

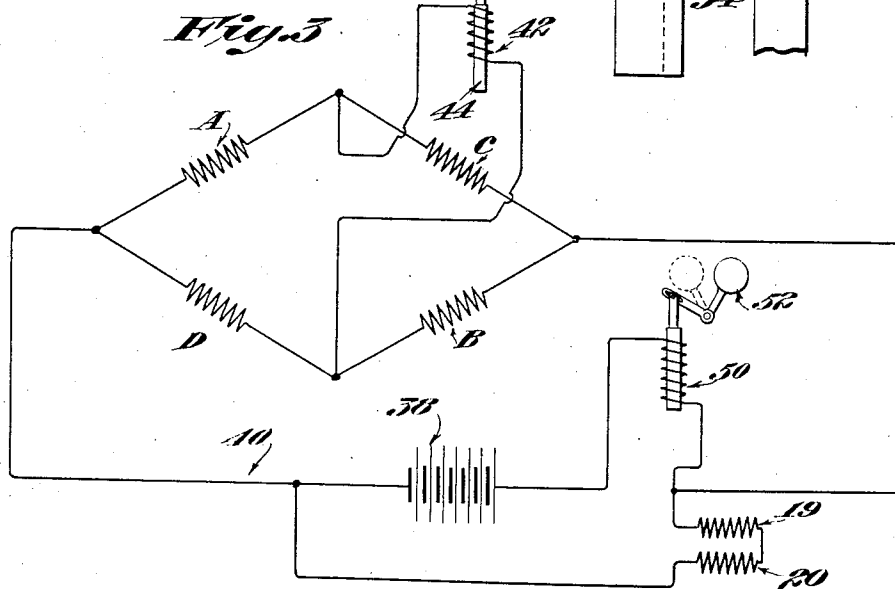
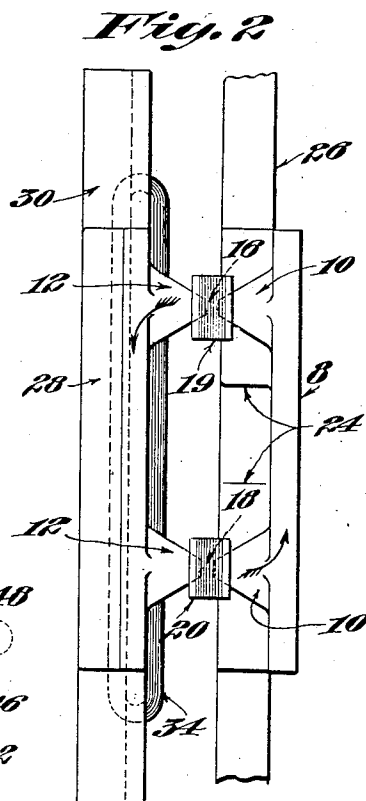
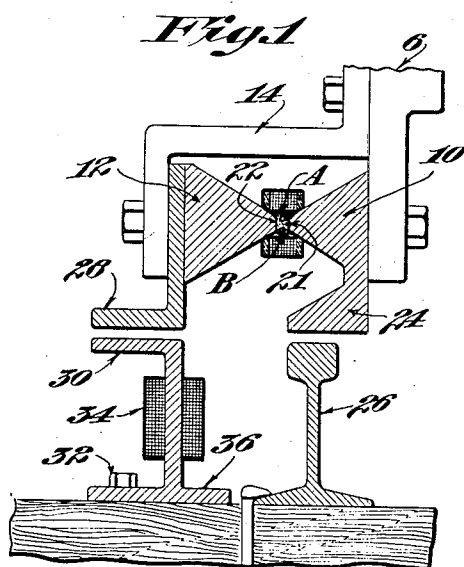
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SIGNAL APPARATUS

Filed July 31, 1923



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UNITED STATES PATENT OFFICE.

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SIGNAL APPARATUS.

Application filed July 31, 1923. Serial No. 654,889.

To all whom it may concern:

Be it known that I, CHARLES G. SMITH, a citizen of the United States, residing at Medford, in the county of Middlesex and State of Massachusetts, have invented certain new and useful Improvements in Signal Apparatus; and I do hereby declare the following to be a full, clear, and exact description of the invention, such as will enable others skilled in the art to which it appertains to make and use the same.

The present invention relates to signal apparatus and is more particularly concerned with safety signal systems for railway vehicles.

The object of the invention is to provide a system of this general nature which will be simple, positively acting and substantially free from moving mechanical parts and by which signals may be transmitted between a moving vehicle and a stationary device to actuate either a stationary signal of the usual form or a safety device carried by the vehicle.

With this object in view, one feature of the invention contemplates the provision of relatively movable magnetic devices arranged to act upon a substance whose electrical properties are sensitive to changes in magnetic field. In the preferred form of the invention, the magnetically sensitive substance consists of a coil or spiral of bismuth wire, which is included in a magnetic air gap and is arranged so that the transmission of a safety signal involves varying the magnetic field through the air gap in a manner to give a corresponding variation in the electrical resistance of the bismuth.

