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R. C. LEAKE

ENGINE RELAY

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FIG. 1.

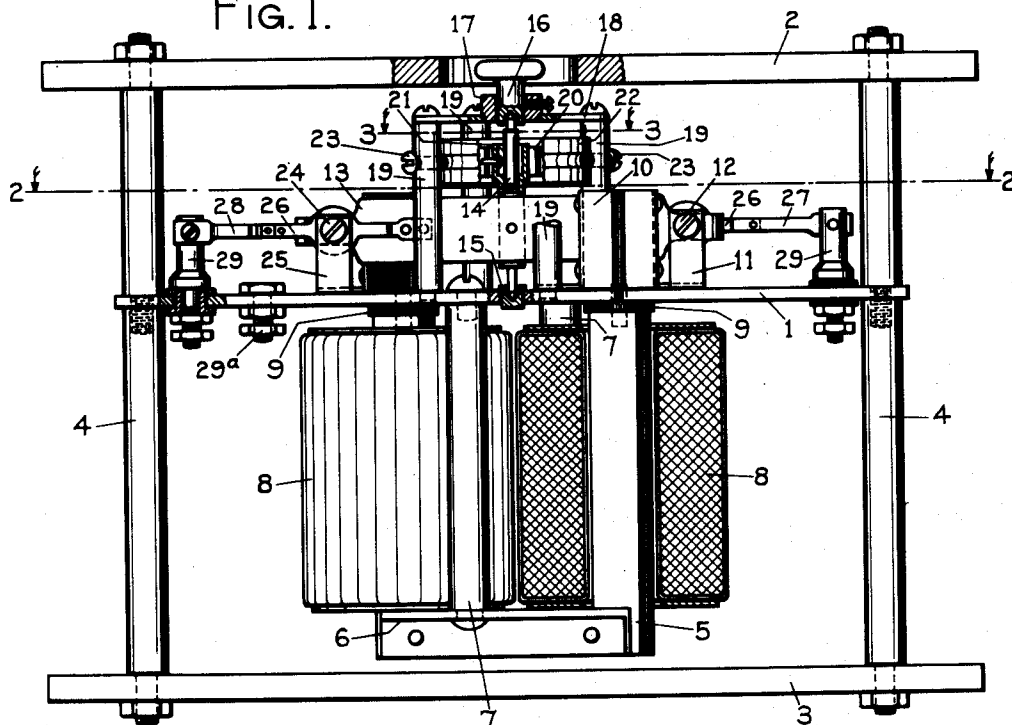


FIG. 2.

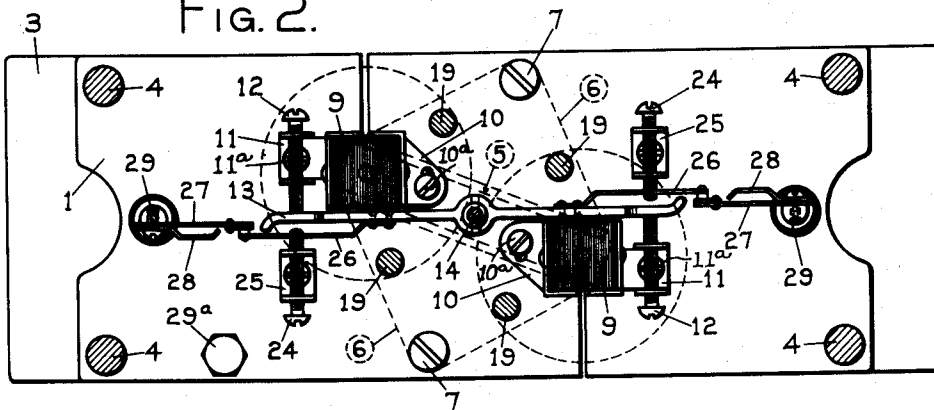
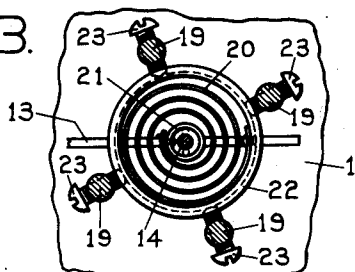


FIG. 3.



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UNITED STATES PATENT OFFICE.

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ENGINE RELAY.

Application filed January 6, 1922. Serial No. 527,508.

This invention relates to electrically operated relays, and more particularly to relays for use in automatic train control systems for railroads, and adapted to be carried on a locomotive or other railway vehicle.

