March 20, 1934. V. HAVENNER ET AL 1,951,409

ELECTRIC CIRCUIT CLOSER

Filed June 30, 1930 2 Sheets-Sheet 1

FIG. 1.

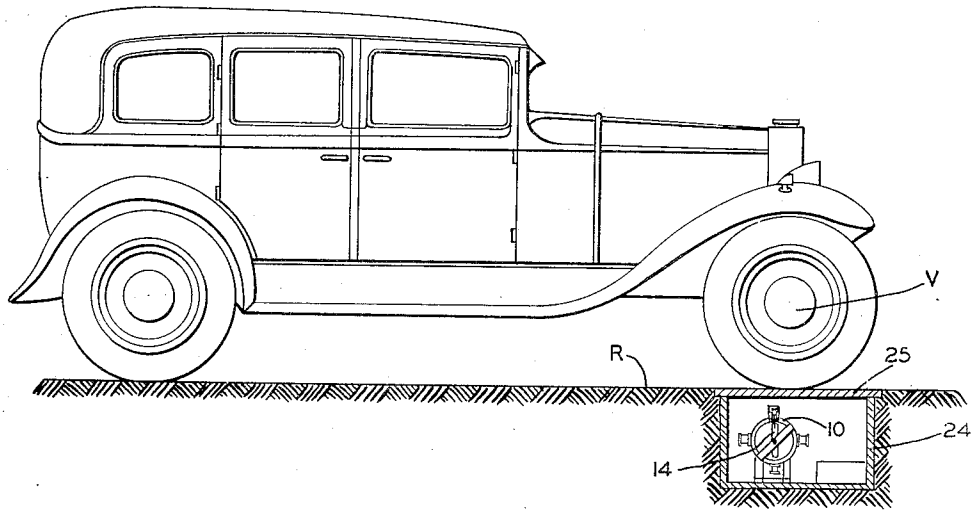
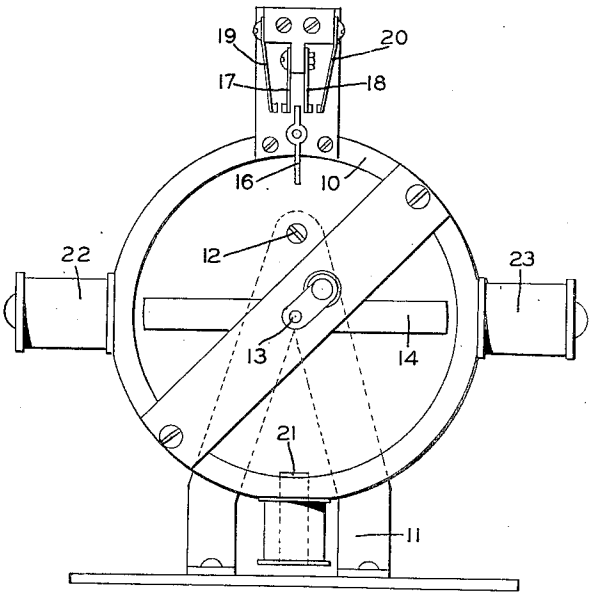


FIG. 2.



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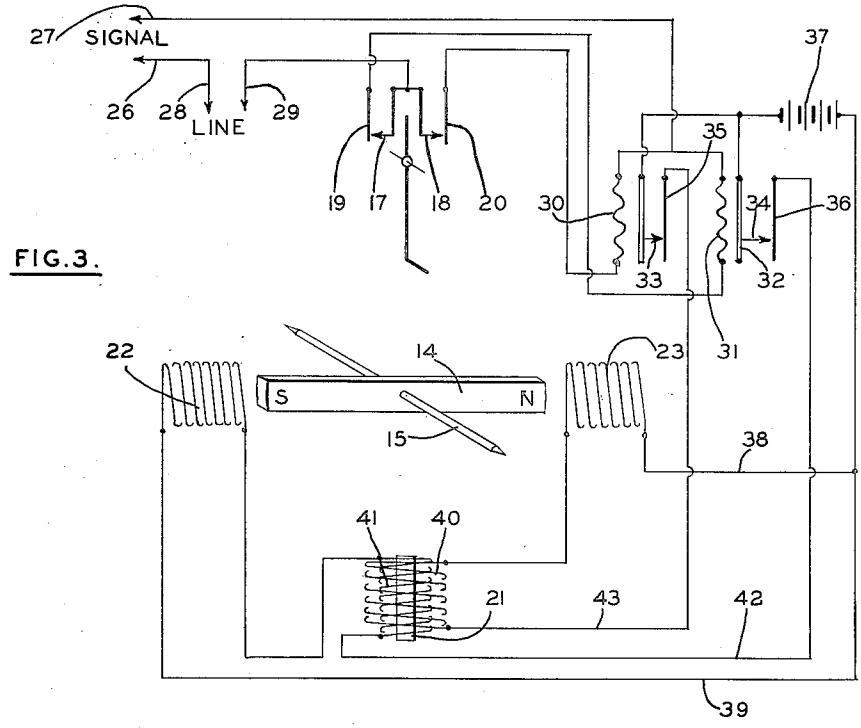


FIG. 3.