Another feature of the invention contemplates the provision of means for rendering the changes in resistance of the bismuth more effective to operate the desired signal devices. According to the preferred construction, the bismuth is included in the arms of a Wheatstone bridge which are so arranged relatively to the magnetic field that an unbalance is obtained during the transmission of the desired signals.

Still further features of the invention consists of certain novel constructions, combinations and arrangements of parts hereinafter described and claimed, the advantages of which will be apparent to those skilled in the art from the following description.

In the accompanying drawings Fig. 1 is

an elevation in section of a signal apparatus embodying the features of the present invention; Fig. 2 is a plan view of the apparatus shown in Fig. 1; and Fig. 3 is a diagram of the electrical connections.

In the illustrated embodiment of the invention, the apparatus is so constructed and designed that upon the indication of unsafe passing, a signal will be transmitted to actuate a safety device carried by the vehicle, either to give an audible or visible alarm or to initiate operation of the air brakes. The moving vehicle itself carries the magnetically sensitive substance and is provided with a shoe which passes above a series of stationary electro-magnets which are placed at intervals along the roadbed. These stationary magnets are conveniently energized whenever it becomes necessary to give an indication of danger through the actuation of the usual semaphores or other desired stationary signaling means.

Referring to the drawings, the moving vehicle carries by means of a bracket 6 an electromagnet indicated generally at 8, which is provided with pole pieces 10 adjacent the bracket 6 and pole pieces 12 directly opposite poles 10 which are attached to the vehicle by means of braces 14 formed of non-magnetic material such as brass. The pole pieces 10 and 12 are tapered to concentrate the magnetic field in gaps 16 and 18. The magnet 8 is energized by coils 19 and 20 conveniently disposed near the gaps. The gap 16 includes a pair of coils of bismuth wire A and B while the gap 18 includes a pair of similarly disposed bismuth coils C and D. The electrical connections of these coils are such as to form a Wheatstone bridge and will be presently described in detail. Each pair of coils is supported in a body of insulating material 21 which is preferably provided with a copper jacket 22 out of contact with the coils for the purpose of preventing erratic changes in temperature. The jacket 22 is cut at one point to prevent possibility of electrical currents in it. Each of the pole pieces 10 is provided with a depending shoe 24 which is adapted to ride a short distance above the rail 26. Connected with the pole pieces 12 is a second shoe 28 which is adapted to be separated a short distance from the tops of a series of magnets 30 which are spaced at intervals along the roadbed and secured to the ties by means of lag

screws 32. Each magnet 30 is surrounded by a normally inactive coil 34 which is energized in a manner obvious to those skilled in the art by any of the usual forms of safety devices which are spaced along the road. In particular, the usual block system may be adapted not only to actuate the common type of semaphore but also to cause energization of the coil 34 at the same time, thereby giving a positive indication of danger in the vehicle itself. The magnet 30 is provided with a foot 36 extending near the rail 26 so that when the coil 34 is energized a magnetic circuit is provided from magnet 34 through shoe 28, pole pieces 12 and 10 and rail 26 back to the magnet 30 during the passage of the vehicle at this point.

The electrical connections for the bismuth coils are shown in Fig. 3. The coils A and B which are included in gap 16 form opposite arms of a Wheatstone bridge, while coils C and D which are together included in gap 18 form the other two arms. The coils are energized by means of a battery 38 through a circuit 40 which is connected between the junction point of arms A and D and the junction of arms B and C. This battery is also used for energizing the coils 18 and 19. Between the other two junction points is connected a safety device which may be actuated upon the passage of current therethrough to give an audible or visible signal or to operate in a manner obvious to those skilled in the art to initiate actuation of the air brakes or other safety contrivances upon the vehicle. For purposes of illustration, the safety device 42 is shown as consisting of a solenoid 42 adapted when energized to draw through it an armature 44 which is connected by a link 46 with an annunciator 48. The arms A, B, C and D are so arranged that the bridge is normally balanced, that is to say no difference of potential exists across the solenoid 44 and no current flows therethrough. This is conveniently carried out by making all of the arms initially of equal resistance. Under normal conditions, the magnetic field through gap 16 will be equal to that through gap 18 so that the bridge will normally remain balanced under the action of the magnetic field. In passing over one of the magnets 30 no change will take place if the coil 34 is not energized. If, however, the coil 34 is energized due to the setting of a semaphore or other signal along the roadbed, a magnetic circuit will be completed from magnet 30 up through pole pieces 12 and 10 and back again. Assuming the original direction of the magnetic lines of force in magnet 8 to be represented by the arrows in Fig. 2, it will be seen that by the influence of the magnetic field from magnet 30, the density of the field in the gap 16 will be increased if the

rail is a north pole while that in gap 18 will be decreased. Coils A and B will therefore undergo an increase in resistance while coils C and D will undergo a corresponding decrease so that the bridge will then be considerably unbalanced. According to the usual operation of the Wheatstone bridge therefore, a current will flow through the solenoid 44 and actuate the safety device 42. If the rail is a south pole the reverse is true. The current through 42 is in one direction if the rail is a north pole and in the opposite direction if the rail is a south pole. Hence, if 44 were a polarized relay means are provided for sending two classes of signals to the system.

