

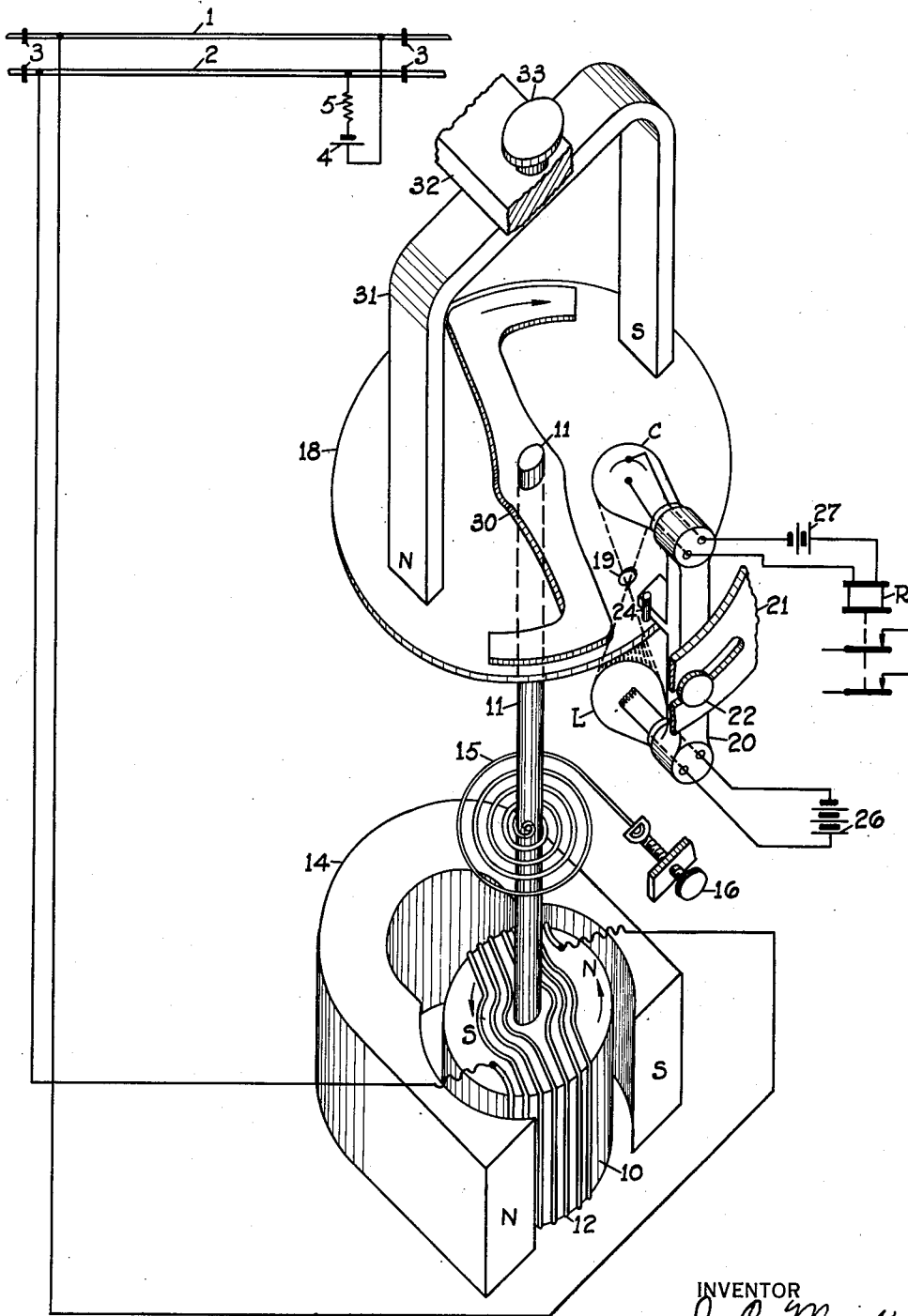
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J. C. MOCK

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TRACK CIRCUIT FOR RAILROADS

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INVENTOR
BY *J. C. Mock,*
Neil H. Preston,
his ATTORNEY

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TRACK CIRCUIT FOR RAILROADS

James C. Mock, Detroit, Mich., assignor to General Railway Signal Company, Rochester, N. Y.

