April 5, 1932. R. C. LEAKE 1,852,423

RELAY

Filed Dec. 4, 1930

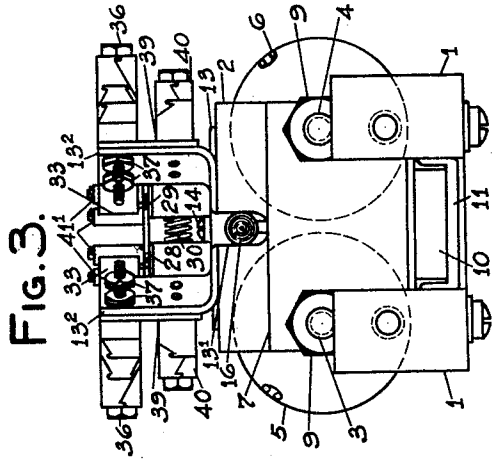

FIG. 3.

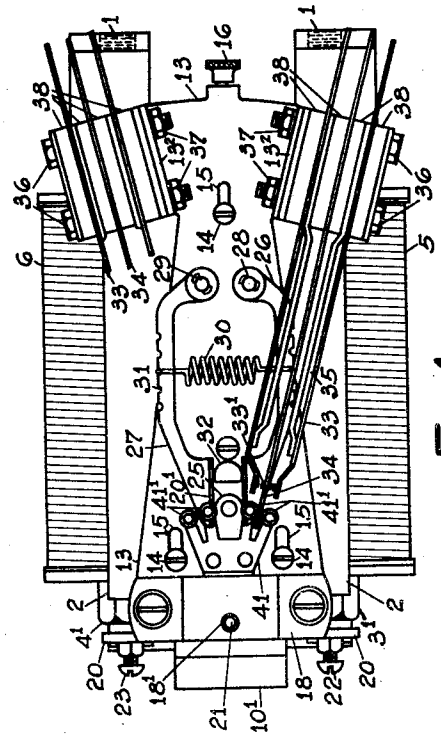

FIG. 2.

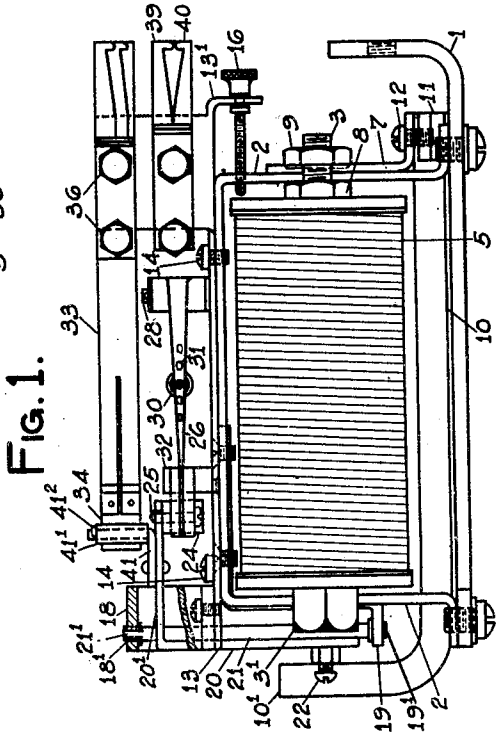

FIG. 1.

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RELAY

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This invention relates to relays and more particularly to the three-position type of polarized relay used in a centralized traffic control system on railroads.

Relays used in railway signal systems must be so constructed that their operation is very reliable and sufficiently rugged to withstand continued operation under somewhat adverse conditions. The particular polarized type of relay used in the well known railroad centralized traffic control system must be kept to as small dimensions as are possible in consistency with reliable operation inasmuch as it has been found necessary to employ a number of such relays grouped in a comparatively small space. This type of relays must be substantially constructed yet such parts as have a reciprocating motion must be lightly built to reduce their inertia because rapid operation is essential.

