K. L. LEHMANN.

RAILWAY SIGNALING DEVICE.

APPLICATION FILED JAN. 8, 1921.

1,413,667.

Patented Apr. 25, 1922.

4 SHEETS—SHEET 1.

Fig. 1

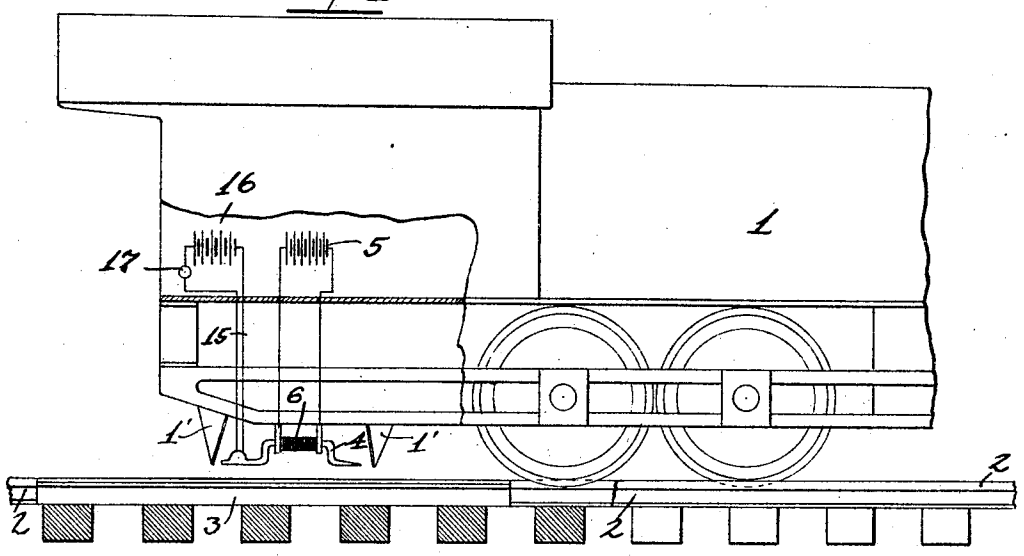
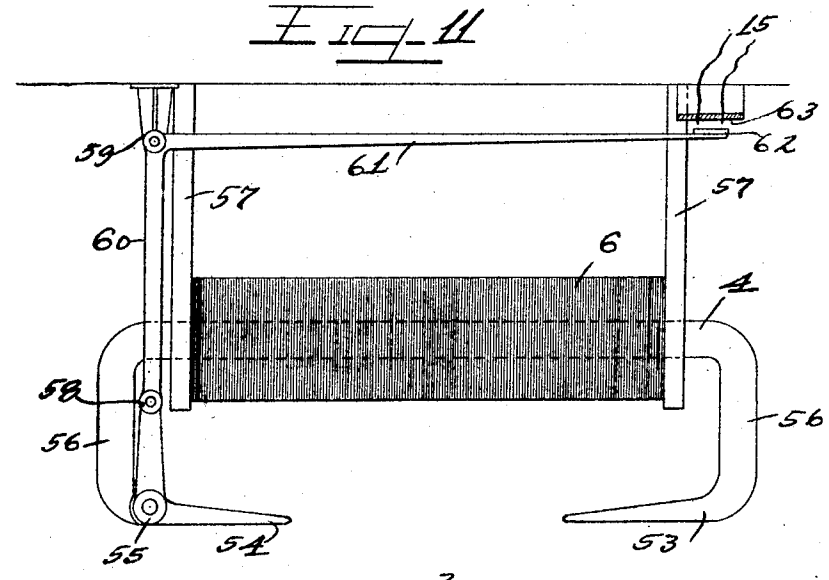
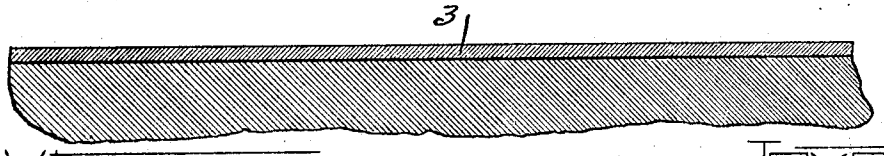


Fig. 11





Witnesses

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4 SHEETS—SHEET 2.