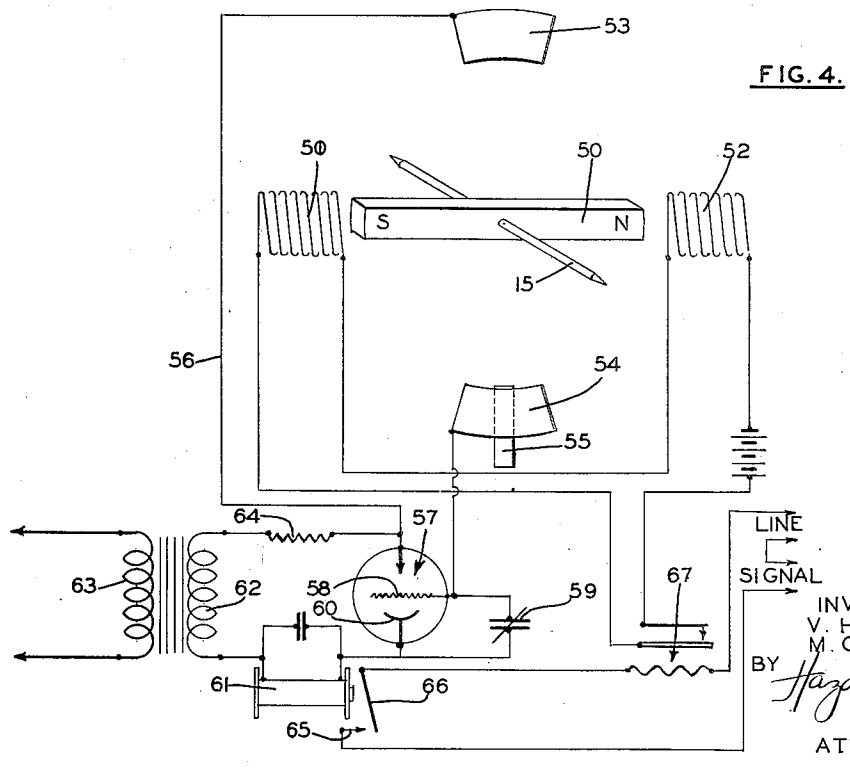


FIG. 4.

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Patented Mar. 20, 1934 1,951,409

UNITED STATES PATENT OFFICE

1,951,409

ELECTRIC CIRCUIT CLOSER

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Application June 30, 1930, Serial No. 464,907

2 Claims. (Cl. 175—375)

This invention relates to improvements in electric circuit closers.

An object of the invention is to provide an improved electric circuit closer which is in the nature of a magnet suspended in equilibrium, and which is adapted to be influenced or disturbed by the approach of moving masses of magnetic or magnetizable materials without coming in direct contact therewith, and which when thus disturbed or influenced will close an electric circuit. While the invention may be used under a large number of different circumstances, it has been primarily designed for use in roadways to close the circuit operating a traffic signal. In the improved arrangement the magnet which is supported or suspended in equilibrium is embedded in the roadway beneath the surface thereof. An approaching vehicle having a material part of its construction formed of iron or steel, either magnetized or non-magnetized, will disturb the magnet although it does not come in direct contact therewith. The movement of the magnet serves to close the circuit of the traffic signal so that a vehicle approaching an intersection will operate the device and thus operate the traffic signal to receive the right of way across the intersection. Such use of the invention is particularly advantageous upon a long well traveled boulevard which is traversed by side streets which are less frequently used. In this manner the traffic on the boulevard may be allowed to run continually and will only be stopped when a vehicle approaches the boulevard from a side street. It will be readily appreciated that such a system is highly advantageous over timed traffic signals which operate to give the side streets the right of way regardless of whether there is an approaching vehicle in them or not.

The invention is not restricted in its use to traffic signals but may be employed in driveways leading to garages to operate an electric circuit which will open or close garage doors. Other analogous uses may be briefly mentioned as use on railroads to operate block signals, and in office buildings adjacent elevators to operate signals and the like.