In view of the above, it is proposed in accordance with this invention to provide a relay of this type which has improved operating characteristics and incorporating means for adjusting such operating characteristics to produce a uniform product and to increase its adaptability.

Other objects, purposes, and characteristic features of the invention will appear as the description thereof progresses, during which references will be made to the accompanying drawings which show, solely by the way of example, and in no manner in a limiting sense, one form which the invention can assume, and in which:—

Fig. 1 is a side elevation of a relay according to this invention, with parts broken away to facilitate in the disclosure.

Fig. 2 is a top view of the relay of Fig. 1, also with parts broken away.

Fig. 3 is an end view of the relay of Fig. 1.

The relay, as illustrated, comprises a non-magnetic mounting bracket 1 to which is secured a supporting member 2 also of non-magnetic material, which supports two electro-magnet cores 3 and 4 carrying coils 5 and 6. A magnetic bridging member 7 is clamped on the supporting member 2 by nuts 8 and 9 threaded on an extension of the cores 3 and 4, thus magnetically bridging together one end of the cores as well as securing them to the supporting member 2. The free ends of the cores 3 and 4 have enlarged hexagonal pole faces 3^1 and 4^1 which rest in recesses in the supporting member 2, and as the threaded ends of the cores 3 and 4 are secured in slots in the supporting member 2 and the magnetic bridging member 7, the coils can be removed from the assembly by freeing the nuts 9. These nuts 9 have a beveled edge resting in a countersunk socket in the magnetic bridging member 7 whereby the cores 3 and 4 are securely locked in position by tightening the nuts 9.

A permanent magnet 10 having an upturned end 10^1 is adjustably clamped to the bridging member 7 by a clamp 11 held thereto by screws 12. This positions the permanent magnet 10 beneath the electro-magnet coils 5 and 6 so that the upturned end 10^1 is equally spaced from the enlarged pole faces 3^1 and 4^1.

The supporting member 2 holds a carrier member 13 slidably mounted thereon by screws 14 passing through slots 15 and tapped into the supporting member 2. Accurate adjustment of the position of the carrier member 13 on the supporting member 2 is obtained by an adjusting screw 16 tapped into the supporting member 2 and having an annular slot receiving a bifurcated extension 13^1 of the carrier member 13.

A top bearing support 18 and a lower bearing support 19 holding bearings 18^1 and 19^1 respectively are each secured to the carrier member 13 and pivotably hold an armature 20 by its pivot pin 21. The armature 20 is thus pivoted between the upturned end 10^1 of the permanent magnet 10 and the electro-magnet pole faces 3^1 and 4^1 so as to permit motion about its pivot pin 21 toward either pole face 3^1 or 4^1. On each side of the pivot pin 21 are adjustable non-magnetic residual pins 22 and 23 which are respectively engageable with pole faces 3^1 and 4^1.

The armature 20 has an integral crank 20^1 which carries a fibre roller 24 mounted on a bearing screw 25. This thimble 24 is engaged on each side by biasing arms 26 and 27 which are movable about their respective pivots 28

and 29 secured to the carrier member 13. These biasing arms 26 and 27 are urged against the roller 24 by a co-acting spring 30 so arranged that the resultant biasing force on the thimble 24 can be varied by shifting the spring 30 into a plurality of spring retaining notches 31 which are spaced at various distances from the pivot points. The central or neutral position of the armature 20 is determined by a stop pin 32 rigidly fastened to the carrier member 13, which engages, and stops any beyond-center-motion of the biasing arms 26 and 27.

The carrier member 13 has two upstanding sides 13^2 each carrying a contact bank consisting of fixed resilient contact fingers 33 and movable resilient contact fingers 34, which are positioned to extend radially from the armature pivot 21. These contact fingers are constructed of suitable flat spring material, such as phosphor-bronze, and the fixed fingers have bifurcated free ends with a low resistance contact point 33^1 on each fork thus allowing each point to be individually resilient. The resilient motion of the stationary contacts 33 is limited in the direction of the movable contacts 34 by rigid stops 35 which are mounted, together with the fixed and movable contact fingers, on the carrier member sides 13^2 by through bolts 36 and nuts 37. The bodies of the through bolts 36 are insulated from the contact banks by suitable insulating bushings (not shown) and the contact fingers are separated from each other and from their supporting member by insulating spacers 38.