FIG. 3

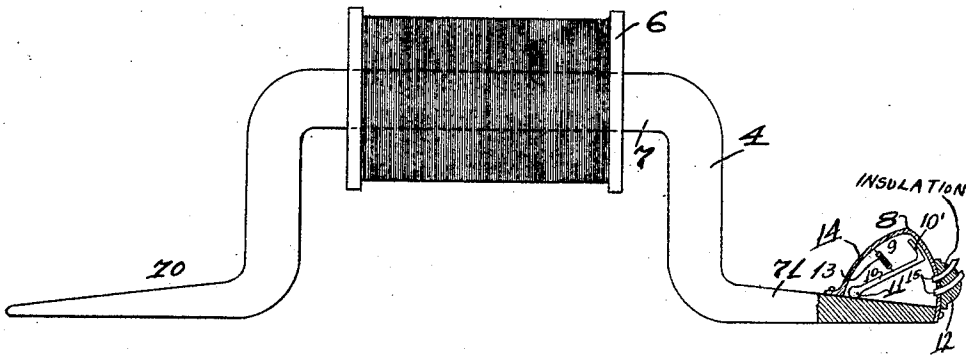


FIG. 4

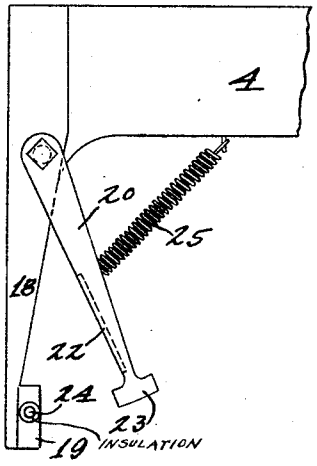
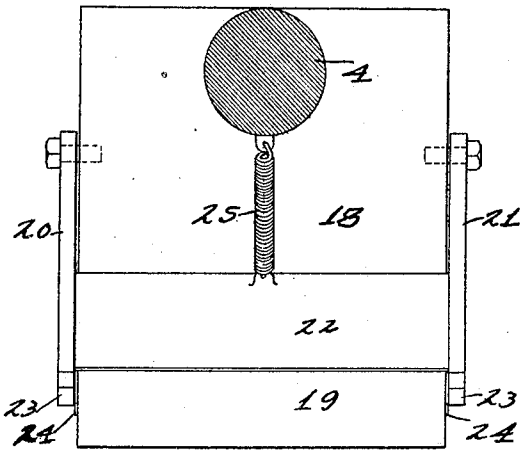


FIG. 5



WITNESSES

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4 SHEETS—SHEET 3.

