W. F. SMITH.
ELECTROMAGNETIC CIRCUIT CONTROLLING DEVICE.
APPLICATION FILED NOV. 30, 1913.

1,104,077. Patented July 21, 1914.
To all whom it may concern:

Be it known that I, William F. Smith, a citizen of the United States, residing at Brooklyn, in the county of Kings and State of New York, have invented a certain new and useful Improvement in Electromagnetic Circuit-Controlling Devices, of which the following is a full, clear, concise, and exact description.

This invention relates to electromagnet circuit-controlling devices, and the principal object is to provide a structure of comparatively few parts adapted to be mounted in any position and to operate efficiently in response to alternating or pulsating currents.

One of the features of this invention relates to means whereby the preliminary movement of an electromagnetically controlled element will cause the operation of a circuit controller, and whereby the said element after such operation may continue to advance to the extreme limit of travel or in response to changes of current strength may vibrate between certain limits without releasing the said controller or interfering with the action thereof. In other words, the armature has a wide range of movement divided into two stages; it is so arranged that the controller is operated during a primary stage and maintained in the operated position during a secondary stage.

A structure embodying my invention is shown in the accompanying drawings in which—

Figure 1 is a general perspective view; Fig. 2 a side elevation partially in section; and Fig. 3 a perspective view showing a construction wherein the terminals of the core of the electromagnet serve the double function of pole piece and spool head.

As shown in the drawings, an electromagnet is provided comprising a core 1 with pole pieces 2 welded thereto and a winding 3 brought out to terminals 17, 18. A yoke 4 of non-magnetic material is mounted on the pole pieces 2. The yoke carries a bracket 5 which serves as a support for the armature 6. Two screws 7 (one not shown) serve as pivotal bearings for the said armature. The armature 6 is Z-shaped and composed of a narrow strip of magnetic material and would under ordinary conditions stay in any position due to the central pivoting but the spring 8 overbalances it and normally holds the ends away from the pole pieces 2 and one end against the adjustable stop 9 which serves to regulate the normal distance between armature and pole pieces. An adjusting device 10 is provided for regulating the tension of the said spring. The yoke 4 is provided with a lug or bracket 11 which serves as a support for a set of springs 13, 14. The armature 6 carries a cam 15 adapted to engage the springs 14. A roller bearing 16 99 is introduced at the point of engagement between the spring 14 and the cam 15 to reduce friction.

Assuming the spring 14 to be a lever, one end secured to the bracket 11, the roller 16 as the point at which the force is applied and located adjacent the fixed end, it will be apparent that any transverse movement of the roller 16 will result in a corresponding movement of the free end of spring 14, but the range of a movement will be much greater.

As shown in Fig. 2, the cam 15 may be
considered as having two engaging surfaces connected by a short inclined plane. The said surfaces approximate arcs of circles of differing diameters but with the pivotal armature support as a common center. The cam is so arranged with relation to the springs 13 and 14 that as the armature 6 is attracted by the pole pieces 2 and turns on its pivotal support 7, it slides under the roller 16 and forces the spring 14 out of its normal position into contact with 13. It is further so arranged that a very narrow angle of forward movement which may be considered as the primary movement will shift the said spring 14 from its normal to its extreme operated position, after which the said cam may continue its movement and at the same time maintain contact between springs 13 and 14. The spring 14 in its normal position together with the said engagement with cam 13 assists the spring 8 in overbalancing the armature, but after the said cam has moved a sufficient distance from its normal position for the roller 16 to ride on the enlarged portion, the spring 14 does not offer any resistance to the movement of the cam except that due to frictional engagement, and the increasing tension of the spring 8 is the only resistance to be overcome. As a result of the central pivoting of the armature and its association with the adjusting spring 8, I can mount my device in any position without affecting the operating efficiency. By the use of magnetic material for the spool heads for the electromagnet and welding them to the ends of the core, as shown in Fig. 3, the reluctance of the core and pole pieces is very low.