The car relays used in cab signal or train control systems for railroads, being carried on a locomotive or similar vehicle, are subjected to irregular and peculiar shocks, jars, and vibrations of magnitude and intensity not found in any other service. In certain types of train control systems, especially in the intermittent inductive type in which the controlling impulses or influences are communicated from the trackway to the moving vehicle through an intervening air gap by track elements located at intervals along the track, it is desirable to employ a car relay capable of working reliably on small current changes of relatively short duration. In order to obtain such a sensitive and quick acting relay, it is considered preferable to employ light moving parts having little inertia and operable on a small amount of energy; but it is found that when a relay is thus constructed so as to operate properly and efficiently under these conditions, the severe jars and vibration to which the relay is subjected tends to cause a false operation. A single false operation is of course prohibitive in a train control system, which must by its very nature be dependable in its performance; and since the car equipment is ordinarily organized, by the use of the stick feature in connection with the relay or device controlled thereby, a single momentary opening of the relay contacts will result in a brake application, or the imposition of some form of automatic control, so that only one momentary operation of the relay contacts by jar and vibration produces a false control that renders the whole system seriously defective.

With these and other considerations in mind, the primary purpose of the present invention is to construct a simple, efficient and reliable relay which will be relatively quick acting and sensitive, and at the same time will not be improperly or falsely operated by the irregular shocks and vibrations encountered on locomotives. Generally stated, it is proposed in this invention to make the moving parts of the relay as light as consistent with efficient and reliable per-

formance; to balance the armature and other parts for rotation about an axis through their center of mass so as to be immune to rectilinear jar and vibration; to provide complementary spring contacts having like periods of vibration, so that while the advantage of yielding or resilient contacts is retained, such contacts will not themselves be operated by vibration; to form an efficient magnetic circuit; and in general adapt and organize the parts of a tractive type relay for efficient and reliable operation under severe shocks, jars and vibration. Other features and advantages of the invention will appear hereinafter as the description progresses.

In describing the invention in detail, reference will be made to the accompanying drawings, in which:—

Figure 1 illustrates a front view of the relay with some parts in section for sake of clearness;

Fig. 2 is a horizontal section taken on the line 2—2 in Fig. 1, and looking in the direction indicated by the arrows; and

Fig. 3 is a detail section taken on the line 3—3 in Fig. 1.

Referring to the accompanying drawings, the main supporting frame of the relay is made up of a middle plate 1, to which the parts of the relay are secured, and upper and lower plates 2 and 3. These upper and lower plates are fastened to the middle plate by four pairs of upper and lower spacing studs 4, as shown, these studs being screwed together and clamped to the middle plate. The relay is preferably mounted vertically in the position shown in Fig. 1, and is supported or hung in any suitable manner by connections to the upper and lower plates.

The magnetic core 5 of the relay is U-shaped, and is preferably formed of laminations in the usual way, held together by two triangular shaped brackets 6 riveted to the opposite sides thereof. Two studs 7 are riveted at their lower ends to the corners of the brackets 6, and are fastened by screws at their upper ends to the middle plate 1. On the legs of the core 5 are mounted a pair of coils 8, preferably form wound, with the size of wire and number of turns selected in accordance with well-known principles to conform with the size and operating performance of the relay. The ends of the core 5 are provided with

enlarged pole pieces 9, preferably formed of laminations, which extend through square holes in the middle plate 1, these holes preferably being large enough to permit a small amount of adjustment. The ends of the cores 5 and the adjacent ends of these pole pieces 9 are preferably accurately machined and fitted together with a dowel pin. To each pole piece are riveted angle brackets 10 and 11 by rivets as shown, the rivets through these angle brackets also serving to clamp and hold together the laminations of the pole piece. The angle brackets 11 are fastened to the plate 1 by screws 11^a, and the angle brackets 10 each have a slot therein through which pass the screws 10^a threaded into the base plate 1, whereby the pole pieces may be adjusted about the screws 11^a as a center. The bracket 11 is formed with integral upstanding legs in which is threaded a screw 12. The plate 1 is slotted opposite the pole pieces, as shown in Fig. 2, to interrupt and prevent the flow of eddy currents in the plate 1 about the pole pieces.