Fig. 6

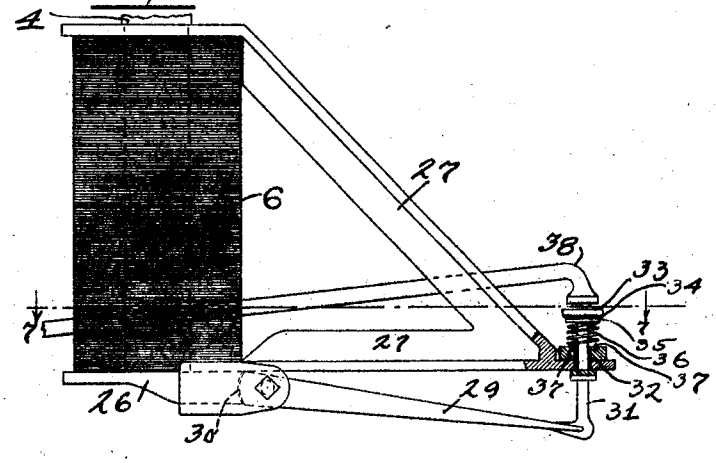


Fig. 7

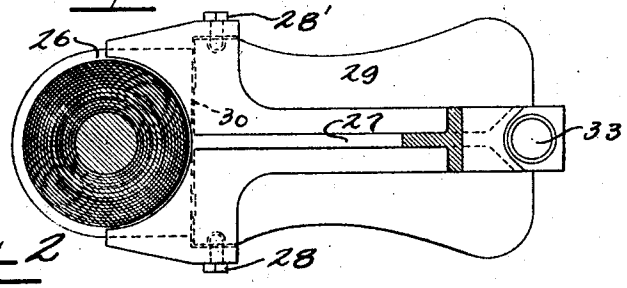
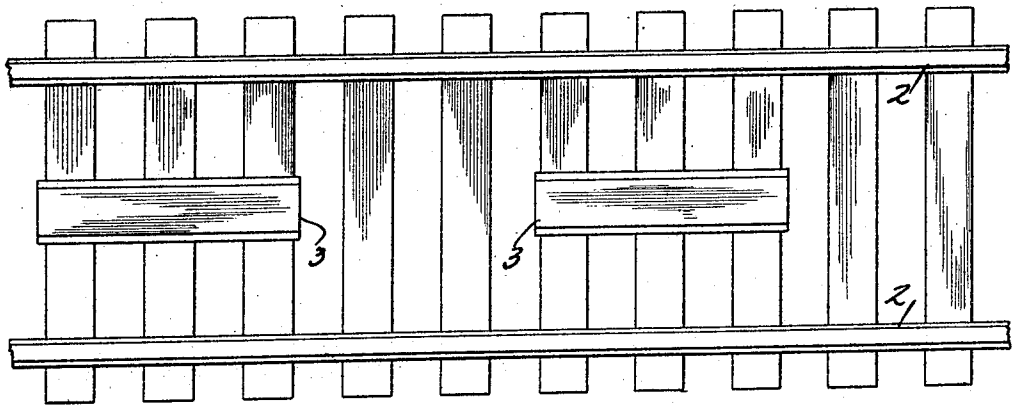


Fig. 2



Witnesses

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4 SHEETS—SHEET 4.

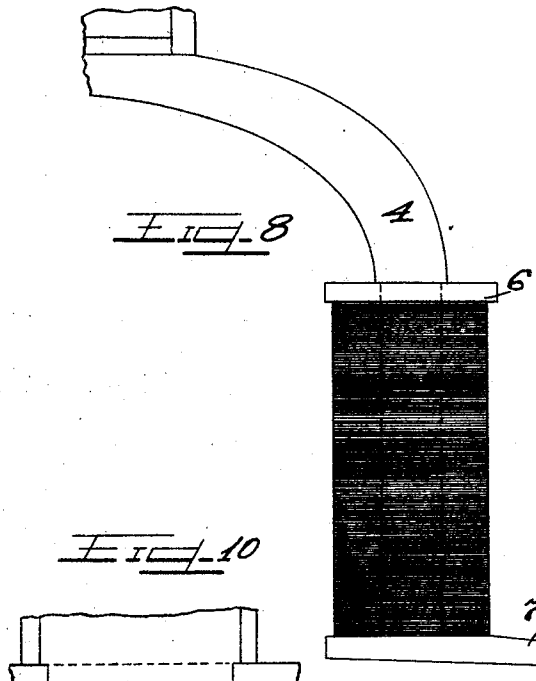


Fig. 8

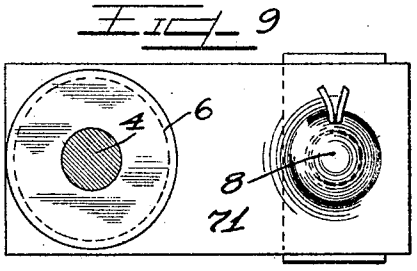


Fig. 9

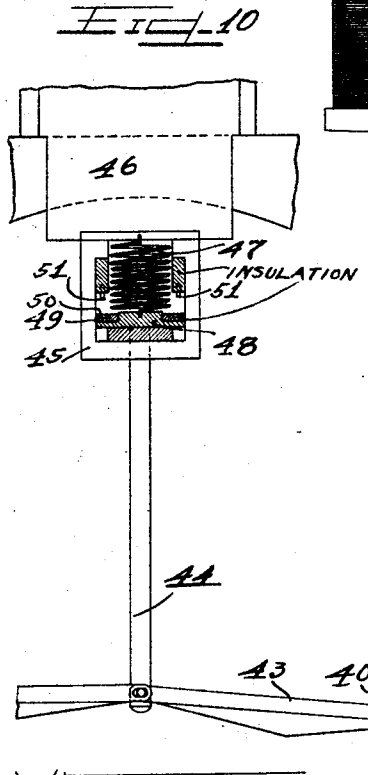


Fig. 10

Witnesses

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UNITED STATES PATENT OFFICE.

KARL L. LEHMANN, OF CHICAGO, ILLINOIS, ASSIGNOR TO CHAMALES-LEHMANN COMPANY, OF CHICAGO, ILLINOIS, A COPARTNERSHIP CONSISTING OF CHRIST J. CHAMALES, JOHN E. ERICSON, ALEXANDER HARPER, AND KARL L. LEHMANN.