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This invention relates to track circuits for railroads, and more particularly to relay means for such track circuits.

The usual tractive type relay has certain operating characteristics which are not particularly suited for detecting small current changes such as produced in a railway track circuit. The principal objectional characteristic being that the ordinary tractive type relay requires a considerable larger energizing current to raise its armature from its released to its attracted position than is required to retain the armature in its attracted position, this being due primarily to the fact that the air-gap or reluctance of the operating magnetic structure is considerably greater when the armature is in its released position than when in its attracted position. Consequently, when this type of relay is employed in a railway track circuit, its normal energization must be considerably in excess of the value which releases its armature in order to insure its attraction from its released position so that proper operation is only provided by a train shunt producing a rather large reduction in the track circuit current.

In view of the above and other considerations, it is proposed in accordance with the present invention to provide a sensitive relay means having operating characteristics adapted to conform with the limitations in the current variations of a track circuit, rather than the operation of contacts. More specifically, it is proposed to provide an electro-responsive means having a uniform air-gap and acting through the agency of a light responsive means, or the like, to control the operation of a repeating relay which actuates the contacts ordinarily operated by the track relay itself.

Other objects, purposes and characteristic features of the present invention will be in part apparent and in part explained as the description thereof progresses, during which references will be made to the accompanying drawing which illustrates in a simplified and diagrammatic manner one specific embodiment of the present invention.

The present invention contemplates the usual track circuit organization in which the track rails 1 and 2 are bonded in the usual manner with insulated joints 3 defining the ends of the track circuit, and with a battery 4 connected across the track rails at one end of this section in series with the usual limiting resistance 5.

The electro-responsive or actuating element of the present relay means is connected to the

track rails at the other end of the track section, and is of the type having a uniform air-gap and providing an operating torque varying substantially in accordance with the current supplied to it from the track rails. An electro-responsive actuating element providing such operating characteristics is found, for example, in a device of the galvanometer or movable coil type, structurally organized similar to ammeters and other measuring instruments. An electro-responsive device of this type is disclosed, for example, in the patent to H. O. Holte, No. 1,737,761, granted December 3, 1929.

The electro-responsive actuating element herein shown comprises a cylindrical magnetic member 10 mounted on a vertical shaft 11 supported by suitable bearings not shown, the magnetic member 10 carrying a suitable coil 12 wound therearound to provide a two pole magnetic rotor which is disposed in a rather strong magnetic field provided by a permanent magnet 14. It is of course understood that the cylindrical magnetic member 10 can be stationary to then form a magnetic core and the coil 12 on a suitable form could alone be attached to shaft 11 to then rotate around the magnetic member 10 which is the usual instrument construction.

The ends of the coil 12 are connected across the track rails as shown in the same manner as the ordinary track relay, and the track circuit current is herein considered to flow through the coil 12 in a direction tending to produce counterclockwise rotation of the cylinder 10 and shaft 11. It will now be clear that the coil 12 wound around the cylindrical rotor 10 will have a magnetic circuit of constant reluctance due to its uniform air-gap regardless of its rotated position, and hence a torque will be provided which varies substantially in accordance with the energization of the coil 12, or in this case in accordance with the interrail voltage.

A spiral spring 15 is attached at its inner end to the shaft 11 with its outer end anchored by an adjusting screw 16 to thus exert a torque biasing the shaft 11 in a clockwise direction in opposition to the magnetic torque produced by the energization of coil 12. The spring 15 is arranged to produce a biasing torque increasing with the counterclockwise rotation of shaft 11 and the intensity of this variable biasing torque may be adjusted by turning screw 16.

