Sept. 22, 1931. H. B. TAYLOR 1,824,178

RELAY OPERATING MECHANISM

Filed March 25, 1926

FIG. 1

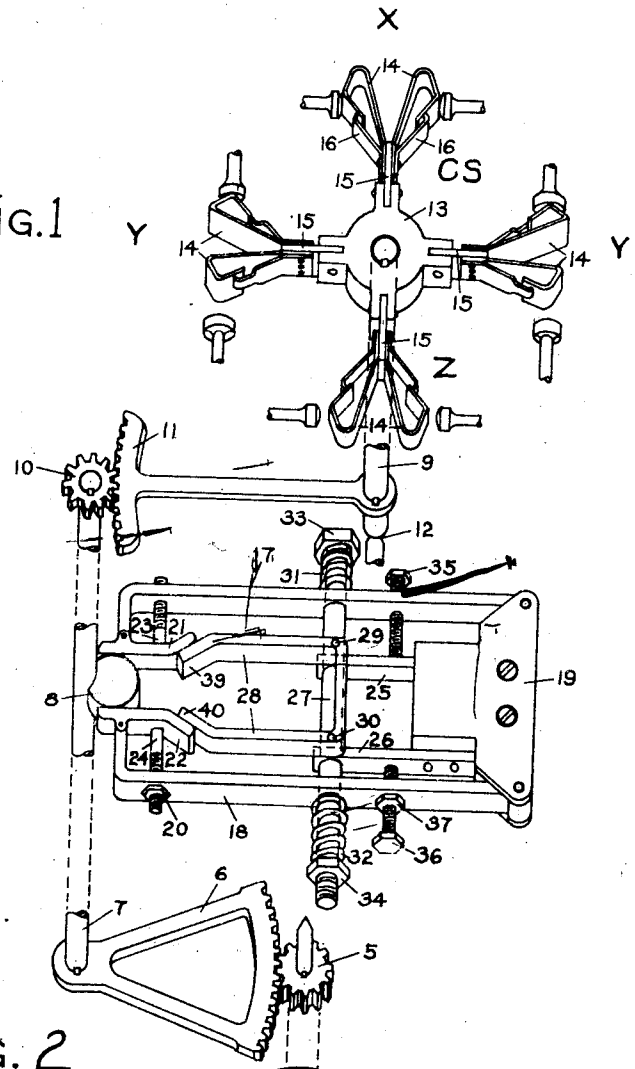
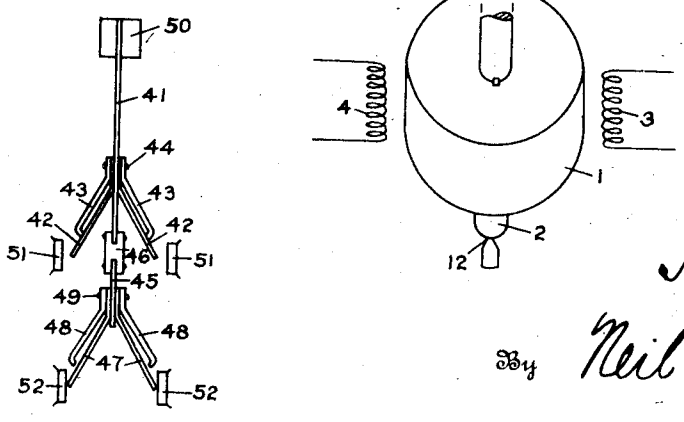


FIG. 2



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RELAY OPERATING MECHANISM

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This invention relates to relays of the three position type, and more particularly concerns a relay mechanism of this type embodying means for preventing the improper operation of the relay contacts due to stray currents in the control circuits, and to the inertia of the moving parts.

In polyphase relays of the well known three position type, suitable contacts are moved to either one of two energized positions in accordance with the phase relation between alternating currents flowing in two field windings, and are moved to a third or neutral position, upon the de-energization of the windings, by means of some suitable mechanical centering device operated by springs or weights. It is often desired that the relay contacts remain in this de-energized or neutral position until a given minimum value of current is supplied to the field windings. This is particularly true in train control practice where stray currents are sometimes encountered in the control circuits, these currents tending to operate the relay when the control currents are cut off. These stray currents are usually weaker than the control currents which normally operate the relay, and it is essential to the satisfactory operation of the train control system that the relay operate only in response to the control currents.