Another object of the invention is to provide an electric circuit closer comprising a permanent magnet suspended or supported in equilibrium and which is adapted to be influenced by an approaching mass of iron or steel to close the circuit, and to provide means for resetting the magnet in its initial position preparatory to a subsequent operation after the circuit has been closed for a predetermined length of time.

With the foregoing and other objects in view, which will be made manifest in the following detailed description, and specifically pointed out in the appended claims, reference is had to the accompanying drawings for an illustrative embodiment of the invention, wherein:

Fig. 1 is a view illustrating the apparatus embodying the invention as having been embedded in a roadway and illustrating it as being actuated by an over-passing vehicle.

Fig. 2 is a view in elevation of the mechanism embodying the invention.

Fig. 3 is a diagrammatic view illustrating one form of electric circuit used in conjunction with the mechanism to illustrate the manner in which the electric circuit is closed and the manner in which the apparatus may be reset.

Fig. 4 is a view similar to Fig. 3 illustrating another electric circuit which may be used in conjunction with the apparatus illustrated in Fig. 2, accomplishing the same functions.

Referring to the accompanying drawings, wherein similar reference characters designate similar parts throughout, the device illustrated is shown as comprising a cylindrical housing 10 preferably formed of aluminum or other material which is not influenced by magnetic flux. This housing is mounted for rotational adjustment on a suitable base or standard 11, screw 12 enabling the housing to be rotatably adjusted. On the front and rear sides of the housing jewel bearings 13 are mounted centrally of the housing, such bearings being preferably employed for antifriction purposes. Within the housing 10 there is disposed a permanent magnet, illustrated as being in the form of a bar magnet 14, formed of cobalt steel or its equivalent which is capable of being highly magnetized and retaining its magnetism. Centrally of this bar magnet there is a spindle 15 the ends of which are supported by the jewel bearings 13. The arrangement of the spindle 15 is such as to support the magnet 14 in perfect balance or in perfect equilibrium although the magnet may be freely rotated on the bearings.

At the top of the housing 10 there is pivotally mounted a lever 16, the lower end of which is adapted to be engaged by the magnet 14 when the magnet is rotated. The upper end of the lever is adapted to engage either of a pair of contacts 17 and 18, adjacent which there are corresponding contacts 19 and 20. In other words if the magnet is rotated regardless of the direction of rotation one end of the magnet will engage lever 16 and swing it, causing its upper end to

move either of the contacts 17 or 18 into engagement wtih their respective opposed contacts 19 or 20. At the bottom of the housing there is mounted a small body of non-magnetized material 21, preferably soft iron so that it can be magnetized. On the sides of the housing 10 there are coils 22 and 23 which are supplied with current as will hereinafter be described. The coils are so arranged that if energized by a common source of direct current, one coil will generate a magnetic flux the north pole of which is toward the center of the housing and the other coil will generate a magnetic flux the south pole of which is toward the center of the housing.

The above described mechanism is preferably installed within a suitable casing 24, having a cover 25, and embedded in the roadway R, the casing and cover likewise being formed of non-magnetizable material so as to be incapable of influencing magnet 14.

The bar magnet 14 is normally in a horizontal position as shown in Figures 2, 3 and 4. However, when a vehicle V moving along the roadway R approaches the mechanism, the magnet 14 will be influenced thereby and disturbed. The mass of iron or steel in the construction of the vehicle need not be magnetized although if magnetized its influence on the bar magnet 14 will be much more pronounced. A non-magnetized body of steel in the vehicle V will attract one pole of the bar magnet 14, causing this end of the bar magnet to swing upwardly into the position shown in Figure 1. As soon as the position of the bar magnet is disturbed, one pole thereof will be nearer the body of soft iron 21 than the other. This pole having a greater influence on the body of soft iron induces magnetism of the opposite polarity therein and in this manner the induced pole in the body of soft iron being opposite in polarity from the inducing pole on the magnet attracts downwardly the approaching end of the magnet, urging the magnet to be quickly swung into a vertical position. In this vertical position lever 16 is engaged and one of the pairs of contacts will be closed and held in closed position by virtue of the magnet being continually attracted to the soft iron 21.

It will thus be appreciated that the improved construction produces a closing of an electric circuit by the mere approach of a magnetic or magnetizable mass and that it is not necessary for the vehicle to come in direct contact with the operating mechanism. This is a decided advantage in that circuit closers requiring direct contact when used in roadways are subject to damage and frequently get out of working order.

