Nov. 8, 1932. P. N. BOSSART 1,886,372

ELECTRICAL RELAY

Filed May 24, 1930

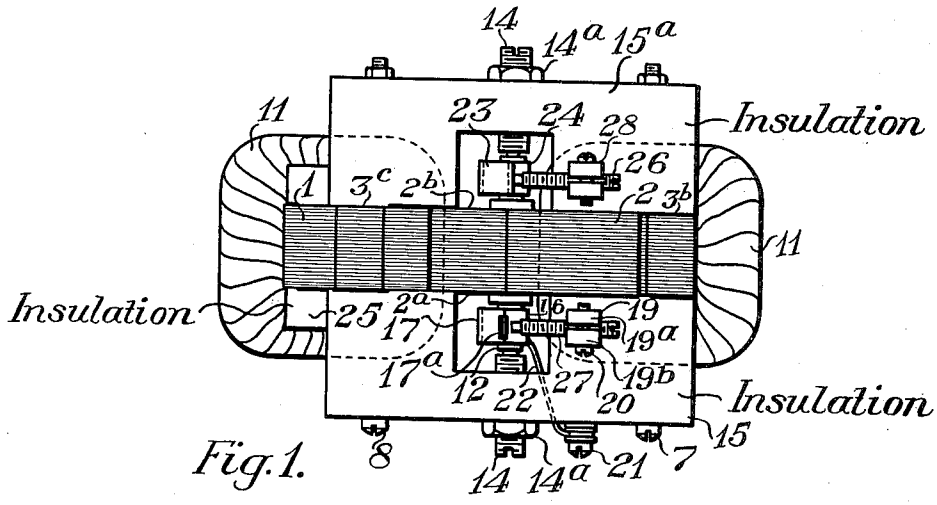


Fig. 1.

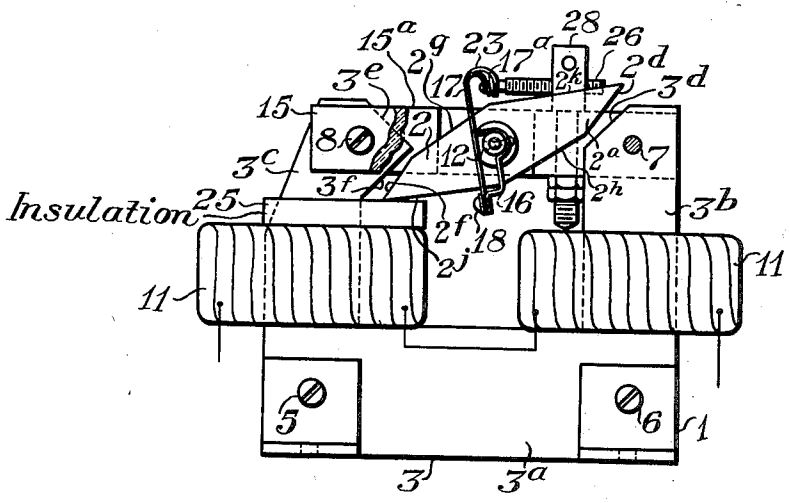


Fig. 2.

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UNITED STATES PATENT OFFICE

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ELECTRICAL RELAY

Application filed May 24, 1930. Serial No. 455,245.

My invention relates to electrical relays, and has for an object the provision of a sensitive high speed alternating current relay of the tractive armature type.

I will describe one form of relay embodying my invention, and will then point out the novel features thereof in the claim.

In the accompanying drawing, Fig. 1 is a top plan view showing one form of relay embodying my invention. Fig. 2 is a front view of the relay shown in Fig. 1, certain of the parts being broken away to illustrate the construction.

Similar reference characters refer to similar parts in both views.