When the relay windings are de-energized, permitting the centering means to act on the moving parts, it is found that the rotor or operating element, together with various other moving parts of the relay, acquire such momentum that the contact operating means is carried beyond its neutral or de-energized position, thus producing an undesirable opening and closing or bobbing of the neutral relay contacts. Most railway signal and train control systems are designed on the closed circuit principle, that is, the devices employed are maintained inactive only when energized, and for this and other obvious reasons, it is essential that the control relay operation be positive and definite, and that such contacts as are closed or opened in the de-energized or neutral position of the relay will remain in such positions respectively until the relay is again energized.

With the above and other considerations in mind, it is proposed in accordance with the present invention to provide a centering means for three position relays which acts to maintain the moving parts in the neutral or de-energized position until a given minimum amount of energy is supplied to the relay windings, and further it is proposed to provide a centering means of this type which permits the full torque developed by the relay to be utilized in moving and compressing relay contacts. It is still further proposed to provide a centering means for relays of this type embodying magnetic means for preventing the false operation or bobbing of the relay contacts due to the inertia of the moving parts.

Other specific objects, advantages and characteristic features of the invention will be apparent as the description thereof progresses.

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

Fig. 1 represents the essential elements of a relay embodying the present invention in a simplified manner, the parts having been shown in perspective and vertically separated to simplify the description thereof; and

Fig. 2 is a plan view of a modified form of contact structure for use in connection with relays of this type.

Referring to the drawings, the relay of the present invention comprises in general a driving element connected through suitable reduction gearing to move a contact carrying element to its energized position, and a centering device also connected to said contact element and acting to return the contact element to its de-energized or neutral position when no torque is developed in the driving element.

The driving element may take any suitable form, and as shown comprises a cup shaped rotor 1, constructed of suitable conducting material such as aluminum, and secured to a shaft 2. Suitable distributed field windings are provided for carrying alternating con-

trol currents which are displaced in phase relation to produce a rotating or a shifting flux in the rotor 1, which flux in turn produces a torque in the rotor in the well known manner, these field windings having been conventionally represented at 3 and 4. The shaft 2 carries a pinion 5 fixed thereto and engaging a toothed sector 6 which is fixed to a second shaft 7. The shaft 7 is provided with an extension 8 comprising a disk shaped member of magnetic material such as soft iron, which is welded or otherwise rigidly secured to the shaft. The shaft 7 is connected to drive a third shaft 9 through a pinion 10 and a toothed sector 11 as shown, the shafts 2, 7 and 9 being journaled in suitable anti-friction bearings such as the pivot bearings 12. The shaft 9 carries a movable contact structure designated as a whole as CS and comprising a collar or hub 13 secured to the shaft 9 and carrying suitable contact fingers. The number and arrangement of the contact fingers may be varied to suit the particular relay to its functions, and in the form shown, four sets of contact fingers are provided, being connected in cruciform arrangement to the collar 13. Each of the sets of contact fingers comprises a pair of flexible strips 14 of conducting metal secured to the opposite sides of a block 15 which is suitably fastened to the collar 13, each of the strips 14 being bent back at its free end and held at an initial tension by the retaining clip 16. The collar 13 or the blocks 15 may be constructed of insulating material to insulate the contacts from the shaft 9 if desired. Suitable stationary contacts are mounted adjacent the contact strips 14 for engagement thereby, these stationary contacts being constructed of a suitable refractory material such as carbon. The movable and stationary contacts may be arranged to close or open various circuits in either the energized or the de-energized position of the movable contacts, and in the embodiment shown, various arrangements of stationary and movable contacts have been illustrated; each of the contacts designated at X being closed, one of the contacts of the pairs represented at Y being opened and one closed, and both of the contacts of the pair designated at Z being open when the relay mechanism is in the neutral position as shown.