As an additional feature of the invention, provision is made for giving a danger or stop signal whenever the apparatus fails to be properly energized, as in the case of open circuits. To this end, the circuit of battery 38 is provided with a solenoid 50 which tends, when energized, to hold a second safety device 52 in nonindicating position, as shown by the dotted lines in Fig. 3. Upon failure of current to pass through solenoid 50 for any reason, the device 52 drops into indicating position, as shown in full lines. As in the case of the safety device 42, connections which are obvious to those skilled in the art may be made to actuate the air brakes under such conditions.

It will be seen that the construction above described gives a positively acting safety device by which danger signals may be given directly in the moving vehicle itself. The apparatus is free from moving parts which would necessarily be subject to considerable wear should it become necessary to transmit signals into the moving vehicle. Furthermore, as an advantage over the usual type of block system, the use of currents through the rails is eliminated so that the present invention is particularly adapted for use in electric railways where the rails themselves are utilized for carrying the driving current.

Although the invention has been illustrated and described as embodied in an apparatus particularly adapted for use in connection with block systems to give a positive indication within the vehicle whenever a preceding train is within the next successive block, it will be understood that the invention contemplates the use of relatively movable magnetic devices in its broadest sense and that the magnets 8 and 30 might be interchanged so that the passage of the train at this particular point might be utilized to operate in itself a block system. Also, as regards the various other features, it will be understood that the invention should not be limited to the specific construction shown and described, but may be embodied in other constructions and ar-

rangements without departing from the broader aspects of the invention.

I claim:

1. A signal apparatus comprising relatively movable magnets, a magnetically sensitive substance included in the field of one of the magnets and adapted to undergo a change in resistance when influenced by the other magnet, and a safety device actuated upon the change in electrical resistance of the sensitive substance.

2. A signal apparatus comprising relatively movable magnets, a Wheatstone bridge having arms formed of magnetically sensitive material placed in the field of one of the magnets, the bridge being normally balanced and adapted to be unbalanced upon the passage of the two magnets adjacent one another, and a safety device operated upon the unbalancing of the bridge.

3. A signal apparatus comprising a magnet having a pair of gaps, a pair of magnetically sensitive coils included in each gap, the four coils being connected to form a normally balanced Wheatstone bridge, a second magnet relatively movable with respect to the first magnet and adapted, when energized, to increase the magnetic field in one of the gaps and decrease the field in the other gap whereby the bridge is unbalanced, and a safety device operated upon the unbalancing of the bridge.

4. A signal apparatus comprising means for creating a magnetic field, a magnetically sensitive substance included in the magnetic field and adapted to undergo a change in resistance upon variation of the magnetic field, a safety device, and means for actuating the safety device including means for varying the strength of the magnetic field in a manner to affect the resistance of the magnetically sensitive substance.

5. A signal apparatus comprising an electromagnet, a magnetically sensitive substance included in the field of the electromagnet and adapted to undergo a change in resistance upon variation of the magnetic field, a normally inoperative safety device connected with the sensitive substance, and a magnet over which the electromagnet passes to vary the magnetic field in a manner to affect the

resistance of the sensitive substance and operate the safety device.

6. A signal apparatus comprising a magnet adapted to be attached to a vehicle, a coil of bismuth wire placed in the field of the magnet, a normally inoperative safety device electrically connected with the bismuth wire, and a stationary magnet over which the first magnet passes and adapted when energized to cause a variation in the electrical resistance of the bismuth wire and operate the safety device.

7. A signal apparatus comprising a normally balanced Wheatstone bridge having arms formed of material whose electrical resistance may be magnetically varied, means for creating magnetic fields across the arms of the bridge, means for varying the magnetic field unequally across the various arms to unbalance the bridge, and a safety device operated upon the unbalancing of the bridge.

8. A signal apparatus comprising a Wheatstone bridge having arms formed of material whose electrical resistance may be magnetically varied, means for passing electrical currents through the arms of the bridge, a safety device connected across a pair of arms of the bridge and being inoperative when the bridge is balanced, means for creating a magnetic field across opposite arms of the bridge, and means for operating the safety device including a magnet for varying the strength of the magnetic field across the sensitive arms in a manner to vary the electrical resistance of the arms.

9. A signal apparatus comprising a magnet having a pair of air gaps, a Wheatstone bridge having arms formed of material whose electrical resistance depends upon the strength of the magnetic field in which the arms are placed, the bridge having each opposite pair of arms placed in one of the air gaps, means for electrically energizing the bridge, a safety device connected across a pair of arms of the bridge and being inoperative when the bridge is balanced, and means for unbalancing the bridge consisting of a stationary magnet over which the first magnet passes.

CHARLES G. SMITH.