RAILWAY SIGNALING DEVICE.

1,413,667. Specification of Letters Patent. **Patented Apr. 25, 1922.**

Application filed January 8, 1921. Serial No. 435,788.

To all whom it may concern:

Be it known that I, KARL L. LEHMANN, a citizen of Norway, and a resident of the city of Chicago, in the county of Cook and State of Illinois, have invented certain new and useful Improvements in a Railway Signaling Device; and I do hereby declare that the following is a full, clear, and exact description of the same, reference being had to the accompanying drawings, and to the numerals of reference marked thereon, which form a part of this specification.

Numerous attempts have been made to devise a system of controlling a signal in a railway cab by means of arrangements along the roadway. Some of these devices make use of the mechanical attraction between an electro-magnet on the vehicle and a bar of iron on the road bed. These possess the disadvantage that the mass to be moved by the comparatively small force exerted through a practical air gap is large and consequently the control of the signal is slowly exercised, and the vibrations caused by curves and grades may prevent their acting or cause them to act in the wrong place.

It is an object of this invention to provide a device of this class in which this difficulty shall be avoided.

It is a further object of this invention to provide a train carried signal device which shall be controlled by means of bars of iron along the road bed but in which the electro-magnet on the vehicle shall remain stationary relative to the vehicle.

It is a further object of this invention to provide a signaling system in which the signal bars used on the road bed may be shorter than has been necessary in the devices heretofore employed.

It is a further object of this invention to provide a signaling system which may be operated by the use of a smaller amount of energy than has been necessary heretofore and which shall thereby be more economical and reliable.

It is a further object of this invention to provide a signaling system in which the moving parts shall be few and light and situated in well protected places.

It is a further object of this invention to provide a magnet with a pole having a moving poleshoe.

It is a further object of this invention to provide a circuit controller on the vehicle adapted to be operated by the movement of a moving portion of the poleshoe of a magnet under the influence of a bar of iron upon the road bed.

Other and further important objects of this invention will be apparent from the disclosures in the specification and drawings.

The invention (in a preferred form) is illustrated in the drawings and hereinafter more fully described.

On the drawings:

Figure 1 is a diagrammatic view of a railway locomotive and a portion of the road bed with this signaling equipment thereon.

Figure 2 is a view of a portion of the road bed.

Figure 3 is a view of the circuit closing device illustrated on the locomotive in Figure 1.

Figure 4 is an end elevation, and

Figure 5 is a section of a modification of the circuit closing device.

Figure 6 is a side elevation and Figure 7 a plan partly in section of a portion of another modification of the circuit closing device.

Figure 8 is an elevation and Figure 9 a plan partly in section of a portion of another modification of the circuit closing device.

Figure 10 is a diagrammatic elevation of still another modification of the circuit closing device.

Figure 11 is a diagrammatic view of still another modification showing also a section of a portion of the road bed.

As shown on the drawings:

The reference numeral 1 indicates the vehicle which runs upon the rails 2. At intervals along the track there are placed bars of iron 3. These may be either between the rails or outside thereof as the designer may propose. They must, however, be so placed that the part 4 carried on the locomotive will pass in close proximity to these bars. The part 4 may be located at any convenient point on the locomotive. If it is between the wheels the bars 3 must be between the tracks. If the part 4 is outside of the wheels the bars 3 must be outside of the tracks. A protective plow and cover against snow 1′ is preferably provided. The part 4 is of

iron or steel and is magnetized by a coil 6 fed from the battery 5.

The core of the part 4 may be a permanent magnet or the part may be a permanent magnet reinforced by current from a battery. Again it may be an electromagnet or an electromagnet in which the current is increased at certain times during its motion.

The particular form of this part 4 illustrated in Figure 1 is shown in further detail in Figure 3. In this figure the iron core 4 is shown as U-shaped with its flattened tapering ends turned at nearly right angles to the arms of the U as indicated at 70 and 71, preferably slanting a little downwardly towards the ends. These ends are to come into a fairly close proximity to the bars 3 when the vehicle passes over that portion of the track near the bar. The coil 6 is wound upon the middle portion 7 of the core 4. Upon the flat end portion 71 is a rounded housing 8 to provide a hollow space 9 in which there is movably mounted a piece of soft iron 10, with a contact index 10′ and turning around hinges 11. Mounted in the side of the space is a block of insulation 12 which contains the contact points of a circuit closer. This contact may be a sliding one as shown or otherwise. A spring 13 normally serves to keep the part 10 out of engagement with these points and the whole space is covered with a cover plate 14 of brass or other non-magnetic material.