Referring now to the centering device which in part comprises the present invention, two centering arms 17 and 18 are provided, being pivotally supported at one end on the fixed block or frame 19 and extending toward the shaft 7 on either side of the extension 8. The free ends of the arms 17 and 18 are provided with shoes 21 and 22 respectively, these shoes being preferably constructed of a suitable magnetic material such as soft iron, and being hingedly secured to the ends of the arms 17 and 18. The shoes 21 and 22 are adjustable, and are maintained in their adjusted positions by means of threaded rods 23 and 24 secured to or integral with the shoes, and passing freely through openings in the arms 17 and 18 respectively, the nuts 20 being provided on the outer ends of the rods 23 and 24 to permit their adjustment. The block 19 carries two side frames 25 and 26, secured thereto by screws or other suitable means, and the free ends of these frames carry a cross rod 27 and a permanent magnet 28, secured thereto in any suitable manner as by the rivets 29 and 30. The cross rod 27 passes freely through enlarged openings in the arms 17 and 18, and springs 31 and 32 are provided on these rods outside of the arms 17 and 18 respectively, being held in initial tension against the arms by the nuts 33 and 34. Two stop screws 35 and 36 are mounted in threaded openings in the arms 17 and 18 respectively, and bear against the side frames 25 and 26 respectively when the relay mechanism is in its neutral position, these screws being held in their adjusted positions by the lock nuts 37. The permanent magnet 28 is constructed of suitably tempered magnetic material, and is of general U-shape as shown, having inturned free ends or poles 39 and 40 which cooperate with the angular faces of the shoes 21 and 22 respectively when the relay mechanism is in the neutral or de-energized position.

Considering now the operation of the relay mechanism, assume that, with the relay in the de-energized or neutral position as shown, the field windings 3 and 4 are energized with alternating currents of a phase displacement to produce a torque in the rotor 1 in a clockwise direction. The initial motion of the relay mechanism in response to this torque in the rotor 1 is strongly opposed by the magnetic structure of the centering device, the permanent magnet 28 creating a flux through the magnetic circuit including the poles 39 and 40, the shoes 21 and 22 and the extension or disk 8, and thus holding the disk 8 in the neutral position as shown. The torque produced in the rotor 1 is arranged to be sufficient to overcome the resistance thus imposed by the magnet 28, and the shaft 7 is moved in a counter clockwise direction, moving the shaft 9 to its clockwise energized position where various contacts are closed and opened by the contact structure CS. The initial motion of the shaft 7 from the neutral position moves the shoe 21 together with the arm 17 connected thereto away from the pole 39 of the magnet 28, and moves the extension 8 out of engagement with the shoe 22, thus breaking the magnetic circuit at two points and rapidly increasing the reluctance of this circuit. This has the effect of rapidly diminishing the resistance offered by

the magnet 28 to the motion of the shaft 7, this resistance being reduced to a practically negligible value during the initial motion of the mechanism. As the stroke of the relay continues, the spring 31, engaging the arm 17 opposes the torque produced in the rotor 1, but the rotor, being relieved of the opposition set up by the magnet 28, rapidly moves the contact structure to the clockwise energized position and compresses certain of the flexible contact strips 14 against their corresponding stationary contacts, thus insuring an electrical connection of low resistance.

When either one or both of the relay windings 3 and 4 are de-energized, no torque is produced in the rotor 1, and the spring 31, acting through the arm 17, the shoe 21 and the extension 8 on the shaft 7, moves this shaft, together with the shafts 9 and 2 to the neutral or de-energized position. The rotor 1 as well as the other moving parts of the relay mechanism, acquire an appreciable velocity and momentum during this return motion, and when the neutral position is reached, this momentum of the moving parts tends to carry the contact element CS beyond the neutral position, and thus to cause the undesirable bobbing of the neutral contacts referred to above. The overrunning or bobbing of the mechanism is prevented by the magnetic feature of the centering device. When the neutral position is reached, the shoe 21 engages or comes into close proximity with the pole 39 of the magnet 28 at the same time that the extension 8 engages the shoe 22, thus completing a magnetic circuit of low reluctance through the magnet 28, the shoes 21 and 22 and the extension 8, the flux through this magnetic circuit tending to maintain the shaft 7, together with the rotor 1 and the other moving parts of the relay, in the neutral position against the force of the momentum acquired by the moving parts. The spring 32, acting through the arm 18 and the shoe 22 against the extension 8, also opposes this momentum of the moving parts when the neutral or de-energized position is reached, and these combined magnetic and mechanical retaining means effectively prevent the bobbing of the neutral relay contacts. As the centering device is symmetrically constructed, its operation when the relay contacts are moved to their counter-clockwise energized position is identical with the operation described above in connection with the motion of the contact structure to its clockwise energized position.

