Nov. 2, 1937. O. S. FIELD 2,097,786

RELAY

Filed March 19, 1935

FIG. 1.

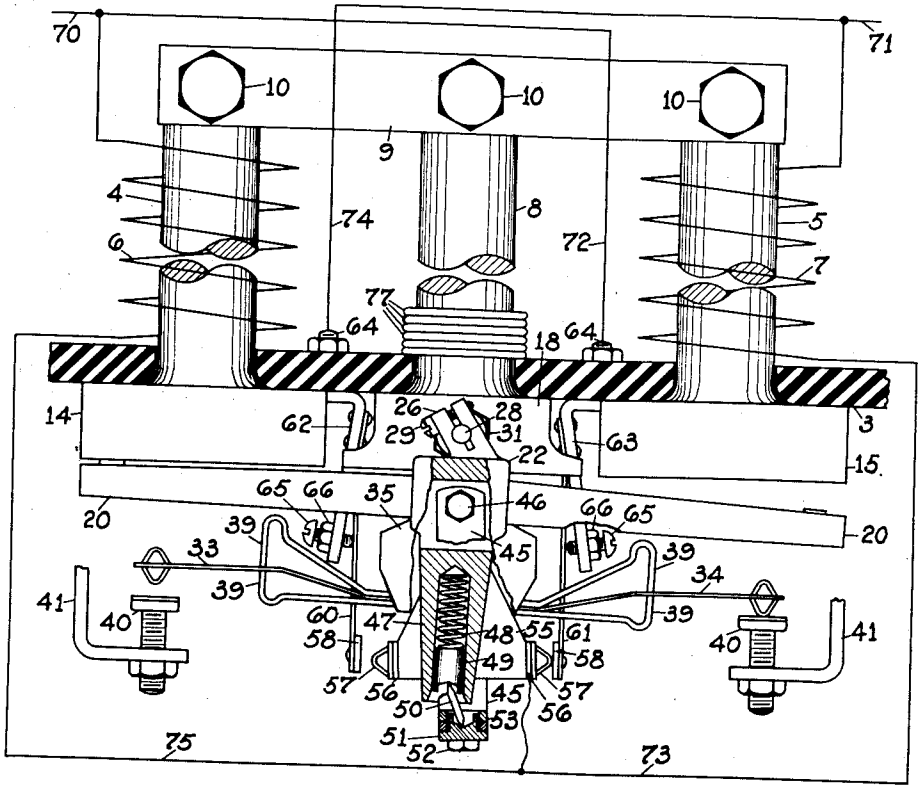
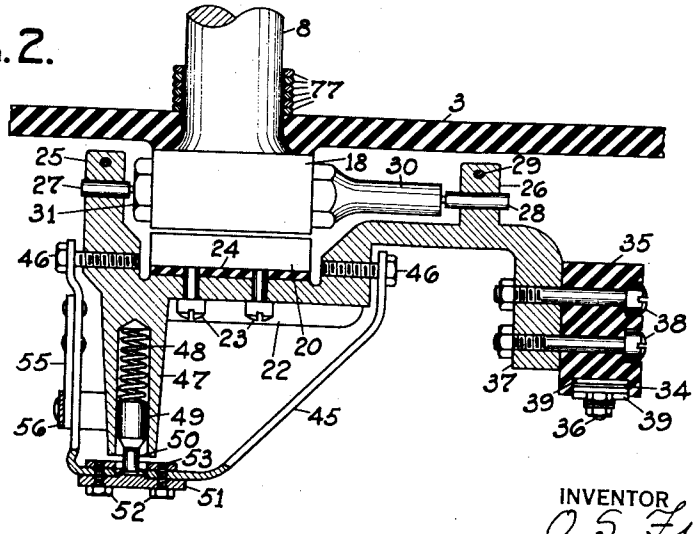


FIG. 2.



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RELAY

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13 Claims. (Cl. 172—126)

This invention relates to relays and more particularly to relays of the oscillating armature type particularly adapted to flash signal lights at highway crossings upon the approach of a railway train.

It is proposed in accordance with the present invention to provide a relay having a center pivoted armature operable to either of two positions according to the energization of either of two electro-magnets wherein an oscillation controlling means actuated by the center pivoted armature is arranged to select the energization of the electro-magnets in a manner to provide improved oscillatory operation of the armature. More specifically, it is proposed to provide a control contact arrangement operated by the armature to shift the energization of the relay from one operating magnet to the other, which control contact arrangement provides reliable and positive starting of the armature oscillation and a uniform and constant rate of oscillation. Other objects include the provision of an oscillating relay having a control contact arranged to reduce to a minimum the arcing in making and breaking electrical circuits and to obtain maximum efficiency of operation by an arrangement offering a minimum amount of friction and requiring a minimum number of ampere turns to start and operate the armature.

