Feb. 2, 1965 E. W. FISHER 3,168,269

TRACK INSTRUMENTS

Filed Dec. 5, 1961

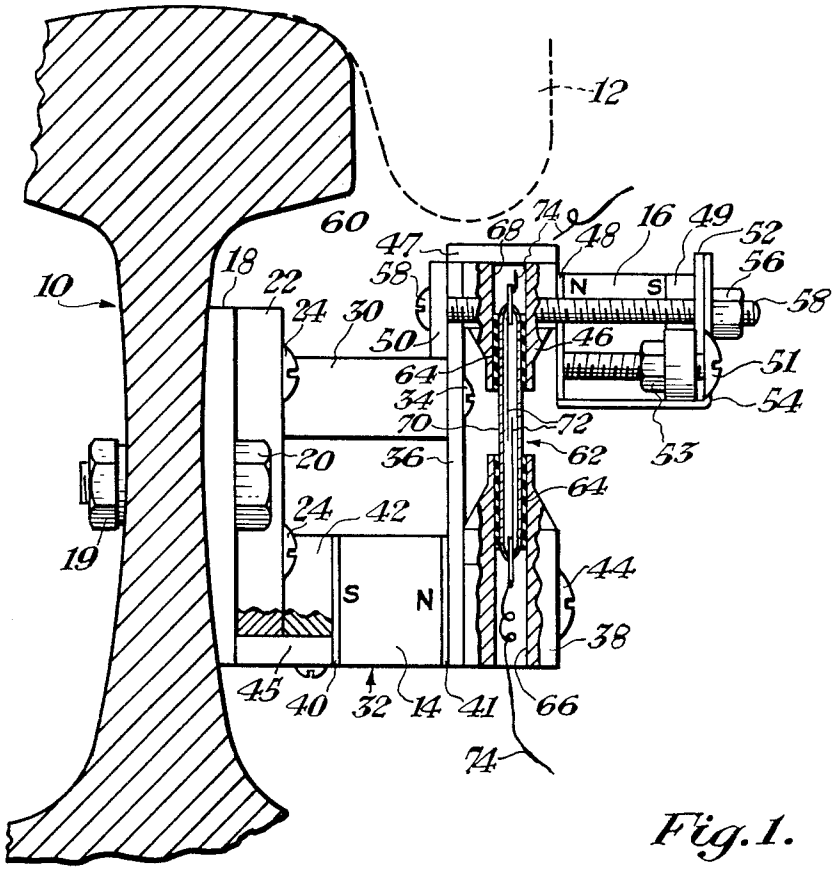


Fig. 1.

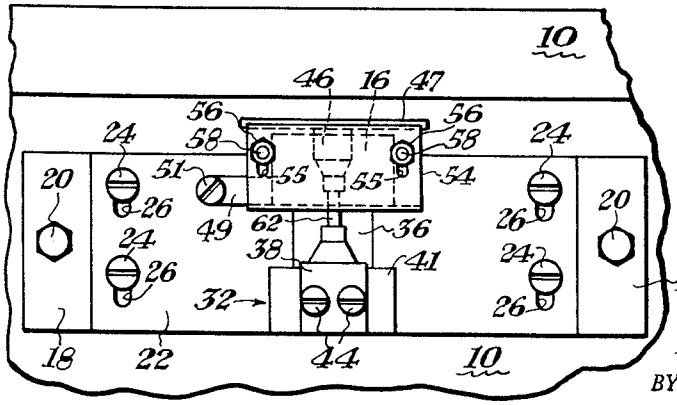


Fig. 2.

INVENTOR.
Ernest W. Fisher.
BY
W. L. Stout
HIS ATTORNEY

United States Patent Office 3,168,269 Patented Feb. 2, 1965

3,168,269

TRACK INSTRUMENTS

Ernest W. Fisher, Dallas, Tex., assignor to Westinghouse Air Brake Company, Wilmerding, Pa., a corporation of Pennsylvania

Filed Dec. 5, 1961, Ser. No. 157,162
7 Claims. (Cl. 246—249)

This invention relates to track instruments and, more particularly, to an instrument which is influenced by the wheels of cars or trains passing along the rail.