The armature of the relay is a flat soft iron bar 13 pivotally supported at its middle and cooperating with opposing faces of the pole pieces 9. In the construction illustrated the armature 13 is disposed lengthwise of the plate 1 and consequently the core 5 is skewed with respect to this plate, and the pole pieces 9 are also set angularly to maintain a substantially uniform air gap between them and said armature. The armature 13 is formed with a transverse hole in its middle and in this hole is pinned a spindle 14 which is supported at its upper and lower ends in suitable anti-friction bearings. In the construction shown, the lower end of the spindle 14 is pointed and fits into a polished metal or jewel bearing 15 fixed in the plate 1. The upper end of the spindle 14 has a similar point bearing in a socket member 16 clamped by a set screw in a circular block 17. The adjustable support for the socket member 16 afforded by this construction permits the bearings to be set up with nicety to avoid lost motion and yet obviate undue friction or binding. The block 17 has its lower end spun over or otherwise suitably fastened in a hole in a disk 18 which is secured by screws to four standards 19 riveted or otherwise suitably fastened at their lower ends to the plate 1. The armature 13 is biased to its retracted position by a flat spirally wound spring 20, similar to the ordinary clock spring. The inner end of the spring 20 is anchored by a pin or rivet to a collar 21 riveted to the spindle 14. The outer end of the spring 20 is riveted to a ring 22 which is supported by the engagement of screws 23 in the four standards 19 with a groove formed around the

outside of said ring. By turning the screws 23 the ring 22 may be adjusted sidewise in any direction to line up the spindle 14 with the axis of its bearings and compensate for any side thrust on this spindle that may be exerted by the spring 20. After these screws 23 are loosened, the ring 20 may be turned to increase or decrease the tension of the spring 20 and its tendency to shift the armature 13 to its retracted position.

The armature 13 is carefully and accurately made so that the axis on which it turns passes through its center of mass. Consequently, this armature has no tendency to turn under the influence of ordinary shocks and jars, since any momentum that it may acquire under such shocks or vibration is directed in line with its bearing axis and causes no turning moment. Obviously, up and down movements in line with the pivotal axis of the armature do not tend to turn it, and since the relay is preferably mounted on the locomotive or other vehicle with its pivotal axis disposed vertically, any up and down motion of the locomotive, as it passes over low joints or the like, does not exert any tendency to shift the armature. This balancing of the armature and associated parts moving therewith constitutes an important feature of this invention.

The movement of the armature 13 toward the pole pieces 18 is limited by the screws 12; and by adjusting these screws, the air gap existing when the armature is in its fully attracted position may be selected as particular conditions may require. Movement of the armature 13 away from the pole pieces under the influence of the spring 20 is limited by screws 24 threaded into the upstanding ears of small plates 25 fastened by screws to the plate 1. The screws 12 constitute front stops for the armature 13, and the screws 24 adjustable back stops.

Each end of the armature 13 is provided with a contact arrangement, and since the construction is the same in both cases a description of one will suffice for both, and the same reference characters may be employed. A spring contact 26 is riveted at one end to the armature 13, and extends substantially parallel with this armature beyond its end. This contact spring is enlarged and perforated, (see Fig. 1) at an intermediate point to clean the screw 24, and this spring has a slight initial tension normally urging the spring against the bent or curved extremity of the armature, this extremity of the armature performing the function of a retaining member. The free end of each contact spring 26 is provided with a contact pin of a suitable non-corrosive and resistant conducting material such as platinum, a tungsten alloy, or the like, and this contact

pin engages a contact piece of similar material riveted to the end of an adjustable stationary spring 27. Associated with the spring 27 is a bent retaining or stop member 28, and this stop member and spring are clamped by a screw to a binding post 29 which is adjustably fastened to the plate 1 and insulated therefrom by flanged bushings and washers in the usual way. Adjustment of the retaining stop member 28 and in turn the spring contact 27 is accomplished by backing off the bottom nut from the binding post 29, and then turning the post to bring the stationary contact spring 27 to the desired point. Two circuits may be controlled by this relay by connecting a common wire to the grounded binding post 29^a, the circuits being completed from the binding post 29^a through the frame, spiral spring 20, spindle 14, armature 13 and the two binding posts 29. If desired, a single circuit may be controlled by connecting the circuit to the binding posts 29, thereby providing a double break when the contacts are opened.