In this form of the device, the main magnetic circuit is through the core 4, the pole piece 71, the air to the member on the track, through this member and the pole piece 70 back to the core 4. There is, however, a branch magnetic circuit which leaves the main magnetic circuit at the hinges 11 and goes through the soft iron piece 10. From there it goes through the air to return to the main magnetic circuit. When the soft iron piece 10 is moved under the magnetic attraction as explained below, the branch magnetic circuit approaches the main magnetic circuit.

The magnetization of the core 4 set up by the current in the coil 6 is not sufficient to overcome the effect of the spring 13. Consequently the spring keeps the member 10 in the position shown in the drawing, but when the device passes over one of the iron bars 3 the flux induced by the coil 6 is very greatly increased because the air gap between the ends 70 and 71 is much better bridged by the iron 3. The increase in flux is sufficient to cause the part 10 to be attracted toward the iron in 71 more strongly than the spring 13 can resist; consequently, the iron member 10 moves downwardly and 10′ comes in sliding contact with both contact points, bridging them and thus affording a closure for the circuit 15 illustrated in Figure 1.

This circuit includes a battery 16 which may or may not be the same as the battery 5 as is desired. The circuit also includes an electro-responsive device 17 which shall give a response whenever the vehicle passes over a point guarded by one of the iron bars 3. This electro-responsive device may be of any type desired. It may give a signal, or set the brakes, or make a record, or shut off power, or do all of these things, as the designer wishes. No invention is claimed in the particular electro-responsive device used, all of these functions being well known to workers in this art.

In the modification shown in Figures 4 and 5 but one end of the U-shaped core 4 is illustrated. This has a depending end 18 terminating in a plate 19 adapted to pass in close proximity to the bars 3 already described. Pivoted to the end 18 are a pair of arms 20 and 21 which support a plate of iron 22. At the lower end of the arms 20 and 21 are a pair of contact makers 23 which, when the arms swing about their pivot approaching the end member 18, will come into sliding contact with the terminals 24 and so close a circuit. The plate 22 and the arms 20 and 21 are held from swinging in this way by the spring 25. Under ordinary circumstances this spring is strong enough to overcome the magnetic attraction and keep the plate 22 in the illustrated position. When the device passes over one of the bars 3 the two ends of the core 4 are bridged by this bar and the magnetic flux is greatly increased; consequently, the attraction of the end 18 for the plate 22 is increased and will now overcome the spring 25. The members therefore turn about their pivots and the parts 23 and 24 come into contact which is sufficient to close the circuit 15.

In this form of the device, the main magnetic circuit is through the core 4 and the depending ends 18 from which it goes through the air to the body upon the track. There is a branch magnetic circuit. If the arms 20 and 21 are of soft iron, this branch is easily traced. It leaves the main magnetic circuit at the pivoted ends of these arms and goes through the arms to the iron member 22 and from there, it returns to the main magnetic circuit through the air in the illustrated position or through the end 23 of the arms 20 and 21 in the attracted position. It is, therefore, evident that when the attraction occurs, the branch magnetic circuit approaches the main magnetic circuit.

If the arms 20 and 21 are not of magnetic material, a similar branch circuit may still be regarded as present. It goes through the air from the depending ends 18 to the upper edge of the plate 22 and returns through the air from the lower edge of this plate to a lower point upon the depending ends 18.

In the modification illustrated in Figures 6 and 7 one end only of the core 4 is illustrat-

ed on a horseshoe formed magnet. Upon this core is the winding 6 which may be near the ends or not as the designer wishes. The core 4 ends in a pole 26. Attached to the core above and below the winding is a bracket 27 preferaby of non-magnetic material. This bracket carries a pair of pivot pins 28, 28'. These pivot pins support a movable part 29 of iron which is very close to the part 26 at the gap 30. Articulated with the outer end of the member 29 is a vertical piece 31 which may be pivoted to 29 or may be rigid therewith. A hole 32 through the end of the bracket 27 may be large enough to permit the motion of the part 31 even when it is not pivoted. At the upper end of the part 31 is an iron plate 33 which is insulated by the layer 34 of insulation and below this is the conducting plate 35. The whole is held in an upward position by the spring 36. When the parts in question are depressed the plate 35 will come into contact with the terminals 37 and close the circuit 15.