In various phases of railroad operation it is often necessary to count the cars entering or leaving a particular area or section of track. Thus, for example, in a classification yard the track fullness condition of each section is a most important factor and is generally determined by devices which count the number of axles entering each section. It is a principal object of this invention to provide a detector which, in effect, counts the number of axles passing a given point.

The various wheel counting devices in use at present are, for the most part, of the magnetic type and generally consist of a magnet arranged in spaced-apart relation to a rail of the track to form an open magnetic circuit which is nearly closed by the wheel of a passing vehicle, thereby strengthening the field of the magnetic circuit. This change in the strength of the field is usually used to induce an electromotive force in one or more coils which in turn actuate appropriate counting circuitry or devices. However, a serious shortcoming which attends most of these magnetic type counting devices is that their operation depends upon the vehicle moving by the given point at a certain minimum speed. Accordingly, another objective of this invention is to provide a proximity detector, the operation of which is independent of the speed of the passing vehicle.

A still further object of this invention is the provision of a magnetically operated proximity detector which is of simple construction and requires no source of power to control its operation.

Generally speaking, the track instrument embodying this invention consists of a reed switch mounted in a structure between two magnets which are so oriented that their fields oppose each other, and so adjusted that an essentially zero magnetic potential exists across the switch in the absence of permeable material in the working gap formed between a pole plate and a portion of the rail. However, when a permeable material, such as the flange of a car wheel, is present in the working gap, the balanced condition between the magnets is disturbed, producing a net field to operate the switch.

Other objects, purposes and characteristic features of my invention will become, in part, obvious from the accompanying drawings and, in part, pointed out as the description of my invention progresses and reference is made to the accompanying drawings, in which similar reference characters refer to corresponding parts throughout the several views, and in which:

FIG. 1 is an end view of a rail onto which an embodiment of my invention has been mounted, with portions broken away to illustrate, to better advantage, certain details of construction; and

FIG. 2 is a front elevational view of the arrangement shown in FIG. 1.

The apparatus shown in connection with FIGS. 1 and 2 relates to railway systems and the control of traffic thereon. However, it should be understood that the principles of the invention are of general application and their association with railway systems is shown as a matter of convenience.

Referring to the constructional details shown in FIGS. 1 and 2, the track instrument of the present invention is

shown secured to the web of a rail **10** and is operated by the wheel **12** of a passing railway vehicle.

Alongside rail **10** are a pair of magnets **14** and **16** separated from each other by an air gap and arranged with their poles in opposition, as shown by the polarity designations N and S in FIG. 1. For reasons presently described, magnet **14** is arranged so that it is in magnetic contact with rail **10** and magnet **16** is positioned so that a magnetic circuit is established between it, rail **10** and magnet **14**. Preferably, the magnets used are of permanently magnetizable material capable of being very strongly magnetized and having a high degree of retentivity. An example of a material which has these qualities is the alloy of aluminum, nickel and cobalt sold commercially under the trade name "Alnico."

As best shown in FIG. 1, a plate **18**, made of a good electrical steel, such as 2½% silicon steel, is formed to fit the contour of the web portion of rail **10**, and is securely fastened as by nuts **19** and bolts **20** to the web portion of rail **10** to effect good magnetic contact. Secured to plate **18** is a mounting plate **22**, formed of a nonmagnetic material, such as brass, which is adjustably maintained in position by means of screws **24** passing through elongated openings **26** in plate **22** in order to facilitate vertical adjustment of plate **22** on plate **18**.

Extending transversely to rail **10** and secured to mounting plate **22** are upper and lower leg portions **30**, **32**, respectively. The upper leg portion **30** is formed of a nonmagnetic metal, such as brass, and is secured to mounting plate **22** by screw **34** which passes through an intermediate portion of a supporting member **36**, upper leg portion **30** and into threaded engagement with mounting plate **22**.

The lower leg portion **32**, which makes up the lower magnet assembly, consists of pole piece **38**, the lower portion of supporting member **36**, flux plates **40**, **41**, magnet **14** and spacing block **42**, and in secured by screws **44** to mounting plate **22**. In accordance with the preferred embodiment of this invention, pole piece **38** and flux plates **40**, **41** are formed of a good electrical steel, such as 2½% silicon steel.