In Figure 3 the circuit diagram illustrated shows a pair of conductors 26 and 27 leading to the signal or other load and thus forming a part of the load circuit. This load circuit is supplied with electric current from any suitable source, such as by conductors 28 and 29. Conductor 29 leads to the two contacts 17 and 18 and the contacts 19 and 20 are connected respectively to thermostatic switches 30 and 31. The particular form of thermostatic switch indicated is immaterial and any conventional switch may be employed. As illustrated, however, each thermostatic switch comprises a heating element adjacent which there is a bimetallic member 32 which, when heated, will be warped and move its contact 33 or 34, as the case may be, into engagement with opposed contacts 35 and 36. Contacts 33 and 34 are connected to one side of a battery 37, or other suitable source of direct current. The other side of the battery is connected to a divided circuit, one side of which is indicated at 38 and the other side of which is indicated at 39. The side 38 contains coil 23 and one of two coils 40 and 41 disposed about the soft iron mass 21. From this coil 40 conductor 42 leads to contact 36. The other side of the circuit 39 contains coil 22 and coil 41, from which conductor 43 leads to contact 35. The coils 22 and 23 are so arranged that one coil generates a south pole magnetic flux toward the center of the bar magnet or armature while the other coil generates a north pole magnetic flux. As illustrated in the drawings, coil 22 generates a north magnetic flux toward the bar magnet and coil 23 generates a south magnetic flux. Coil 40 which is in series with coil 23 generates a north magnetic flux when energized toward the bar magnet and coil 41 when energized generates a south magnetic flux.

When the bar magnet is in the vertical position it engages lever 16, causing lever 16 to close contacts 17 and 19 or 18 and 20. Assuming that the south pole of the bar magnet has been attracted upwardly, contacts 17 and 19 will be closed, closing the load circuit. At the same time the heating element of the thermostatic switch is being heated, causing the bimetallic member 32 to be warped. In the course of a short time contact 34 will engage contact 36, closing the circuit through coils 23 and 40. As coil 40 generates toward the bar magnet a north magnetic flux, it will repel the lower end of the bar magnet. At the same time as coil 23 generates a south magnetic flux toward the bar magnet, it will attract the lower end of the bar magnet. In this manner coils 23 and 40 cooperate to return the bar magnet to its normal position, overcoming the attraction that the bar magnet has for the soft iron mass 21. When the bar magnet disengages lever 16, contacts 17 and 19 open, breaking the load circuit and allowing the thermostatic switch to cool, causing contacts 34 and 36 to separate. As soon as they are separated the direct current circuit through coils 23 and 40 is broken and the bar magnet is then free to be influenced by another approaching vehicle.

It will be noted that by this arrangement wherein a certain length of time is required for the thermostatic switch to heat, that during this period of time the load circuit remains closed so that the load circuit is closed by the bar magnet for a predetermined length of time. After the load circuit is opened an appreciable length of time is required for the thermostatic switch to cool before contacts 34 and 36 can open and thus break the circuit through coils 23 and 40. By thus keeping coils 23 and 40 energized for an appreciable length of time after the load circuit is open, it is impossible to consecutively close the load circuit without an appreciable length of time intervening. This prevents vehicles approaching a boulevard from a side street in fairly quick succession from continually closing the load circuit and monopolizing the right of way.

It will be readily appreciated that in the event the north pole of the bar magnet was attracted upwardly, that contacts 18 and 20 would be closed, closing the load circuit and causing the thermostatic switch to close contacts 33 and 35. This would cause coils 22 and 41 to be energized, the south magnetic flux generated by coil 41 serving to repel the south pole of the bar magnet and the north magnetic flux of coil 22 serving to attract the south pole of the bar mag-

net to restore the bar magnet to its original position.

In Figure 4 a modified circuit is illustrated. In this arrangement the bar magnet is designated by the reference character 50, having adjacent coils 51 and 52 similar to coils 22 and 23. At the top and bottom of the housing there are small bodies of aluminum or similar material indicated at 53 and 54. It is intended that the bar magnet merely swing adjacent these bodies without coming in contact therewith. In the lower body there is a mass of soft iron 55 similar in construction and serving the same purpose as the soft iron mass 21. The upper body of aluminum 53 is connected by conductor 56 to one contact of a thermionic tube 57. The grid 58 is connected to the body 54 and also through a variable condenser 59 to the opposite terminal of the tube, indicated at 60. This terminal of the tube is connected through a relay switch 61 to the secondary 62 of an alternating current transformer. The primary of the transformer is indicated at 63. The opposite side of the secondary is connected through a resistance 64 to conductor 56. The relay switch when energized closes contacts 65 and 66 which control the load circuit. The load circuit contains a single thermostatic switch 67 which opens and closes the direct current circuit containing coils 51 and 52.