The spring 36 may be sufficient to keep the parts normally elevated or it may be substituted for or supplemented by a magnetic arrangement to hold the parts up. This is illustrated at 38 where a soft iron bar is shown coming to the point immediately over 33. The other end of this bar is held close to the far end of the U-shaped frame 4 and so has a polarity opposite to that of the plate 33. The spring 36 or the combined effect of this spring and the magnet 38 is sufficient to maintain the parts 39 in the illustrated position under normal conditions. When the device passes over an iron bar 3 the magnetic flux between the parts 29 and the bar 3 is sufficient to lower the part 29 and cause the plate 35 to contact with the terminal 37 and so close the circuit.

In this form of the device, the main magnetic circuit is through the core 4 to the pole piece 26, from there to the body of iron upon the track and from this body of iron to the pole piece at the other end of the core 4. There is a branch magnetic circuit which leaves the main magnetic circuit at the right-hand edge of the pole piece 26, as illustrated in Figure 6, and goes along the member 29 from which it goes through the air to the body of iron upon the track where it rejoins the main magnetic circuit.

The modification illustrated with a horseshoe magnet in Figures 8 and 9 is closely similar to that illustrated in Figure 3. It shows a rounded housing 8 as part of poleshoe 71. This is applicable when the proximity of the part 10 to the iron 8 is sufficient to insure that this part will be attracted toward 8 and not toward the bar 3. This modification may be adopted when conditions call for a large clearance, and may be arranged without a spring as by a piston in an air-tight cylinder or to act by gravity only.

In the modification illustrated in Figure 8, the main magnetic circuit is through the core 4, the pole piece 71, the rounded portion 8 of the housing and from the end of the pole piece through the air to the body of iron upon the track member whence it returns to the core 4 in the same way as with the other modifications. A branch magnetic circuit leaves the pole piece 71 at the left-hand edge of the inner surface of the rounded housing 8, as illustrated in Figure 8, and goes through the insulation or through the air to the member 10. It then goes through the member 10 to the opposite edge thereof and from there through the insulation or air to the right-hand edge of the housing 8. It will again be obvious that when the attraction occurs, the branch magnetic circuit approaches the main magnetic circuit.

In the modification shown in Figure 10 one end of the core 4 is illustrated and a portion of the winding 6. The core may be U-shaped and a further winding may be applied at the far end of it as is desired. The core ends in a rounded pole 40. Mounted thereon with small bronze ball bearings is a movable piece 41 of soft iron which is separated from 40 by a very small air gap 42. This piece 41 pivots about the rounded ends 40 of the magnet. In the illustration it is to be understood that both ends of the core have moving poleshoes. It is held in the illustrated position against the weight of the part 45 of the piece 41 by the weight of levers 43 and a piston rod 44 which goes to a circuit controller 45 supported on the frame 46 of the vehicle. This circuit controller is controlled by a spring 47 which cooperates with the weight of the parts just mentioned to hold the piece 41 in the illustrated position. The spring 47 acts against a plate 48 which is on the end of the piston rod 44. This plate extends to the sides of the housing enclosing the circuit controller and serving to guide the movement of the movable contact 50. This contact is separated from the plate 48 by the insulation 49. Situated at the other end of the travel of this plate are two pins 51 which are the terminals of the circuit 15. The force of the spring 47 added to the weight of the rod 44 and the levers 43 is ordinarily sufficient to keep the parts in the illustrated position but when the device passes over an iron bar 3 the magnetic flux is increased and the attraction between the bar 3 and the member 41 draws down the end 41' causing the member 41 to pivot about the end 40 of the magnet 4. This tilts the levers 43 and causes the rod 44 to move upward bringing the angular member 50 into contact with the terminal 51 and closing the circuit 15. The

guards 52 prevent the member 41 from moving too far downward. It may easily be seen that a sliding contact bridging another circuit can be had in the wall of the circuit controller 45 or on 41′ to increase the current in 6 after a very small movement has begun and thus increase the strength of the magnet with little expenditure of electric current.