In order to form a continuous magnetic circuit, without an air gap, between magnet **14** and rail **10**, mounting plate **22** and spacing block **42** are notched, along their undersides, to receive an insert **45**, formed of a suitable magnetic material, which extends from and is in contact with both flux plate **40** and plate **18**. It should also be noted at this point that although the presence of the lower end of the nonmagnetic supporting member **36** between plate **41** and pole piece **38** amounts to an air gap, this arrangement is not necessarily essential to the proper operation of the track instrument. In other words, a magnetic shunt, generally similar to insert **45**, may be provided to shunt the flux between plate **41** and pole piece **38**.

The upper magnet assembly consisting of pole piece **46**, pole plate **47**, flux plates **48**, **49**, magnet **16**, cross members **50**, **52**, and magnet support member **54**, is secured by nuts **56** and bolts **58** to the upper portion of supporting member **36**. In order to establish a good magnetic path within the upper magnet assembly, pole piece **46**, pole plate **47**, and flux plates **48**, **49** are preferably formed of a good electrical steel such as, for example, 2½% silicon steel. Furthermore, in order to minimize flux leakage across air gap **60**, formed between pole plate **47** and the rail head, pole piece **46** is narrow in the dimension parallel to the rail and pole plate **47** in cross section is only thick enough to prevent saturation, that is to say, vertically in the plane parallel to the rail. In addition, as best shown in FIG. 2, pole plate **47** is made long in the direction parallel to the rail so as to present the optimum gap area when permeable material, such as wheel

12, is present in air gap 60, thereby resulting in the maximum flux change.

The purpose of flux plates 40, 41 and 48, 49 on opposite sides of magnets 14 and 16, respectively, is to collect flux from the pole faces of the magnets and these plates are designed to have a large enough cross sectional area so that they are not saturated by that portion of the flux supplied by the projecting ends of the magnets even when the magnetic circuit is short circuited. In addition, flux plates 48 and 49 are formed to project beyond one of the edges of magnet 16, and plate 49 is made thick enough to enable it to be tapped to receive a steel shunting screw 51 of sufficient length to span the poled ends of magnet 16 and rest in snug contact with the projecting portion of plate 48. A lock nut 53 is provided to secure shunting screw 51 in its adjusted position in accordance with the adjustment procedure presently described.

As best shown in FIG. 1, a reed switch 62 is shock mounted, adjacent each of its opposite ends, in pieces of neoprene tubing 64 encased within apertures 66, 68 drilled longitudinally through pole pieces 38 and 46, respectively. Reed switch 62 is a well-known type of magnetically controlled switching device which generally takes the form of a cylindrical enclosure 70 of electrically insulating nonmagnetic material such as glass, surrounding a pair of reeds 72 extending into the enclosure 70 from opposite ends. Reeds 72, which are of magnetic material such as soft iron and may have precious metal contact surfaces, are positioned to overlap at their spaced inner extremities, the inner extremities, however, being normally separated by a small distance. Leads 74 are secured, as by soldering, to the outer extremities of reeds 72 and extend through pole pieces 38 and 46 to an appropriate counting circuit and/or indicating device (not shown).

In accordance with the operation of the preferred embodiment of the track instrument illustrated and described herein, it is desirable that the magnetic circuit established between the lower magnet assembly, rail 10 and the upper magnet assembly be adjusted so that reeds 72 are separated when there is no permeable material, such as wheel 12, in air gap 60 and that reeds 72 move into closed contact when a permeable material is present in air gap 60. In order to achieve this condition, two magnetic adjustments are provided for in the upper magnet assembly. The first adjustment consists of loosening nuts 56 on bolts 58 and, with shunting screw 51 making contact with the projecting portion of plate 48, moving magnet 16 vertically a distance limited by the length of the slotted openings 55 in support 54 to a critical point where reeds 72 in switch 62 move into contact with each other when permeable material is present in gap 60 and where reeds 72 separate when the permeable material is removed from gap 60. When this condition is achieved, as a result of the manipulation of magnet 16 sandwiched between flux plates 48 and 49 on magnet support member 54, nuts 56 are then tightened on bolts 58, thereby locking magnet 16 in its adjusted position. The second adjustment is, in effect, a fine sensitivity adjustment of the response of switch 62 to the presence or absence of permeable material in air gap 60, and is made by moving shunting screw 51 toward or away from the projecting portion of plate 48. When this fine adjustment has been made, shunting screw 51 is secured in position by tightening lock nut 53 against plate 49.