Referring to the drawing, the relay comprises an electromagnet 1 and an armature 2. The electromagnet 1 comprises a substantially C-shaped field core 3 having a backstrap 3^a and two upwardly extending legs 3^b and 3^c. The core 3 is preferably formed in its entirety of thin, high quality, high silicon content, steel laminations of substantially uniform thickness. The laminations are clamped together by means of four bolts, two of which, 5 and 6, extend through the laminations adjacent their lower corners, and the remaining two of which, 7 and 8, extend through the laminations adjacent the upper ends of the legs 3^b and 3^c, respectively. In order that the core losses may be kept as low as possible, all four bolts are preferably located along the center lines of the flux paths through the core so that no flux will link and hence no eddy currents wasting power will flow in the short circuits produced by these bolts.

The inside corner of the upper end of the leg 3^b is cut away to form a flat pole face 3^d, which, as best seen in Fig. 2, is disposed at an angle of approximately 45° with the axis of this leg. The upper end of the leg 3^c is provided with a polar projection 3^e having a flat pole face 3^f on its under side which is parallel to and which confronts the pole face 3^d. An energizing winding 11 is located on each leg of the core, these windings, as here shown, being connected in series. The parts are so proportioned that these windings may be placed on the legs by slipping the coils over the upper ends of the legs, thereby eliminating the necessity for dove-tailing of the laminations in the construction of the core.

The armature 2 is located between the legs 3^b and 3^c of the core 3 adjacent their upper ends, and is also constructed in its entirety of thin laminations of the same high quality steel that is employed in the construction of the core. The armature is dynamically balanced on a shaft 12 pivotally supported at its ends in trunnion screws 14 and, as here shown, is in the form of an irregular octahedron having two parallel hexagonal faces 2^a and 2^b which extend at right angles to the axis of the shaft 12, and three pairs of flat rectangular faces 2^d 2^f, 2^g 2^h, 2^j 2^k, respectively, the faces of each pair being parallel, and being so arranged that the armature tapers from its center toward its ends as will be apparent from an inspection of Fig. 2. The faces 2^d and 2^f, cooperate with the pole faces 3^d and 3^f, respectively, of the core 3, and are so disposed that when the armature is in the position which it occupies when the relay is energized, the faces 2^d and 2^f are parallel to and in contact with the pole faces 3^d and 3^f. The trunnion screws 14 which support the shaft 12 are threaded through the sides of supporting blocks 15 and 15^a of suitable insulating material, such as a phenol condensate product, these blocks in turn being fastened to the opposite sides of the legs 3^b and 3^c of the core 3 by means of the same bolts 7 and 8 which clamp the laminations of the core together at their upper ends. A nut 14^a is screwed on each trunnion screw to lock the trunnion screws in place.

Secured to the shaft 12 on the lower side of the armature as viewed in Fig. 1 is a contact spring support 16 carrying a contact spring 17. The contact spring 17 is attached at its lower end to the spring support 16 by means of a screw 18, and has its upper end bent into the shape of an inverted U and provided with a low resistance contact tip 17^a which cooperates with a fixed contact 27 to close a contact 17—27 (Fig. 1). The fixed contact 27 is carried by a binding post 19 having its upper end split into two parts 19^a and 19^b in such manner that the

fixed contact may be clamped in an adjusted position by tightening a screw 20 arranged to draw the two parts 19^a and 19^b together, as will be apparent from an inspection of the drawing. The contact spring 17 is electrically connected, by means of a flexible connector 22, to a binding post 21 screwed into the side of the block A as best seen in Fig. 1.

Means are also provided for biasing the armature to a deenergized or open position in which it engages a suitable stop here shown as a U-shaped insulating member 25 which partially surrounds the leg 3^c of the field core 3 above the winding 11. This biasing means, in the form here shown, comprises a spring 23 carried by a support 24 attached to the shaft 12 on the opposite side of the armature 2 from the contact finger 17, and cooperating with an adjustable stop screw 26 screwed through a binding post 28 mounted on the insulating block 15^a. The support 24 is exactly like the support 16 which carries the contact finger 17, and the binding post 28 is like the binding post 19 which carries the fixed contact 27.