Still other objects, purposes and characteristic features of the present invention will appear as the description thereof progresses, during which references will be made to the accompanying drawing, in which:—

Fig. 1 is a front elevational view of a relay structure embodying the present invention wherein certain parts have been shown diagrammatically and other parts have been sectioned or broken away to more clearly show the construction thereof.

Fig. 2 is a side elevational sectional view of the relay structure shown in Fig. 1 and also having certain parts broken away and other parts removed.

Referring to the accompanying drawing, the arrangement illustrated as embodying the present invention is constructed to conform with the requirements of railway signalling practice, and the portion of the relay construction which embodies the major portion of the present invention is shown in greater detail than certain other parts which may for example be arranged in the manner illustrated in Patent No. 1,969,065 granted on August 7, 1934 to O. S. Field. The various parts of the relay illustrated herein are carried by a top plate 3 of insulating material such as bakelite or the like, the electro-magnetic structure being arranged above the plate 3 while the armature and various contacts operated thereby are carried below and enclosed by a glass case (not shown) in accordance with the usual construction.

The electro-magnetic construction comprises two outer cores 4 and 5 carrying windings 6 and 7 respectively and a center core 8, the cores 4, 5 and 8 being all magnetically joined at their upper ends by a strap 9 clamped through by bolts 10. The cores 4, 5 and 8 extend through the top plate 3 and terminate in enlarged pole pieces 14, 15 and 18 respectively, the magnetic structure including these cores being supported on the top plate 3 by screws not shown herein passing through the plate 3 into the pole pieces 14, 15 and 18.

An armature 20 is arranged beneath the enlarged pole pieces so that, when in its position illustrated in Fig. 1, the pole pieces 14 and 18 are magnetically joined thereby and is operable about a center pivoting means to magnetically bridge pole pieces 15 and 18. The armature 20 is attached to a cradle member 22 by screws 23 as shown in Fig. 2, and a semi-resilient strip 24 is provided to separate the armature 20 from the cradle member 22 as shown.

The cradle member 22 is provided with upwardly extending lugs 25 and 26, the lug 26 carrying a trunnion pin 28 adjustably clamped therein by screw 29 as shown in Fig. 1, and the lug 25 carries a trunnion pin 27 also clamped therein in the same manner. An inwardly extending reduced end of the trunnion pin 28 rotatably fits within a bearing in the end of an elongated spacing screw 30 threaded into the pole pieces 18, and in a similar manner, the reduced end of trunnion pin 27 is rotatably held by a shorter spacing screw 31 also threaded into the pole piece 18. In this manner it will be obvious that the cradle member 22 is pivotally supported from the center core 18 in a manner to permit the armature 20 to freely operate into engagement with either pole piece 14 or 15.

The contact arrangement for controlling external circuits in accordance with the operation of armature 20 has herein been shown in as simple a manner as possible, it being understood that an arrangement similar to that shown in Patent No. 1,969,065 may be employed. The illustrated arrangement however comprises movable contact fingers 33 and 34 clamped, together with their respective re-enforcing spring arrangement 39,

to an insulating block 35 by through bolts 36 as shown in Fig. 2. The insulating block 35 is fixed to a downwardly extending arm 37 integral with the cradle member 22 by through bolts 38, and it is clear that the number of contacts operated by the armature 20 may be increased to satisfy the demands of the particular application by other insulating contact carrying blocks similar to 35 mounted for example on the opposite side of the arm 37.

The contact fingers 33 and 34 are engageable with respective fixed back contacts 40, which contacts 40 are adjustably carried by arms 41. The arms 41 are broken away in Fig. 1, but it is understood that they are held by terminal posts to the top plate 3 in the usual manner. Fixed front contacts coacting with the movable fingers 33 and 34 may of course be provided also if required, and it is understood that the fingers 33 and 34 are to be connected by flexible leads to terminal posts on plate 3 in accordance with the usual practice.