This contact construction is designed to prevent operation of the cooperating contact elements and resultant interruption of the circuit control thereby due to slight movements of the armature 13 away from the pole pieces 9. It will be observed that both of the contact springs 26 and 27 are flexed slightly away from their cooperating retaining or stop members when the armature 13 is in its fully attracted position, and consequently, until spring 26 engages the extremity of the armature, or the spring 27 engages its retaining member 28, the electrical connection between these springs is not interrupted. Consequently, the armature may move away slightly from its attracted position without causing actual separation of its contacts. In other words, the contact springs 26 and 27 follow up, so to speak, as the armature moves part way away from its attracted position. Also, the two contact springs 26 and 27 with their associated contact elements are weighted the same and provided with like resiliency and stiffness, so as to have the same period of vibration and vibrate in synchronism. By virtue of this construction, individual vibration of the contact springs 26 and 27 will be harmonious and of the same magnitude, so that the circuit will not be interrupted. It may be added that the inertia and disposition of the circuit in these contact springs 26 and 27 is of more importance than the respective tensions, because when the armature is in its attracted position, these springs will be opposing each other and will be subjected to equal bending forces. While the contact construction described prevents operation of the contacts and interruption of the circuit by slight movements of the arma-

ture at its attracted position, when the coils 8 are deenergized, or partly so, and the tension of the return spring 20 over-balances the attraction of the armature, it is thrown back against its back stop screws 24, and since this movement of the armature is greater than that permitted by the space between the contact springs 26 and 27 and the respective retaining members, the contacts are separated and the circuit is interrupted. The adjustment of these parts is determined by trial and experiment to obtain the best performance under the existing operating conditions.

Having thus shown and described one form of my invention, I desire to have it understood that the particular construction illustrated is susceptible of considerable modification and adaptation, and the specific embodiment of my invention shown and described is merely an illustration of the idea of means constituting my invention.

What I desire to secure by Letters Patent is:—

1. A relay comprising, a U-shaped core having pole pieces, a coil on said core, an armature pivoted at its middle between said pole pieces, adjustable stops on both sides of said armature to engage the armature directly and to adjust the pick-up and drop-away characteristic of the relay, and means operated by said armature including spring contact fingers for closing a circuit when said relay is energized, said spring contact fingers being disposed with respect to said armature so that said circuit is not opened in spite of slight vibration of said armature.

2. A relay comprising, a core having a pair of pole pieces, a coil on said core, an armature pivoted between said pole pieces, means for resiliently holding said armature away from said pole pieces, a stationary spring contact, and a movable spring contact having a period of vibration substantially equal to that of the stationary spring contact.

3. A relay comprising, a core having a pair of pole pieces, a coil on said core, a balanced armature pivoted between said pole pieces and spring pressed therefrom, a stationary spring contact, and a movable spring contact having substantially the same moment of inertia and elasticity as the stationary spring contact.

4. A relay comprising, a core having a pair of pole pieces adjustable to tilt the active face thereof, a coil on said core, an armature pivoted between said pole pieces and tensioned in one direction by a spring, and means for controlling a circuit operated by said armature.

5. A relay comprising, an armature pivotally supported and having its axis extending through its center of mass, and spring means including a spring for biasing said armature

in one direction about its axis, said spring means being adjustable to permit the center of gravity of the spring to be brought into the axis of said armature.

6. A relay comprising, an armature pivotally supported and having its axis extending through its center of mass, and spring means including a spring for biasing said armature in one direction about its axis, and means for adjusting both the tension of said spring and the location of the center of gravity of such spring.

7. A relay comprising, a core having pole pieces, a balanced armature pivoted between said pole pieces, adjustable stops on opposite sides of said armature for engaging the armature directly and limiting its motion, a stationary spring contact having limited movement toward its cooperating movable contact, a movable spring contact carried by said armature having limited movement in the direction toward its cooperating stationary contact, and a spring for biasing said armature against one of said adjustable stops.

8. A relay comprising, a core having pole pieces provided with means to adjust the angular relation of the faces thereof, a balanced armature pivoted between said pole pieces, adjustable stops on opposite sides of said armature arranged to engage said armature directly, a stationary spring contact having limited movement, a movable spring contact carried by said armature having limited movement, and a spring for biasing said armature against one of said adjustable stops.

9. A relay comprising, a pivoted armature and means for tensioning said armature from said magnet comprising a spring connected to said armature, a ring for adjustably anchoring the other end of said spring having an external groove, and a plurality of screws engaging said groove to hold the ring in an adjusted position.