When the track instrument of the present invention has been mounted and adjusted in the manner shown and described, a magnetic circuit may then be traced, in the absence of permeable material in gap 60, from the north pole of magnet 16 through flux plate 48, pole piece 46, pole plate 47, across gap 60, through the rail head and web of rail 10, through plate 18, insert 45, flux plate 40, magnet 14, flux plate 41, pole piece 38 and through the air gap between pole piece 38 and flux plate 49, through flux plate 49 and into the south pole end of magnet 16. As a result of the polarity orientation of magnets 14 and 16, an essentially balanced or zero magnetic potential exists across the air gap between pole pieces 38 and 46, thereby permitting reeds 72 of switch 62 to remain in a normally spaced apart, deenergized position.

When a permeable material, such as wheel 12 of a railway vehicle, is present in air gap 60, the reluctance of this gap is decreased, thereby disturbing the balanced condition, just referred to, between magnets 14 and 16. As a result, a net field is established through reed switch 62, the effect of which causes reeds 72 to move into closed contact with each other, thus causing current to flow through leads 74 to an appropriate recording device (not shown). In this manner the presence of wheel 12 in air gap 60 is detected and recorded.

When wheel 12 moves along rail 10 and out of air gap 60, the flux through switch 62 decreases below the pick-up value of the switch, and reeds 72 separate, thereby cutting off the current flow through leads 74 to the recording device (not shown).

As is apparent from the foregoing description, no source of power is required to control the operation of the switch. Furthermore, with the exception of reeds 72, there are no moving parts in the track instrument to wear out or adjust. Also, as a result of the comparatively high power handling capabilities of reed switches, no power amplification is generally required when the track instrument is used to drive other apparatus.

Although the present invention has provided an instrument for, in effect, counting the axles of railway cars, it is to be understood that this form is selected to facilitate the disclosure of the invention and is not intended to limit the number of forms which it may assume or the number of applications in which it may be employed. Moreover, it is to be further understood that various modifications, adaptations and alterations may be applied to the specific form shown to meet the requirements of practice, without in any manner departing from the spirit or scope of the present invention.

Having thus described my invention, what I claim is:

1. In a flanged wheel detecting device the combination, with a rail, of a first magnet having one of its poles in magnetic contact with the web of the rail and projecting outwardly therefrom; a second magnet supported in spaced relation to the rail and forming an air gap in the path of travel of a wheel flange; the first and second magnets oriented with their fields in opposition and positioned with one of their like poles in spaced adjacency; the adjacent like poles of the first and second magnets having pole pieces secured in magnetic contact thereto, the rail, air gap and first and second magnets forming a magnetic circuit; a switch including contacts secured at its opposite ends in each of said pole pieces and influenced by the reluctance in the air gap to a first position in the absence of a flange in the air gap and to a second position in the presence of a flange in the air gap.

2. In a wheel detecting device the combination, with a rail, of a first magnet positioned with its polar axis substantially perpendicular to the web of the rail and having a pole in magnetic contact therewith; a supporting member secured to the opposite pole of the first magnet and extending upwardly in a plane substantially parallel to the web of the rail and in spaced relation thereto, a second magnet secured to the supporting member in spaced relation to the rail forming an air gap through which a wheel passes; the first and second magnets oriented with their fields in opposition and positioned with one of their like poles in spaced adjacency; the adjacent like poles of the first and second magnets having pole pieces secured in magnetic contact thereto; the rail, air gap, the first and second magnets and the pole pieces forming a magnetic circuit; a switch including contacts secured at its opposite ends in each of said pole pieces and influenced by the reluctance in the air gap to a first position in the absence of a wheel in the air gap and to a second position in the presence of a wheel in the air gap.