The stationary and movable contact fingers extend beyond their insulating spacers 38, with provisions, therein, (in the form of notches as shown) to facilitate in soldering external wire connections. Directly beneath each contact bank are mounted two soldering lugs 39 and 40 which are insulated in the same manner as the contact fingers 33 and 34 and are employed to terminate the leads from the electro-magnet coils 5 and 6 so that external wire connections can be conveniently made.

The armature 20 operates the movable contacts 34 by means of a forked member 41 carried by the armature crank 20^1 and having upstanding spaced fingers 41^1 carrying insulating sleeves secured thereto by small keys 41^2. These sleeves engage each side of both movable contacts 34 and actuate them in either direction in accordance with the motion of the armature 20.

If it is now considered for example that the upturned end 10^1 of the permanent magnet 10 is a north pole, it is evident that the flux emanating therefrom passes through the armature 20, into the cores 3 and 4 and returns to the opposite end of the permanent magnet 10 through the magnetic bridging member 7. The permanent magnet 10 is placed equidistant from the two cores 3 and 4 which causes the aforesaid permanent magnet flux in the armature 10 to be substantially equally distributed each side of the pivot pin 21 and consequently the magnetomotive force acting thereon produces equal and opposite turning efforts resulting in maintaining the armature 20 in a neutral positon.

The coils 5 and 6 are so arranged that when commonly energized their core ends 3^1 and 4^1 are made opposite poles, and it will first be considered that the end of core 3^1 is made a north pole and 4^1 a south pole by the application of a definite polarity of energization. It is evident now from Fig. 2 that the flux emanating from the north pole or from core 3 opposes the permanent magnet flux flowing in the corresponding half of armature 20 but the flux in core 4 is additive in direction to the permanent magnet flux already flowing therein, which results in the passage of practically all the permanent magnet flux through the half of the armature adjacent the core 4. This unbalances the flux and produces sufficient turning effort to rotate the armature 20 against the biasing arm 26 so that the residual pin 23 engages the core end 4^1 and accordingly operates the movable contact fingers 34.

If now it is considered that the coils 5 and 6 are energized with an opposite polarity to that previously assumed, the core end 3^1 is made a south pole and 4^1 a north pole. In this case the permanent magnet flux joins entirely with the flux in core 3 and the consequent operation of the armature is reversed or is rotated so that the residual pin 22 engages the core end 3^1 and a reverse engagement of the contacts is accordingly accomplished.

The biasing arms 26 and 27 are arranged to return the armature 20 to a neutral position upon the interruption of either of the previously assumed applications of energy. The particular construction of this biasing means obviates the tendency for the armature to be carried beyond center by an oscillating motion inasmuch as such motion of either arm 26 or 27 is stopped by the pin 32 and the momentum of the armature is counteracted by the inertia of the opposite biasing arm.

The biasing force on the armature can be suitably adjusted by changing the moment arm of the biasing spring 30 which is made convenient by a plurality of spring retaining notches 31. The biasing spring 30 can also be obliquely positioned so as to relatively change the moment arms of 26 and 27 to compensate for any possible unbalance of neutral magnetomotive force on the armature caused by a slight unsymmetrical arrangement of parts and to compensate for any inequality in the length or weights of the biasing arms, or the like.

In certain applications it is advantageous

to employ a relay which does not return to its neutral position upon de-energization but remains in its last energized position. Such operation can be obtained from a slightly modified form of the above relay or namely from the above relay with the biasing arms 26 and 27 and their coacting spring 30 omitted.

