10 and 10^a are opposite the middle of the faces of poles 5 and 6. The armature remains in this position until the flow of the alternating flux through the armature is interrupted.

This armature may be used for operating any desirable mechanism. For the purpose of illustration, I have shown it operatively connected through crank arm 12, pin 18 and a link 19 with a contact finger 20 which is pivoted at 21, so that contact tip 22 coöperates with a fixed contact block 23.

As long as switch S is open, the windings on core C are deënergized, so that the armature is in the position shown on the drawing and crank arm 12 rests against stop 13, so that contact tip 22 is out of engagement with block 23. Closure of switch S causes flow of alternating current through the windings, which sets up an alternating flux through armature 7, so that the armature turns counter clockwise until bars 10 and 10[a] are opposite the middle of the pole faces. In doing so, crank arm 12 moves link 19 upward until contact finger 20 brings tip 22 into engagement with contact 23. Contact 22—23 remains closed until switch S is re-opened, whereupon the armature is turned back to the initial position by the weight of the contact finger and its connecting mechanism.

If the electromagnetic device as thus far described is subjected to the flow of direct current through its windings there is set up in the core a direct flux which flows through the armature but has no tendency to rotate it, because, being substantially constant, this field induces no currents in the armature circuit.

The direct flux flows through the core C in two paths similar to the alternating flux and the flux in each path exerts a magnetic attraction on the armature. If the distribution of the flux in the air gaps between the poles and the armature were entirely symmetrical with regard to the vertical and horizontal planes passing through the axis of rotation of the shaft 8, the magnetic attraction of the armature in one direction would be balanced by an equal attraction in the opposite direction, so that the resultant magnetic force acting on the armature would be *nil*. A truly symmetrical distribution of the flux can only be approximated in devices built for commercial use, for it has been found that small variations in the air gaps, in the magnetic qualities of the iron laminations and various other factors make enough difference in the reluctance of the two paths to cause unequal flux distribution. This causes the armature to be attracted from its central position in the direction of the greater flux density, so that there is a tendency for the armature to bind in its bearings and resist rotation with more or less friction. For example, if the air gap between armature 7 and pole 5 should be shorter than the air gap between the armature and pole 6, the armature would be attracted toward pole 5 by a greater force than toward pole 6, and this unbalanced condition would tend to cause the armature to bind in its bearings. A small amount of direct flux through the armature does not cause any serious unbalanced attraction of the armature so that the bearing friction caused thereby is comparatively small. However, a heavy direct flux generally causes such an unbalanced attraction of the armature that it resists turning with considerable friction. This is serious especially where the device is designed for operation by comparatively feeble alternating currents because then the rotative forces on the armature may be insufficient to overcome the bearing friction and so may be insufficient to turn the armature.

In order to make the device immune to even a heavy direct current, I provide a shunt magnetic path around the armature, which shunt path is of very low reluctance to the direct current flux, but opposes the passage of the alternating flux. As here shown, this shunt magnetic path comprises a strap 16 of soft iron which connects members 3 and 4 of core C adjacent the poles 5 and 6. The ends of the strap are pressed into firm contact with the laminations, so that there is practically no air gap between the strap and the laminations. The reluctance to direct flux of this magnetic path from one pole to the other is very small compared to the relutance of the parallel path comprising armature 7 and the air gaps between the armature and the poles; so that when direct flux is set up in core C practically all of it flows through this shunt path instead of the armature. In order to keep the alternating flux from taking this same path, I provide around strap 16 closed bands 17 and 17[a] of copper or other electro-conductive material. When alternating flux flows through strap 16 it causes the flow of currents in these bands which set up counter magnetomotive forces opposing the flow of the alternating flux through the strap, so that nearly all of it is caused to flow through the armature. In this manner the two fluxes are separated to such an extent that the instrument is free to respond to the flux of the alternating current even when a heavy direct current flows through its windings.

Electromagnetic devices embodying by my invention are adapted for many uses. As an instance, they may be used as relays in railway signaling systems where alternating current is used in the track circuits controlling these relays. The amount of current that can be sent through these relays is limited by the leakage and various other factors of the track circuits, so that the relays must be responsive to comparatively weak alternating currents. It frequently happens in such installations that heavy direct currents get into the relay windings due to grounds and crosses of the conducting wires, which currents generally interfere with the proper operation of some types of relays. This is not the case with relays embodying my invention as I have explained hereinbefore.

Although I have herein shown and de-

scribed only one form of electromagnetic device embodying my invention, it is understood that various changes and modifications may be made therein within the scope of the appended claims without departing from the spirit and scope of my invention.

Having thus described my invention, what I claim is:

1. An electromagnetic device comprising a ring-like field member having pole-faces on opposite legs thereof, an armature located between said pole-faces and mounted to oscillate, windings on said field member for creating magnetic flux in two paths comprising the armature and the portions of the field member on opposite sides thereof respectively, the fluxes in said two paths passing through the armature in the same direction and the distribution of the flux in said armature being substantially symmetrical so that the magnetic attraction on the armature is substantially balanced in all directions, a winding on said armature whereby torque is exerted thereon by alternating flux in said paths, a shunting member of low reluctance bridging said opposite legs adjacent the pole-faces, and a closed circuit of low resistance around said shunting member.

2. An electromagnetic device comprising an armature of magnetizable material mounted to oscillate, a field member for passing magnetic flux through said armature, the distribution of said flux being substantially symmetrical whereby the magnetic attraction on said armature is substantially balanced in all directions, a closed electroconductive circuit carried by said armature, the armature being biased to such position that the said flux passes through said circuit, whereby torque is exerted on said armature when said flux is alternating in character, a member of magnetizable material for shunting from said armature flux created in said field member by direct current, and a closed circuit of low resistance around said shunting member.

3. An electromagnetic device comprising a field member, means for creating magnetic flux therein, an armature mounted to oscillate in the path of the field flux, the distribution of the flux in said armature being substantially symmetrical so that the magnetic attraction on said armature is substantially balanced in all directions, a winding on said armature whereby torque is exerted on the armature by alternating current in the field, a member of magnetizable material for shunting from said armature flux set up in said field member by direct current, and a closed circuit of low resistance around said shunting member.

4. An electromagnetic device comprising a field member having two confronting pole-faces, an armature pivotally mounted at a point midway between said pole-faces, the air gaps between said armature and pole-faces being substantially equal and constant throughout the range of movement of the armature, a closed circuit of electroconductive material carried by the armature, said armature being biased to such position that magnetic flux passing through the armature from said pole-faces passes through said circuit, means for creating magnetic flux in said field member, a member of magnetizable material for shunting from said armature flux created in said field member by direct current, and a closed circuit of low resistance around said shunting member.

5. In combination, an armature, a field core and windings disposed substantially symmetrically with respect to the armature so that the magnetic attraction of said armature by flux in said armature and said core is approximately balanced in all directions, a member of low reluctance connected to parts on said field core of opposite polarities for shunting from said armature flux created in said core by direct current in said windings, a low resistance circuit around said member for preventing the passage through said member of flux created in said core by alternating current in the windings, so that said alternating flux is caused to flow through said armature, and a winding on said armature responsive to said alternating flux.

In testimony whereof I affix my signature in presence of two witnesses.

CHARLES R. BEALL.

Witnesses:

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A. C. NOLTE.

Copies of this patent may be obtained for five cents each, by addressing the "Commissioner of Patents, Washington, D. C."