The operation of the relay is as follows: When no current is being supplied to the winding 11, the electromagnet 1 is deenergized, and the armature 2 occupies the position shown due to the bias of spring 23. The parts are so proportioned that under these conditions contact 17—27 is open. When current is supplied to the windings 11, however, the electromagnet 1 becomes energized, and a flux is then set up in the air gap between the legs 3^b and 3^c of the core 3 which threads the armature 2. The armature 2 therefore moves against the bias of spring 23 to the position in which its faces 2^d and 2^f engage the pole faces 3^d and 3^f, respectively, thereby closing contact 16—27.

It is desirable that a relay embodying my invention should have for a given winding as low as impedance to alternating current as possible and, in order to obtain this result, it is necessary that the losses should be kept as low as possible, and that the reactance be neutralized by tuning. It is for this reason that I have constructed the core of high quality steel, and have shaped and clamped the laminations together in such manner that the minimum amount of eddy currents will be induced in the armature and core and in the clamping bolts as pointed out hereinbefore. It is for this reason, also, that I have provided insulating blocks for supporting the armature and binding posts, thus eliminating any possibility of eddy currents being induced in these blocks by the leakage flux which is greatest adjacent this part of the relay. Furthermore, I have constructed the core in such manner that its minimum cross-sectional area is greater than the maximum cross-sectional area of the armature, and I have made the cross-sectional area of the backstrap 3^a larger than the cross-sectional area of the legs 3^b and 3^c, so that the flux density in the core and the armature will be comparatively low. This likewise tends to decrease the losses. In addition, I have designed the core in such manner that the flux path through the core and armature is relatively short, thereby reducing the volume of iron in the core and armature and hence the amount of the iron loss. In spite of the short path for flux through the core and armature, however, the leakage paths are long so that there is practically no loss due to leakage flux.

In addition to having a low ratio of resistance to reactance to alternating current, it is desirable that a relay embodying my invention should operate on a small amount of power. To accomplish this result, it is necessary that a small current in the windings 11 should produce a comparatively large flux in the armature and hence that the reluctance of the flux path should be low. I therefore construct the core and armature in such manner that when the armature occupies the position to which it is biased by the spring 23, the air gaps between the armature faces 2^d and 2^f and the pole faces 3^d and 3^f, respectively, are short, and that when the armature is closed, the armature faces 2^d and 2^f meet the pole faces 3^d and 3^f with a fitted metal to metal contact. With the relay constructed in this manner, I have found that the relay may be held in its closed position by energy of the order of .003 watts.

It should be pointed out that since the armature is dynamically balanced, the operation of the relay is not affected by mechanical shock or by vibration. Since the armature is thick at the middle and tapers toward its ends as pointed out hereinbefore, the armature has a low moment of inertia, and an approximately constant flux density in the armature is obtained. This shape also results in the lowest loss in the armature for a given amount of material and a given length of flux path. Furthermore, a long lever arm is obtained, so that the armature exerts a large holding torque. A low moment of inertia is desirable in order that the relay will operate very quickly upon becoming energized or deenergized.

It should be further pointed out that the contact structure provides a contact tip which is close to the shaft about which the armature rotates, and permits the contact spring which supports the contact tip to be long enough to obtain considerable deflection when the contact is closed without exceeding the elastic limit of the spring. Furthermore, the short distance of the contact spring tip from the axis of rotation of the armature allows a high contact pressure with a small counter torque. If more than one contact is desired,

the shaft 12 may be lengthened to provide the necessary space.

Although I have herein shown and described only one form of electrical relay embodying my invention, it is understood that various changes and modifications may be made therein within the scope of the appended claim without departing from the spirit and scope of my invention.

Having thus described my invention, what I claim is:

A relay comprising a pivotally mounted shaft, a contact support fixed to said shaft, and a contact spring one end of which is attached to said support on one side of said shaft, which spring extends across the shaft and coacts at its other end with a fixed contact member, whereby the length of said spring from its point of attachment to its point of engagement with the fixed contact member is considerably greater than the distance from the axis of said shaft to the said point of contact engagement.

In testimony whereof I affix my signature.

PAUL N. BOSSART.