The control contact arrangement operable to effect oscillation of the armature 20 during energization of the present relay is provided in accordance with the present invention by a U-shaped bracket 45, the upper ends of the bracket 45 being carried rotatably on screws 46 threaded into the cradle member 22 at points directly beneath the location of the trunnion pins 27 and 28. A hollow arm 47 integral with the member 22 extends downwardly therefrom and houses a compression spring 48 acting upon a cylindrical plunger 49. The plunger 49 is V-shaped at its lower end as shown in Fig. 1 whereby to receive an upper knife-edge of a toggle link 50, and a lower knife-edge of this toggle link 50 enters a V-shaped upper end of a bearing member 51, which bearing member 51 is clamped to the bracket 45 by screws 52 passing therethrough and threaded into a retaining member 53.

A triangular shaped member 55 is riveted to the back upright portion of the bracket 45 as shown in Fig. 2 and carries a contact holding strip 56 having its ends bent forwardly around the edges of member 55 to hold low resistance contacts 57 at each end thereof. The contacts 57 are engageable with respective low resistance contact surfaces 58 carried by the lower ends of vertical contact fingers 60 and 61. The contact fingers 60 and 61 are riveted to downwardly extending rigid arms 62 and 63 which are in turn attached to the top plate 3 by bolts 64. The lower ends of the arms 62 and 63 carry screws 65 threaded therethrough to engage the associated fingers 60 and 61, whereby it is obvious that the flexible contact fingers 60 and 61 may be adjustably positioned relative to their cooperating contacts 57, and the adjusted position of screws 65 may be retained by locking nuts 66.

The contact fingers 60 and 61 are adjusted to positions effective to hold the degree of travel of bracket 45 within certain limits, which degree of travel is necessarily less than that of its actuating arm 45. For example, the finger 61 in Fig. 1 is so adjusted that the arrested position of the bracket 45 positions the toggle link 50 at a certain oblique angle, which angle is such that the pressure between contacts 57 and 58 provided by the horizontal component of the force transmitted from spring 48 through link 50 effects a low resistance electrical connection.

In describing the operation of the present relay, it will be considered that (+) potential of energy is applied to wire 70 in Fig. 1 and (—) or opposite potential is applied to wire 71, so that with the relay in its illustrated position, current flows from (+) on wire 70, through wire 72, contact 58 closed contact finger 61, wire 73, through coil 7 to (—) in wire 71. In other words, the illustrated position of bracket 45 engages contact 57 with contact finger 61 which shunts coil 6 and allows current to flow in coil 7 only, thus producing flux flowing from the lower end of core 5, through the right hand side of armature 20, upwardly through core 8, and through strap 9 back to the upper end of core 5.

This flux obviously attracts the right hand end of armature 20 toward pole piece 15 so as to rock the armature 20 about its center pivot pins 27 and 28 in a counter-clockwise direction as viewed in Fig. 1. The downwardly extending arm 47 of the cradle member 22 is then moved to the right by this movement of armature 20, whereby it is obvious that the toggle link 50 is first operated toward a vertical position which increases the distance between plunger 49 and bracket 45, or in other words, the plunger 49 is moved upwardly to compress spring 48 until the link 50 reaches a vertical position. When the link 50 moves beyond its vertical position, it is obvious that the horizontal component of the force transmitted therethrough from spring 48 to bracket 45 is reversed in its direction, thereby snapping the lower end of bracket 45 to the left to a position wherein contact 57 engages contact finger 60.

The contact finger 60 is adjusted to stop the bracket 45 in a position wherein the link 50 is at an oblique angle but slanting in a direction opposite from that illustrated. It is clear then that the contact fingers 60 and 61 should be so adjusted that the angle of vertical displacement of link 50 is equal at the two extreme positions of armature 20, and it is of course necessary to maintain the total travel of bracket 45 less than the total travel of arm 47.

The disengagement of contact 57 from contact finger 61 obviously removes the shunt from coil 6, but the engagement of contact 57 with contact finger 60 immediately establishes a circuit from (+) on wire 70, through coil 6, wire 75, through contact 57 closed on contact finger 60, wire 74, to (—) on wire 71. It will then be clear that when armature 20 has operated into engagement with pole piece 15, coil 7 is shunted thereby allowing coil 6 to produce flux flowing from the upper end of core 4, through strap 9, downwardly through core 8, through the left hand end of armature 20 and back to the lower end of core 4, thereby attracting the left hand end of armature 20 toward pole piece 14 and operating the armature in a clockwise direction back to its illustrated position.