It sometimes occurs that stray currents are induced or for other reasons exist in the control circuits connected to the relay windings 3 and 4. If these currents are of phase relation to produce torque in the rotor 1, the relay will tend to operate. In the relay of the present invention, this false operation of the relay by stray currents is effectively prevented by the resistance to the intitial motion of the parts from the neutral position exerted by the magnet 28 as described above, the stray currents encountered in the control circuits being substantially weaker than the normal control currents, and therefore being incapable of producing a torque which will overcome this resistance to the initial motion of the relay parts.

The force exerted by the magnet 28 when the relay mechanism is in the neutral position may be adjusted by moving the shoes 21 and 22 toward or away from the poles 39 and 40 of the magnet 28 and thus increasing or decreasing respectively the pull exerted by the magnet by varying the reluctance of the magnetic circuit therethrough. This adjustment is conveniently accomplished by means of the nuts 20 on the rods 23 and 24 connected to the shoes 21 and 22, the shoes being hinged to the arms 17 and 18 respectively as described above.

Referring now more particularly to the contact structure shown in Fig. 2, this structure comprises a supporting bar 41, preferably constructed of a suitable conducting material which carries a pair of flexible contact strips 42. The contact strips 42 are preferably constructed of a resilient flexible conducting material, and are held in an initially tensioned position by means of the retaining clips 43, the strips 42 and the clips 43 being secured to the bar 41 by suitable means such as the rivet 44. A second supporting bar 45 is secured to the end of the bar 41 by means of an insulating block 46, and suitable resilient contact strips 47 having retaining clips 48 are secured to the bar 45 by the rivet 49 as clearly shown. The entire structure is supported by the bar 41 from a suitable movable element 50 which may be a collar similar to the collar 13 shown in Fig. 1, or may be any other movable part of a relay mechanism. The arrangement of the stationary contacts which cooperate with the contact strips 42 and 47 may be varied to suit the conditions encountered in practice, but in the form shown, the arrangement is such that one closed and two open neutral contacts are provided, the stationary contacts 51 being out of engagement with the corresponding contact strips 42, and the stationary contacts 52 being engaged by the contact strips 47 when the mechanism is in the neutral position as shown. This arrangement of the contacts on a single arm or bar 41 permits a large number of possible contact arrangements to be provided in a very compact and simple structure.

As the relay structure of the present invention has been described in connection with certain specific mechanical elements arranged in a single specific manner, it should be clearly understood that the invention is not limited in its scope to the exact elements

or arrangement shown except to the extent indicated by the appended claims.

What it is desired to secure by Letters Patent is:—

1. In a relay, a movable contact element having two operated positions, electrically operable means for moving said element to one of said positions, mechanical means for moving said element to the other of said positions, said element being constructed to allow it to move beyond said positions, and magnetic means for exerting a magnetic force for stopping and retaining said element in one of said positions.

2. In a relay, a movable contact element for resiliently engaging stationary contacts in an energized position and in a de-energized position, and being mechanically free to overrun, electro-magnetically operable driving means for moving said contact element to said energized position, spring means for moving said contact element to said de-energized position and magnetic means for magnetically stopping and holding said element in said de-energized position.

3. In a relay, a movable contact element having an energized position and a neutral position, an electro-magnetically operable driving means mechanically connected to said contact element through reduction gearing and adapted to move said contact element to said energized position, a spring operated centering device mechanically connected to said contact element and acting to move said element and said driving means to said de-energized position, and magnetic means for preventing the momentum acquired by said driving means and said contact element from carrying said parts past said neutral position when moved by said centering device.

4. In a relay, a movable contact element having a neutral position and two energized positions, electro-magnetically operable driving means for moving said contact element to either of said energized positions from said neutral position, and a centering device comprising spring means for moving said contact element from either of said energized positions to said neutral position and magnetic means for maintaining said contact element in said neutral position.