In this form of the device, the main magnetic circuit is through the core 4 into the left-hand end of the member 41, as illustrated in Figure 10. From there, the main magnetic circuit is through the air to the body of iron upon the track and returns to the other end of the core 4 in the same way as with the other modifications. The branch magnetic circuit leaves the main magnetic circuit at the end of the core 4 illustrated in Figure 10 and goes along the member 41 to its end 41′. From there, it goes through the air to the body of iron upon the track where it rejoins the main magnetic circuit.

In the modification shown in Figure 11 the magnetic core 4 is carried on the vehicle by supports 57 preferably of non-magnetic material. The parts 56 of this core are turned downward and the end 53 at one end of the core is turned toward the other end. At the other end of the core there is an end member 54 which is pivoted at 55 to the part 56. The magnetism produced by the winding 6 induces an attraction between the parts 53 and 54, which ordinarily keeps these parts in the illustrated position, but when the device passes over an iron rail 3 attraction of this rail for the part 54 causes it to tilt about the pivot 55. The loose joint 58 causes the motion of the member 54 to be imparted to the ball-crank whose arms are 60 and 61 and which is pivoted at 59. The motion of this bell-crank causes the end of the arm 61 to rise bringing a plate 62 into contact with the terminals 63 and closing the circuit 15.

In this form of the device, the magnetic circuit is through the core 4 and through the end pieces 53 and 54. Between these end pieces, the magnetic circuit goes through the air. When the device is positioned over the body of iron 3 upon the track, the magnetic circuit leaves the end pieces 53 and 54 and goes through the air to the body of iron 3. There is, however, some flux remaining between the inner ends of the poles 53 and 54. Although no sharp line of division between these two portions of the flux exists, either portion may be regarded as a branch magnetic circuit and the other portion as in the main magnetic circuit.

It will thus be seen that the invention provides a device for closing a circuit carried upon the train each time that the train passes a stationary iron bar 3. These bars may be placed at the approach to a switch or a curve or other dangerous points, or they may be arranged to be movable, being depressed or tilted out of the way when there is no danger and brought back to operative position when danger exists. All of such arrangements are well known in the art and do not constitute a part of this invention. It will be noted that each of the modifications described includes a small movable part mounted upon the magnetic core or poleshoe and that this part is moved by the change in the magnetic flux density which occurs when the iron bar 3 bridges the large air gap in the magnetic circuit. This feature is believed to be new in the art and possesses the advantage that the moving part although magnetic is not heavy and consequently the device may be made sensitive and effective without the expenditure of any large amount of energy for the magnetizing current.

Several parallel magnets with current from the same battery can be used in connection with parallel iron bars as the space taken up and cost involved is small.

Automobile roads can be supplied with cross rails in the pavement with iron longitudinal connections like a grating at dangerous crossings for the use of this device as it is very sensitive and does not need a long iron bar to produce a signal and can be worked with permanent magnets reinforced by a small battery or reinforced at intervals. A soft iron anchor may be used on the magnet when the magnet is not in use.

I am aware that numerous details of construction may be varied through a wide range without departing from the principles of this invention, and I therefore do not purpose limiting the patent granted otherwise than necessitated by the prior art.

I claim as my invention:

1. In a device of the class described, a vehicle, an incomplete magnetic circuit carried thereon, a body of magnetic material outside said vehicle adapted to complete said magnetic circuit when the vehicle passes said body except for the air gap needed for clearance, a piece of magnetic material on the vehicle separated from the main part of the magnetic circuit by an air gap small compared to the clearance air gap, said piece being adapted to be moved by the increase in flux when the vehicle passes the body, constantly acting means for returning the piece after such movement, a circuit closer controlled by said piece, a circuit controlled thereby, and a traffic controlling device in said circuit.

2. In a railway signaling device, a magnetic circuit comprising a part on the vehicle and a magnetic body on the wayside, a member of magnetic material movably mounted on the vehicle carried part of said magnetic circuit and constituting a portion of a branch

magnetic circuit and a contact controller carried by said movably mounted member, the vehicle carried part also including a source of magneto-motive-force whereby upon the passage of the vehicle past the magnetic body on the wayside the flux will be increased and the member of magnetic material so moved as to bring the branch magnetic circuit toward the first named magnetic circuit thereby actuating the contact controller.

In testimony whereof I have hereunto subscribed my name in the presence of two subscribing witnesses.

KARL L. LEHMANN.

Witnesses:

CARLTON HILL,

EARL M. HARDINE.