It will of course be clear that during the first part of the travel of armature 20 toward pole piece 14, the lower end of arm 47 moves to the left and operates link 50 toward a vertical position thereby again comprising spring 48. When the link 50 has passed beyond its vertical position, the horizontal component of the force transmitted therethrough from spring 48 to bracket 45 is again reversed in its direction, thereby snapping the bracket 45 to the left to engage contact 57 with contact finger 60 as illustrated. The contact fingers 33 and 34 are of course operated directly by the armature 20 to engage and disengage their associated fixed contacts 40 to thereby make and break various external electrical circuits.

In this manner, it is obvious that the armature

20 is operated first into one position and then into the other due to the selective shunting of the operating coils 6 and 7 by the control contact arrangement operated by the armature, and it may be seen from the foregoing description of the flux paths involved in operating the armature 8 from one position to the other that the coils 6 and 7 are so arranged that flux flows first in one direction and then in the other through the center core 8. Consequently in order to hold the rate of operation of armature 20 within certain desired limits, a plurality of short-circuited washers 77 of non-magnetic material are placed around core 8, which act in the usual manner to retard any change in flux flowing in core 8. It will be obvious that the washers 77 will be effective to retard the rate of operation of armature 20 by delaying the reversal of the direction of flux in core 8, and of course the rate of operation of armature 20 may be conveniently decreased by adding more washers or may be increased by removing one or more of washers 77 from core 8.

A relay of the oscillating-armature type has thus been provided, wherein a center pivoted armature is operable in one direction in response to the flow of current in one electro-magnet and is operable in the other direction in response to the flow of current in another electro-magnet, and wherein an armature-operated contact is arranged to shift the flow of current from one magnet to another in a manner to effect oscillation of the armature.

An important feature of the present invention is the provision of an oscillation-controlling contact which retains one set of contacts closed until the armature has nearly completed the associated direction of movement and shifts its position to close a different set of contacts preparatory for the opposite direction of armature movement only after the armature has completed nearly all of its travel, thereby providing a positive and uniform rate of operation and a more efficient relay structure. Specifically, it may be seen from the particular form illustrated that this feature is provided by an arrangement whereby the contact 57 is not moved in response to the first part of movement of armature 20, but rather the contact 57 is moved only after the toggle link 50 has operated beyond its vertical position, and the position of bracket 45 allows the link 50 to assume a vertical position only when the armature has nearly completed its travel.

Another important feature of the present invention is the arrangement of an oscillation controlling contact which remains in its last operated position upon de-energization of the relay, and when in such last operated position exerts sufficient pressure upon the fixed contact engaged thereby to permit positive and reliable starting upon subsequent energization of the relay. It will also be obvious that an arrangement has been provided wherein a pressure which provides a low resistance connection between the movable and stationary oscillation controlling contacts is maintained as the armature moves through the greater part of its travel or until the movable contact is operated, and the snap operation of this movable contact of course acts in the usual manner to reduce arcing in breaking the electrical circuit therethrough. Attention is also directed to the arrangement of knife-edge bearings in the toggle arrangement whereby wear and friction are reduced to a minimum to provide a more substantial and efficient device.

The above rather specific description of one form of the present invention is given solely by way of example, and is not intended in any manner whatsoever in a limiting sense. It is further to be understood that various modifications, adaptations and alterations may be applied to the specific form shown without departing from the spirit or scope of the present invention, except as limited by the appended claims.

What I claim is:—

1. In a relay of the oscillating armature type, a pivoted armature, two electro-magnets one on each side of the pivotal axis of the armature whereby the armature is swung in one direction or the other according to the selective energization of the electro-magnets, a contact-operating arm for effecting alternate energization of the electro-magnets, an actuating arm on the armature, a rigid biased toggle link operatively connecting the contact-operating arm and the actuating arm, said toggle link being arranged to snap operate the contact-operating arm only during the latter quarter portion of the travel of the actuating arm and in an opposite direction to said travel.

2. In a relay of the oscillating armature type, a pivoted armature, two electro-magnets one on each side of the pivotal axis of the armature whereby the armature is swung in one direction or the other according to the selective energization of the electro-magnets, an actuating arm on the armature, a contact-operating arm for effecting alternate energization of the electro-magnets, and pivoted to the actuating arm on the armature, a toggle link connecting the contact-operating arm and the actuating arm, and biasing means acting on the toggle link in a manner to snap-operate the contact-operating arm in a direction opposite to the direction of movement of the actuating arm during a movement of the toggle link through a center-position.