5. In a relay, a movable contact element adapted to control electrical circuits and having an energized position and a neutral position, an electro-magnetically operable rotor connected to operate said contact element from said neutral position to said energized position, and a centering device for moving said contact element and said rotor from said energized position to said neutral position, said centering device having magnetic means for strongly opposing the initial motion of said contact element from said neutral position to said energized position.

6. In an induction type relay, a movable contact element having a neutral position and two energized positions, a shaft mechanically connected to said contact element, an electro-magnetically operable rotor connected to said shaft for moving said contact element and said shaft to either of said energized positions from said neutral position, an extension rigidly secured to said shaft, two spring pressed pivotally mounted arms engaging said extension for moving said shaft and said contact element to said neutral position from either of said energized positions, and magnetic means associated with said arms for maintaining said shaft and said contact element in said neutral position.

7. In a relay, a movable contact element comprising initially tensioned flexible contacts in cruciform arrangement, stationary contacts adapted to be engaged by certain of said flexible contacts when said contact element is in a neutral position and by others of said flexible contacts when said contact element is in an energized position, electrically operable means for moving said contact element to said energized position, spring means for moving said contact element to said neutral position, and magnetic means for maintaining said contact element in said neutral position.

8. In a relay, a movable contact element having an energized position and a de-energized position comprising, an arm carrying a plurality of sets of initially tensioned contact fingers, stationary contacts arranged to engage certain of said fingers when said element is in said energized position, and certain others of said fingers when said element is in said de-energized position, electro-magnetically operable means for moving said contact element to said energized position and mechanical means for moving said contact element to said de-energized position.

9. In a relay, a contact member having a neutral and two energized positions, means for driving the member to either energized position, and a centering device operable to return the member to neutral position and including magnetic means comprising a magnetic circuit of relatively low reluctance arranged to be changed to one of relatively high reluctance upon movement of the member away from neutral position to either energized position.

10. In an induction type relay, a movable contact element having a neutral position and two energized positions, a shaft mechanically connected to said contact element, an electro-magnetically operable rotor connected to said shaft for moving said contact element and said shaft to either of said energized positions from said neutral position, an extension rigidly secured to said shaft, two spring pressed pivotally mounted arms for moving said shaft and said contact element to said neutral position from either of said

energized positions, a shoe of magnetic material at the end of each said arm and engaging said extension when the contact element is in neutral position, magnetized means interconnecting said shoes when the contact element is in neutral position to form a substantially closed magnetic circuit including said extension, shoes and magnetized means, for stopping and holding said contact element in neutral position.

11. In an induction type relay, a movable contact element having a neutral position and two energized positions, a shaft mechanically connected to said contact element, an electro-magnetically operable rotor connected to said shaft for moving said contact element and said shaft to either of said energized positions from said neutral position, an extension rigidly secured to said shaft, two spring pressed pivotally mounted arms for moving said shaft and said contact element to said neutral position from either of said energized positions, a pivoted, adjustable shoe of magnetic material at the end of each said arm and engaging said extension when the contact element is in neutral position, a magnetizable core interconnecting said shoes when the contact element is in neutral position to form a substantially closed magnetic circuit including said extension, shoes and magnetized means, for stopping and holding said contact element in neutral position.

12. In an induction type relay, a movable contact element having a neutral position and two energized positions, a shaft mechanically connected to said contact element, an electro-magnetically operable rotor connected to said shaft for moving said contact element and said shaft to either of said energized positions from said neutral position, an extension rigidly secured to said shaft, two spring pressed pivotally mounted arms for moving said shaft and said contact element to said neutral position from either of said energized positions, a shoe of magnetic material at the end of each of said arms and engaging said extension when the contact element is in neutral position, magnetized means interconnecting said shoes when the contact element is in neutral position to form a substantially closed magnetic circuit including said extension, shoes and magnetized means, said extension operating, upon movement of said contact element from its neutral position, to move away from one of said shoes, and to move the other of said shoes away from said magnetized means whereby to initially strongly resist movement of said contact element away from its neutral position.

In testimony whereof I hereby affix my signature.

HERBERT B. TAYLOR.