A shutter 18 shown in the form of a disc preferably of non-magnetic material is attached to the upper end of shaft 11 and is provided with

an opening or window 19. A bracket shown as a substantially E-shaped member 20 is adjustably mounted on a stationary supporting member 21 by a screw 22 in a manner permitting the bracket 20 to be adjustably positioned about the edge of the shutter 18. A lower portion of the bracket 20 carries an electric lamp L in a position beneath the shutter 18, while a similar upper portion of bracket 20 carries a light sensitive cell C in a position above the shutter 18.

A stop for limiting the energized or counterclockwise rotation of the shutter 18 is provided by a pin 24 engaging a center extension of the bracket 20, and in such a stopped position, the window 19 is positioned to transmit light from the incandescent lamp L to the cell C. The lamp L is normally energized to incandescence from a suitable source of energy such as a battery 26, and the light sensitive cell C may be of the usual photo-electric type which will pass an effective amount of current from a battery 27 to a repeating relay R only when receiving light from the lamp L. The repeating relay R operates contacts ordinarily associated with the track relay for controlling the block signalling circuits and the like.

In order to provide a desired critical point in the operating characteristic of the present relay means, a supplemental biasing means is provided in addition to the biasing spring 15. This supplemental bias is herein provided magnetically by a Z-type magnetic armature 30 shown as attached to the upper surface of the shutter 18 and operable beneath the lower ends of a permanent magnet 31 by a clock-wise rotation of the shutter 18 from its illustrated position. The permanent magnet 31 is suspended from a stationary supporting member 32 by a means herein represented by screw 33 for adjustably positioning the magnet 31 about an axis aligning with shaft 11.

In applying the present relay means to a railway track circuit, the winding 12 is energized while the track section is unoccupied with a normal track circuit current which varies slightly according to the interrail ballast resistance, but it will herein be considered that these variations do not approach the degree of variation caused by the application and removal of a train shunt. It is considered advisable to adjust the present relay means in accordance with the lowest ballast resistance which provides the minimum normal current in coil 12, and under such conditions, the E-shaped member 20 may be adjusted in the supporting bracket 21 to a point about the edge of the shutter 18 where this current in coil 12 produces the maximum counterclockwise torque with the stop pin 24 resting against member 20.

The permanent magnet 31 is now positioned as shown so that its lower ends are slightly displaced in a clock-wise direction from the ends of the Z armature 30, or so that a minimum of clock-wise magnetic biasing torque is provided thereby, and the clock-wise biasing torque of spring 15 may then be increased by turning screw 16 to a point where the pin 24 engages the member 20 with a force just sufficient to reliably hold the shutter 18 in its normal position against jars and vibrations.

It will now be seen that when the track section is unoccupied, the present adjustment of the relay means under the minimum track circuit current positions the shutter 18 at a point which passes light from lamp L through its window 19 to the light sensitive cell C, thereby hold-

ing relay R in its attracted position, and in the event the ballast resistance increases, the current in coil 12 will increase slightly but this will merely increase the force engaging pin 24 with member 20 but will not change the position of the shutter 18. However, when a train enters the track circuit, the current in coil 12 is reduced in the usual manner below the minimum normal current under which these adjustments were made, and consequently the clock-wise biasing torque of spring 15 overcomes the counterclockwise magnetic torque which is proportionally reduced and operates the shutter in a clock-wise direction to exclude the light of lamp L from the cell C, thereby releasing relay R.

It is contemplated that the biasing magnet 31 may be adjusted vertically or turned horizontally in a manner to effectively coact with the Z armature 30 only after the shutter 18 has moved out of its normal position, and to thereafter provide a progressively increasing clock-wise biasing torque acting to accelerate the initial movement of the shutter 18. In other words, it is contemplated to adjust the magnet 31 relative to the Z armature 30 so that a current decrease in the coil 12, which is sufficient to effect a movement of the shutter 18 out of its normal position to exclude light from cell C, moves the Z armature 30 into a position to be influenced sufficiently by the magnet 31 to continue this movement of the shutter 18 to a certain limited extent.