While many different forms of thermionic tubes might be employed in this circuit, we prefer to employ what is now generally known to the trade as a "Knowles grid glow tube". When the bar magnet 50 is influenced by an approaching magnetizable mass it swings into the vertical position and is held in this position by the attraction to the soft iron body 55. While the bar magnet 50 does not contact the aluminum bodies 53 and 54, it forms a small condenser with these bodies. This condenser effect is sufficient to cause a current discharge or current flow to take place through the tube 57, causing the relay switch 61 to be actuated, closing contacts 65 and 66, and thus closing the load circuit. When the load circuit is closed the thermostatic switch 67 begins to operate and eventually closes the direct current circuit through coils 51 and 52. The effect of these coils being energized is to restore the bar magnet 50 to its initial position, disappointing the condenser action between the bar magnet and the aluminum bodies 53 and 54. This stops current flow through the tube 57, opening contacts 65 and 66, and in the course of a short time thereafter the thermostatic switch cools and opens the circuit through coils 51 and 52, leaving the bar magnet in freely suspended or balanced horizontal position so as to be capable of being influenced by a subsequent approaching mass of magnetizable material.

In the above description the bar magnet has been described as assuming a normal horizontal position. This has been adopted for purposes of simplicity. However, in installing the construction in a roadway where the plane of rotation of the bar magnet is due north and south, or approaches it, the bar magnet will tend to assume a normal position which is inclined due to the declination of the earth's magnetic field. Under such circumstances the housing is rotatably adjusted on screw 12 so that the ends of the magnet when in normal position will be equi-distant from the lower end of lever 16 and the coils 22 and 23 or 51 and 52, as the case may be, will be opposite the ends of the bar magnet when the bar magnet is in its normal position.

In some instances also adjacent bodies of steel, such as street car tracks, sewer pipes and the like will cause the bar magnet to assume a normal position which is other than horizontal. Likewise under these circumstances the housing is rotatably adjusted to compensate for the non-horizontal normal position of the bar magnet.

It sometimes occurs that a street car track or sewer pipe or other influencing construction which is relatively long is close to the construction. Under these circumstances we find it advantageous to so position the housing that the plane of rotation of the bar magnet will be parallel to the length of the street car track, sewer pipe, or the like, so that the influencing effect of the adjacent street car track, or sewer pipe, will be substantially neutralized. It is further contemplated within the scope of the invention to position compensating permanent magnets in the neighborhood of the bar magnet to compensate for outside influences in a manner similar to that which is employed on mariners' compasses.

From the above described construction it will be appreciated that a novel, simple and advantageous circuit closer is provided adapted to produce the closing of a circuit by the mere approach of a moving body of steel. All moving parts are inclosed and do not come in direct contact with the moving body. By virtue of this construction the parts are adequately protected from damage or abuse. As previously stated, the device may be advantageously employed for operating traffic signals but may be used under a large variety of other circumstances, such as opening and closing garage doors, operating block signals, operating elevator signals, and the like. In fact the device can be used under any circumstance where it is desired to close an electric circuit on the approach of a moving mass of either magnetized or magnetizable material.

Various changes may be made in the details of construction without departing from the spirit or scope of the invention as defined by the appended claims.

We claim:

1. In mechanism of the class described, a circuit closer, an oscillatory permanent bar magnet supported in normal equilibrium on a horizontal pivot and adapted to be attracted, by the direct effect thereon of a mass of iron when presented within the area in which the lines of force of said magnet are effective, means cooperable with the magnet when the normal position or longitudinal declination thereof has been disturbed for acting upon the circuit closer, means for restoring the magnet to a normal position after the circuit closer has been acted upon for a predetermined length of time, means for preventing another operation of the co-operable means until the expiration of a predetermined interval of time, and means for holding the magnet in a definite position relative to the co-operable means and the said restoring means as may depend upon a tendency of the magnet to assume a position induced by the declination of the earth's magnetic field when the vertical plane of rotation of the magnet is due north and south or approximately so.

2. An organization of the class described comprising a circuit closer, means for actuating said circuit closer and embodying an oscillatory permanent magnet correlated therewith and nor-

mally suspended in equilibrium from a horizontal axis so that when a mass of iron is presented within the area in which the lines of force of said magnet are effective and whose attraction is reciprocal relative to the normal attraction exerted by said magnet, motion will be imparted to the magnet in a vertical plane to effect actuation of said circuit closer, and means co-operable with said magnet for effecting a return of the magnet to a normal position at the end of a predetermined time.

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