The simplified construction of this device makes it very easy to assemble and the parts are so arranged that all can be assembled by one operator, or if desirable, the assembling operation can be distributed among a number of operators and the device built up into units. The units can later be assembled into a complete structure. As an example of such a division of the work, the electromagnet including core, pole pieces and winding may be assembled in one department simultaneously with the assembling of the yoke 4 and its associated armature and circuit controllers in another department.

In the operation of this device, the armature terminals are attracted by the pole pieces 2. The said armature is arranged in such relation to the electromagnet that in moving toward the core terminals, the air-gap between the armature and core terminal is gradually reduced and in addition the developed magnetic surface between the said armature and terminal is gradually increased. The reduced air-gap combined with the increased magnetic surface results in a magnetic circuit in which the reluctance is gradually reduced. As a result of a reduction in the reluctance of the magnetic circuit, the effect of residual magnetism in the various parts of the said circuit is increased and upon a reduction in current strength in the electromagnet exerts a strong retarding influence against backward or release movement of the armature. Movement of the armature is also retarded by its inertia. A further result of the gradually increased magnetic surface developed between armature and core terminal is a gradually increased magnetic pull; but to partially counterbalance the effect of such increased pull provision is made whereby forward movement of the armature is against the action of the spring 8.

This device is so constructed that the armature never comes in actual contact with the pole pieces but is held from receding to its normal position by the magnetic effect of the energizing current in the coil; in other words, the armature when out of its normal position, floats in the magnetic field set up by the coil and slight changes in the magnetic field will cause it to move in synchronism therewith. The armature will vibrate in response to alternating or pulsating currents having frequencies ranging from 16 to 120 periods per second, but on account of the retarding influence hereinbefore specified the vibrations will not be of sufficient amplitude to permit the breaking of the connection between contacts 13 and 14. In other words, the armature will not move back far enough for the cam 15 to slide from under and release the spring 14.

I claim:

1. The combination with an electromagnet, of lateral extensions from the terminals of the core thereof, a yoke secured to the said extensions, a centrally pivoted armature supported by the yoke, a set of contacts supported by the yoke and contact operative means carried by and located near the center of the armature.

2. In an electromagnetic device the combination with a core, of spool heads of magnetic material attached to the terminals thereof and adapted to serve as polar extensions for the said core, a centrally pivoted armature, a set of contacts and means near the center of the armature for operating the said contacts.

3. In a relay the combination with an electromagnet, of a centrally pivoted armature, a set of contacts, and actuating means carried by the armature and located near the center thereof adapted upon a slight movement of the armature to produce a wide range of movement of the said contacts.

4. In a relay, the combination with an
electromagnet, of an armature, a set of contact devices, a roller carried by one of the
said devices, a cam carried by and located near the center of the armature adapted
to engage the roller to cause the operation of the contact devices.
5. In a relay, the combination with an electromagnet, a core, a yoke supported by
the core, two lateral projections from the said yoke, an armature and an armature
support carried by said yoke, a set of contacts mounted upon one lateral projection
and in operative relation to said armature, and adjusting and tensioning devices for
the said armature mounted on the other projection.
6. In a relay, the combination with an electromagnet, of a set of contact springs,
a notched cam, a roller carried by one contact spring and normally resting in the
notch of said cam, and an armature for the electromagnet adapted to operate the cam whereby
the notch is moved away from the said roller and lateral movement is transmitted
to the contact springs.
7. In a relay, the combination with an electromagnet, a core, a yoke supported by
the core, two lateral projections from the said yoke, an armature and an armature
support carried by said yoke, a set of contacts mounted upon one lateral projection
and in operative relation to said armature, and adjusting and tensioning devices for
the said armature mounted on the other projection.
In witness whereof, I hereunto subscribe my name this 1st day of October, A. D.,
1912.
WILLIAM F. SMITH.
Witnesses:
R. C. Horsey;
T. R. Cernew.