It is of course obvious that in adjusting the bias provided by the Z armature 30, consideration must be made for restoring the shutter 18 to its normal position by the increase of the energization of coil 12 to its normal value. In other words, when the train departs from the track section, the current in coil 12 returns substantially to its normal value, and the torque produced by this normal current value in coil 12 must exceed the torque tending to retain the Z armature 30 beneath magnet 31 plus the reduced torque of spring 15 due to its unwound position.

In this manner, the present electro-responsive device may be regulated to assume a definite position while the track section is unoccupied regardless of minor variations in track circuit current such as caused by changes in interrail ballast resistance, but when the track rails are shunted, the energization of the operating coil is reduced below a critical value to initiate operation of the shutter after which a supplemental magnetic biasing means becomes effective to amplify or continue this movement. The biasing torque tending to hold the shutter in this released position, however, is only amplified to a degree slightly less than the opposing magnetic torque which is produced upon the increase of the track circuit current in the operating coil to its normal value, so that when the train shunt is removed from the track section, the normal track circuit current operates the shutter back to its normal position.

An electro-responsive device has thus been provided wherein energization of the actuating coil above a certain critical point operates the moving parts into their normal position, while a very slight reduction of this energization below the same critical point has a certain "trigger" action of initiating operation of the moving parts into the influence of a supplemental magnetic biasing means which is effective to continue this operation to a point where the moving parts can only be restored to their normal position by an in-

crease in the degree of energization of the operating coil above said critical value.

An electro-responsive device operating in this manner has the obvious advantage of responding to a much smaller degree of change in its energization than could possibly cause a response of a tractive type relay, and inasmuch as the present device controls an electrical circuit without the use of mechanical contacts, a response having the torque or power ordinarily required in a contact operating relay is not necessary, thus permitting still greater sensitivity and reliability to be provided by such a device.

A further advantage of the present relay means particularly when used in a track circuit is provided by the so-called "trigger" action whereby a high resistance and a fluctuating shunt can initiate a response of the present relay means which is thereafter continued by a supplemental biasing means to a position wherein the actuating element cannot directly respond to minor current variations caused by subsequent fluctuations in shunt resistance, and wherein the normal condition of the relay means can only be restored by the departure of the train to restore the normal energization of the actuating element.

It will also be clear that only one polarity of energization of the present actuating element can cause an operation of the shutter 18 to a position energizing relay R. This feature prevents the possibility of improperly picking up relay R due to stray energy of a reverse polarity such as from an adjacent track circuit.

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

What I claim is:—

1. In a track circuit, a contact operating relay, a light source and a photo-electric cell for controlling the energization of the relay, electro-responsive means energized by the track circuit and controlling the supply of light from the source to the cell, spring biasing means opposing movement of the electro-responsive means with a force increasing with said movement, and supplemental biasing means opposing movement of the electro-responsive means with a force decreasing with said movement.

2. In a track circuit, a contact operating relay, a light source and a photo-electric cell for controlling the energization of the relay, electro-responsive means energized by the track circuit and controlling the supply of light from the source to the cell, spring biasing means opposing movement of the electro-responsive means with a force increasing with said movement, and a magnetic biasing means opposing movement of the electro-responsive means with a force decreasing with said movement whereby to provide a critical point in the response of the electro-responsive means to changes in the energization of the track circuit.

3. In a track circuit, a coil in the track circuit movable in a magnetic field to provide a torque substantially proportional to the track circuit current, a first and a second biasing means each opposing the torque of the coil, the first biasing means having a torque varying in a different relation to the movement of the coil than that of the second biasing means, whereby to provide a critical point in the response of the moving coil to changes in the track circuit current.

4. In a track circuit, a coil in the track circuit movable in a magnetic field to provide a torque substantially proportional to the track circuit current, a first and a second biasing means each opposing the torque of the coil, said biasing means being relatively adjustable to provide a non-linear relation between the movement of the coil in response to changes in track circuit current above and below a predetermined value.

JAMES C. MOCK.