10. A relay comprising, an armature pivotally supported and having its axis extending through its center of mass, and spring means for biasing said armature in one direction about its axis, said spring means having its center of mass substantially in the axis of said armature.

11. A relay comprising, a core having a pair of oppositely disposed poles, a balanced armature, pivotally supported so that its opposite ends are in cooperating relation with the poles of said core, a coil spring having its one end operatively connected to said armature, and unitary means for anchoring the other end of said spring and for centering and adjusting the tension of said spring.

12. A relay comprising, a plate of non-magnetic material, enlarged pole pieces of magnetic material fastened to said plate and extending through holes in said plate,

a balanced armature pivotally supported between said pole pieces, and a U-shaped core having a coil thereon and fastened to the bottom side of said plate so that the ends thereof butt against said pole pieces, whereby the coils on said core may be replaced without interfering with said pole pieces and armature.

13. A relay comprising, a base plate of non-magnetic material, pole pieces of magnetic material and a cooperating pivotally supported armature wholly supported from one side of said plate, and a core and an associated coil wholly supported from the other side of said plate.

14. In a quick-acting relay for automatic train control systems, the combination of a U-shaped laminated core of magnetic material terminating in pole pieces, a relatively thin wide armature pivotally supported flatwise between said pole pieces so that its center of mass falls in the axis of the pivot, means for biasing said armature away from said pole pieces, and a coil normally having a current flowing therein for maintaining said armature in its normal attracted position against the force of said biasing means.

15. In a quick-acting relay for automatic train control systems, the combination of a U-shaped core terminating in pole pieces having flat active faces facing opposite sides of a plane, a spindle having its axis in said plane, an armature comprising a flat strip of magnetic material fastened to said spindle so that the axis of the spindle lies in the plane of said strip and the center of mass of said armature falls in the axis of said spindle, whereby the armature is balanced and disposed with respect to the pole pieces to constitute two air gaps in series in a magnetic circuit each of which afford a large area for the passage of magnetic flux.

16. A quick-acting relay for automatic train control systems comprising, a U-shaped core terminating in pole pieces having flat active faces facing opposite sides of a plane, a pivotally supported spindle having its axis in said plane, a flat armature secured to said spindle so as to cooperate with said pole pieces and so that the axis of said spindle falls in the plane of said armature, a spiral spring for biasing said armature away from said pole pieces, contacts on the ends of said armature, stationary insulated contacts adapted to cooperate with said first mentioned contacts, and means for conducting current to said armature through the medium of said spiral spring.

17. A quick-acting relay for automatic train control systems comprising, a laminated U-shaped core terminating in angularly adjustable pole pieces, a coil on said core, a flat armature pivoted near its middle and having the pivotal axis in the plane of

the armature and mounted so that both ends of said armature simultaneously approach said pole pieces, and circuit closing means operated by said armature.

5 18. A quick-acting relay for automatic train control systems comprising, a U-shaped core terminating in pole pieces, a flat armature pivotally mounted so that the pivotal axis extends through the plane of the armature, a spring for urging said armature
10 away from said pole pieces, an adjustable stop directly engaging said armature for limiting the movement of said armature toward said pole pieces, an adjustable stop for limiting the movement of said armature away
15 from said pole pieces, a spring contact finger extending from the end of said armature, and an adjustable stationary contact adapted to cooperate with said spring finger, whereby the contact pressure, the pick-up
20 current and the dropaway current of the relay may be adjusted.

19. A quick-acting relay for automatic train control systems comprising a U-shaped
25 core terminating in pole pieces having flat active faces facing opposite sides of a plane,

a pivotally supported spindle having its axis in said plane, a flat armature secured to said spindle so as to cooperate with said pole pieces and so that the axis of said spindle falls in the plane of said armature, a spiral spring for biasing said armature away from said pole pieces, means for adjusting the tension of said spring, contacts on the ends of said armature, and stationary insulated
30 contacts adapted to cooperate with said first mentioned contacts. 35

20. A relay comprising, a core having a pair of oppositely disposed poles, a balanced armature, pivotally supported so that its opposite ends are in cooperating relation with the poles of said core, a coil spring having its one end operatively connected to said armature and its other end secured to a ring, a groove in said ring and a plurality
40 of screws engaging said groove, whereby said spring may be centered and its tension may be adjusted. 45

In testimony whereof I hereby affix my signature.

RICHARD C. LEAKE.