When such a relay is de-energized, the majority of the permanent magnet flux passes through the half of the armature which is engaging a core end, as this path is of lower reluctance due to its smaller air gap, which results in retaining the armature in this particular operated position. It is evident that upon an application of a polarity of energization corresponding to the reverse operation, the flux causing this retaining force is opposed and the majority of flux transposed to the opposite half of the armature 20 thereby causing a reverse operation.

From the accompanying drawings and the foregoing description it is seen that a relay, definitely responsive to polarized energy, is provided which is sufficiently compact for use in a railroad centralized traffic control system. Sufficient adjustments have also been provided to adapt its operating characteristics to the particular requirements, and its utility can be further increased by employing the slight modification previously described.

The above rather specific description of one form of the present invention is given solely by the way of example rather than to limit the number of forms which it may assume; and various modifications, adaptations and alterations may be applied to the specific form shown to meet the requirements of practice, without in any manner departing from the spirit or scope of the present invention except as limited by the appended claims.

Having thus shown and described my invention, what I claim is:—

1. A relay including two electro-magnets, a permanent magnet, an armature positioned in the magnetic circuit of said electro-magnets and said permanent magnet so as to distinctively operate in accordance with the direction of current flow in said electro-magnets and biasing means acting on said armature to retain the same in a neutral position when said electro-magnets are de-energized, said biasing means comprising two arms, each urging the armature to a central position from their particular operating direction by a common spring, said biasing arms being adapted to retain said spring at variable distances from their pivots.

2. A polarized relay including two electro-magnets, a permanent magnet, an armature positioned to distinctively operate in accordance with the energizing polarity of said electro-magnets, circuit changing means actuated by said armature operation, a carrier member for said armature and said circuit changing means which is adjustably mounted with respect to said electro-magnets and a manually operable means on said carrier member permitting vernier adjustment thereof relative to said electro-magnets.

3. A relay comprising a supporting member of non-magnetic material, two electro-magnets including cores magnetically connected at one end so as to extend in spaced parallel relation, a permanent magnet adjustably clamped at the junction of said electro-magnets so as to present an upturned end equally spaced from the free ends of said electro-magnets, a carrier member of non-magnetic material mounted on said supporting member so as to permit adjustment relative thereto in alinement with said electro-magnet cores, an armature pivotally mounted on said carrier member between the upturned end of said permanent magnet and the free ends of said electro-magnets and including adjustable non-magnetic residual pins arranged to limit its pivoted motion against either of said electro-magnets, a plurality of fixed and movable resilient contact fingers secured to said carrier member and a crank on said armature carrying upstanding sleeves engaging each side of said movable contact fingers whereby said contact fingers are operated in accordance with the movement of said armature, said fixed resilient contact fingers having bifurcated free ends with a contact point included on each fork.

4. A polarized relay including an electro-magnetic structure, a permanent magnetic structure, an armature positioned to distinctively operate in accordance with the condition of the electro-magnetic structure and means biasing said armature to a definite neutral position, said biasing means comprising two pivoted independent arms engaging said armature at the free ends thereof and being urged against a rigid stop by a common spring, said common spring being adapted to engage said arms at various distances from said pivots.

5. A polarized relay including a non-magnetic supporting member, two electro-magnets and a permanent magnet secured to said supporting member, a carrier member mounted on said supporting member by screws passing through slots therein whereby said carrier member can be clamped in a position which is adjustable relatively to said supporting member and an armature pivotally mounted on said carrier member and arranged to distinctively operate circuit changing means in accordance with the energizing polarity of said electro-magnets.

6. A polarized relay including two electro-magnets having extending cores, a permanent magnet, a non-magnetic supporting member having recesses therein to receive said extending cores of said

electro-magnets, a magnetic member having slots substantially aligning with slots in said non-magnetic supporting member and adapted to receive one extending end of each electro-magnet cores, said magnetic member being retained by nuts threaded on the aforesaid extending core ends and having beveled sides engaging in sockets in said magnetic member slots and an armature positioned to distinctively operate contacts in accordance with the energizing polarity of said electro-magnets.

In testimony whereof I affix my signature.

RICHARD C. LEAKE.