3. In a relay of the oscillating armature type, a center pivoted armature, two electro-magnets for operating the armature to oppositely disposed positions, a movable contact coacting with two fixed contacts to selectively energize either of the electro-magnets, an actuating arm extending from the armature, a rigid toggle member extending from the actuating arm to the movable contact member, and a biasing means compressing the toggle member and operating the toggle member into one oblique position at one position of the armature whereby to engage the movable contact with one fixed contact and operating the toggle member into an opposite oblique position at the other position of the armature whereby to engage the movable contact with the other fixed contact.

4. In a relay of the oscillating-armature type, a center pivoted armature, two electro-magnets for operating the armature to oppositely disposed positions, a pivoted movable contact carried by the armature and coacting with two fixed contacts to selectively energize either of the electro-magnets, an actuating arm extending toward the movable contact from the armature, a rigid knife-edge toggle member extending from the actuating arm to the movable contact, and a biasing means in the actuating arm operating the toggle member into one oblique position at one position of the armature whereby to engage the movable contact with one fixed contact and operating the toggle member into an opposite oblique position at the other position of the armature whereby to engage the movable contact with the other fixed contact.

5. In a relay, a center-pivoted armature, two electro-magnets one on each side of the pivotal axis of the armature whereby the armature is operated in either direction according to the selective energization of the electro-magnets, a downwardly extending arm operated directly by the armature, a bracket pivotably mounted on the arm and extending around the lower end of the arm, two fixed contacts limiting the travel of the bracket, a toggle link extending between the lower end of the actuating arm and the lower end of the bracket, and biasing means acting on the toggle link to snap-operate the bracket between the two fixed contacts in a direction opposite to the movement of the actuating arm.

6. In a relay, a contact arm operable to definite positions either side of a center line, an actuating arm operable to definite positions either side of the same center line and operable a greater degree than the contact arm, toggle means connecting the contact arm with the actuating arm, and a compression biasing means in the actuating arm acting on the contact arm through the toggle means, whereby the contact arm is operated by a movement of the actuating arm beyond a position wherein the actuating arm aligns with the contact arm.

7. In a relay, an armature, coils for operating the armature, a pivoted contact arm operable to two extreme positions for controlling the coils, an actuating arm operable by the armature to two extreme positions, a rigid toggle link connection between the two arms, means in compression biasing the toggle link and urging the two arms apart, the connection being arranged so that the biased toggle connection causes operation of the contact arm only during the last portion of the travel of the actuating arm.

8. In a relay, in combination, a pivoted armature movable to two extreme positions, an actuating arm on the armature, an actuated arm, a rigid link pivotally connecting the two arms, and a compression biasing means maintaining the link under compression.

9. In a relay, in combination, operating coils for operating an armature, a pivoted armature movable by the coils to two extreme positions, an actuating arm on the armature, an actuated arm pivoted to the actuating arm, a rigid link pivotally connecting the two arms, and a compression biasing means maintaining the link under compression.

10. In a relay, in combination, a pivoted armature, electro-magnets for operating the armature to two extreme positions, an actuating arm on the armature, an actuated arm pivoted to the actuating arm, energizing circuits for the electro-magnets controlled by the actuated arm, a rigid link pivotally connecting the two arms, and a compression biasing means maintaining the link under compression whereby the electro-magnet energizing circuits are controlled only at the end of movement of the armature.

11. In a relay, in combination, a pivoted armature, electro-magnets for operating the armature to two extreme positions, an actuating arm on the armature, an actuated arm pivoted to the actuating arm, energizing circuits for the electro-magnets controlled by the actuated arm, a rigid link pivotally connecting the two arms, and a compression biasing means maintaining the link under compression whereby the electro-magnet energizing circuits are controlled only at the end of movement of the armature.

12. In a relay of the oscillating-armature type, a center pivoted armature, two electro-magnets for operating the armature to oppositely disposed positions, a pivoted movable contact coacting with two fixed contacts to selectively energize either of the electro-magnets, an actuating arm extending toward the movable contact from the armature, a toggle member extending from the actuating arm to the movable contact, and a biasing means operating the toggle member into one oblique position at one position of the armature whereby to engage the movable contact with one fixed contact and operating the toggle member into an opposite oblique position at the other position of the armature whereby to engage the movable contact with the other fixed contact.

13. In a relay, in combination, an oscillating armature, a pivoted movable contact carried by the armature, an actuating arm extending from the armature toward the movable contact, a rigid toggle member extending from the actuating arm to the movable contact, and a biasing means in the actuating arm operating the toggle member into one oblique position of the armature, and into an opposite oblique position at the other position of the armature.

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