3. In a wheel detecting device the combination, with a rail, of a first magnet positioned with its polar axis substantially perpendicular to the web of the rail and having a pole in magnetic contact therewith; a supporting member secured to the opposite pole of the first magnet and extending upwardly in a plane substantially parallel to the web of the rail and in spaced relation thereto; a second magnet secured to the supporting member in spaced relation to the rail forming an air gap through which a wheel passes; the first and second magnets oriented with their fields in opposition and positioned with one of their like poles in spaced adjacency; the adjacent like poles of the first and second magnets having pole pieces positioned in substantial vertical alignment and secured in magnetic contact thereto; the rail, air gap, the first and second magnets and the pole pieces forming a magnetic circuit; a switch including contacts secured at its opposite ends in each of said pole pieces and influenced by the reluctance in the air gap to a first position in the absence of a wheel in the air gap and to a second position in the presence of a wheel in the air gap; and shunting means spanning the poles of one of the magnets for adjusting the sensitivity of the switch to the presence or absence of the wheel in the air gap.

4. In a wheel detecting device the combination, with a rail, of a first magnet positioned with its polar axis substantially perpendicular to the web of the rail and having a pole in magnetic contact therewith; a supporting member secured to the opposite pole of the first magnet and extending upwardly in a plane substantially parallel to the web of the rail and in spaced relation thereto; a second magnet positioned with its polar axis substantially parallel to the polar axis of the first magnet and adjustably secured to the supporting member in spaced relation to the rail forming an air gap through which the wheel passes; first and second flux plates in magnetic contact with the opposite poles of the second magnet and having portions projecting beyond an edge thereof, one of said portions adapted to receive an adjustable shunting screw of sufficient length to span the poles of the second magnet and contact the projecting portion of the opposite flux plate; the first and second magnets oriented with their fields in opposition and position with one of their like poles in spaced adjacency; the adjacent like poles of the first and second magnets having pole pieces positioned in substantial vertical alignment and secured in magnetic contact thereto; the rail, air gap, the first and second magnets and the pole pieces forming a magnetic circuit; a switch including contacts secured at its opposite ends in each of said pole pieces and influenced by the reluctance in the air gap to a first position in the absence of a wheel in the air gap and to a second position in the presence of a wheel in the air gap; and shunting means spanning the poles of the second magnet for adjusting the sensitivity of the siwtch to the presence or absence of the wheel in the air gap.

5. A device for indicating the presence of an object

having low reluctance, comprising, a series magnetic circuit which includes a first magnet, a second magnet and magnetic means forming a first and a second air gap, said magnets and air gaps being chosen such that a first predetermined magnetic condition exists in a third air gap formed between like poles of said first and second magnets when no object having low reluctance is present in said first air gap and a second predetermined magnetic condition exists in said third air gap when an object having low reluctance is present in said first air gap, and means for indicating the state of the magnetic condition in said third air gap.

6. A device for indicating the presence of an object having low reluctance, comprising, a series magnetic circuit which includes a first magnet, a second magnet and magnetic means forming a first and a second air gap, said magnets and air gaps being chosen such that a balanced magnetic potential exists in a third air gap formed between like poles of said first and second magnets when no object having low reluctance is present in said first air gap and a net magnetic potential exists in said third air gap when an object having low reluctance is present in said first air gap, and means for detecting the net magnetic potential in said third air gap.

7. A device for detecting a flanged wheel on a rail, comprising, in combination, a first magnet having its first pole in magnetic contact with said rail, a second magnet secured in spaced relation to said rail such that a first air gap exists between the first pole of said second magnet and said rail through which a flanged wheel passes, a second air gap exists between the first pole of said second magnet and the second pole of said first magnet, said second pole of said first magnet and said first pole of said second magnet being of like polarity, and a third air gap exists between the second pole of said second magnet and the second pole of said first magnet, said magnets and air gaps being chosen such that a balanced magnetic potential exists in said second air gap when no flanged wheel is present in said first air gap, and a magnetic reed relay positioned in said second air gap and responsive to a net magnetic potential in said second air gap whenever a flanged wheel is present in said first air gap.

References Cited in the file of this patent

UNITED STATES PATENTS

1,975,762	Behmer	Oct. 9, 1934
2,231,105	Block et al.	Feb. 11, 1941
2,938,091	Canfield	May 24, 1960
2,963,563	Patterson	Dec. 6, 1960
3,013,137	Broeck	Dec. 12, 1961

FOREIGN PATENTS

192,454	Austria	Oct. 25, 1957
730,359	Great Britain	May 18, 1955
767,724	Great Britain	Feb. 6, 1957