United States Patent

Wandrisco

[15] **3,705,531**

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[54] **METHOD AND APPARATUS FOR DETERMINING THE OPERATING PERFORMANCE OF WHEELED VEHICLES ON A TRACK**

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[73] Assignee: **United States Steel Corporation**

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[21] Appl. No.: **159,897**

[52] **U.S. Cl.** **73/146**

[51] **Int. Cl.** **G01l 5/20**

[58] **Field of Search** 73/146; 33/144

[56] **References Cited**

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[57] **ABSTRACT**

Apparatus for measuring the lateral movement of the rails of curved tracks as locomotives or railroad cars pass thereover includes a support positioned adjacent each rail. A linear differential transformer carried by the support has its axially movable core connected to the adjacent rail by means of a non-magnetic rod. Movement of the core changes the output of the transformer and this output is connected to a recorder which provides a chart of the movement. A wheeled vehicle known to be in first class shape is first passed over the rail to provide a first chart which will be substantially identical for all vehicles of the same type which are in first class shape. When other similar vehicles whose condition is not known passes over the curved rail and its chart is obtained at the same location a comparison of the two charts will indicate whether or not the wheels, axles, or other truck components of the car are in first class condition or not.

10 Claims, 7 Drawing Figures

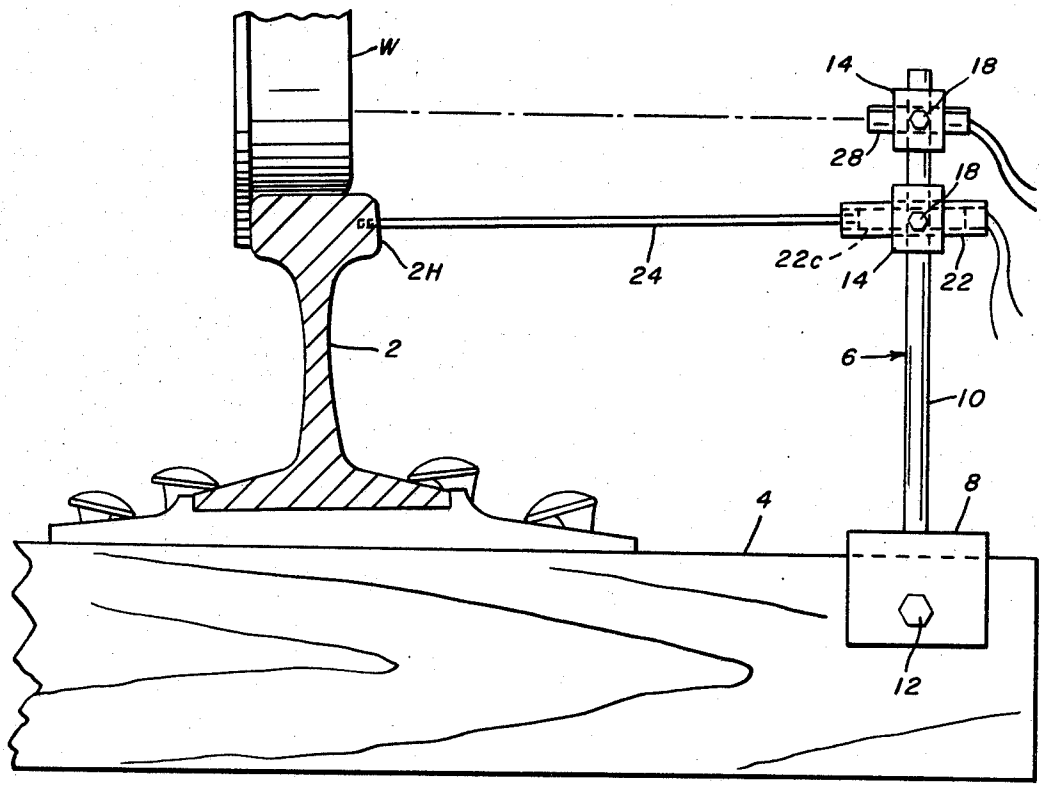

FIG. 1.

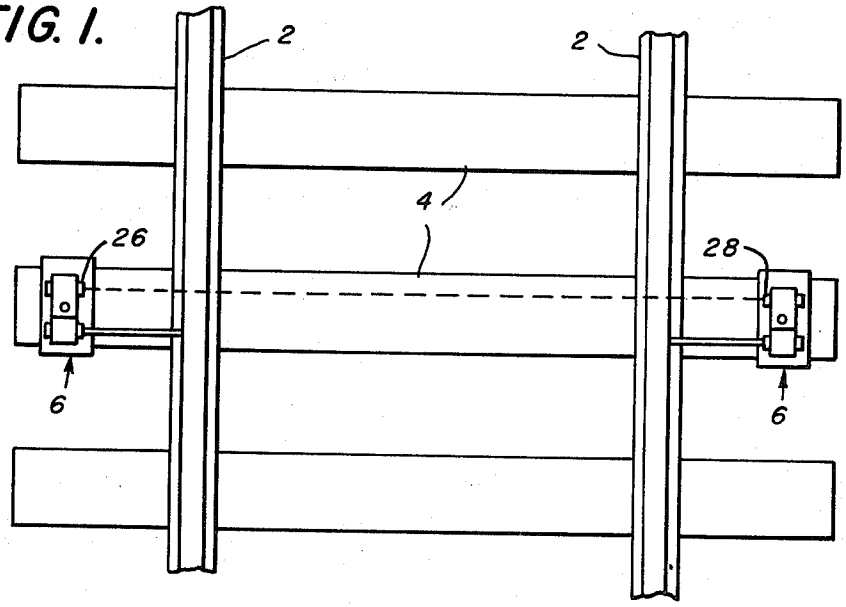

FIG. 2.

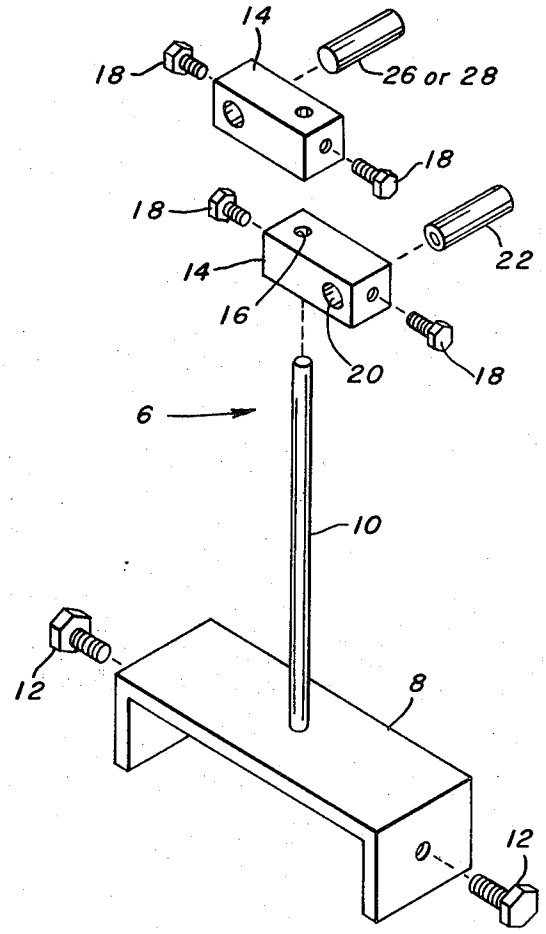

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FIG. 3.

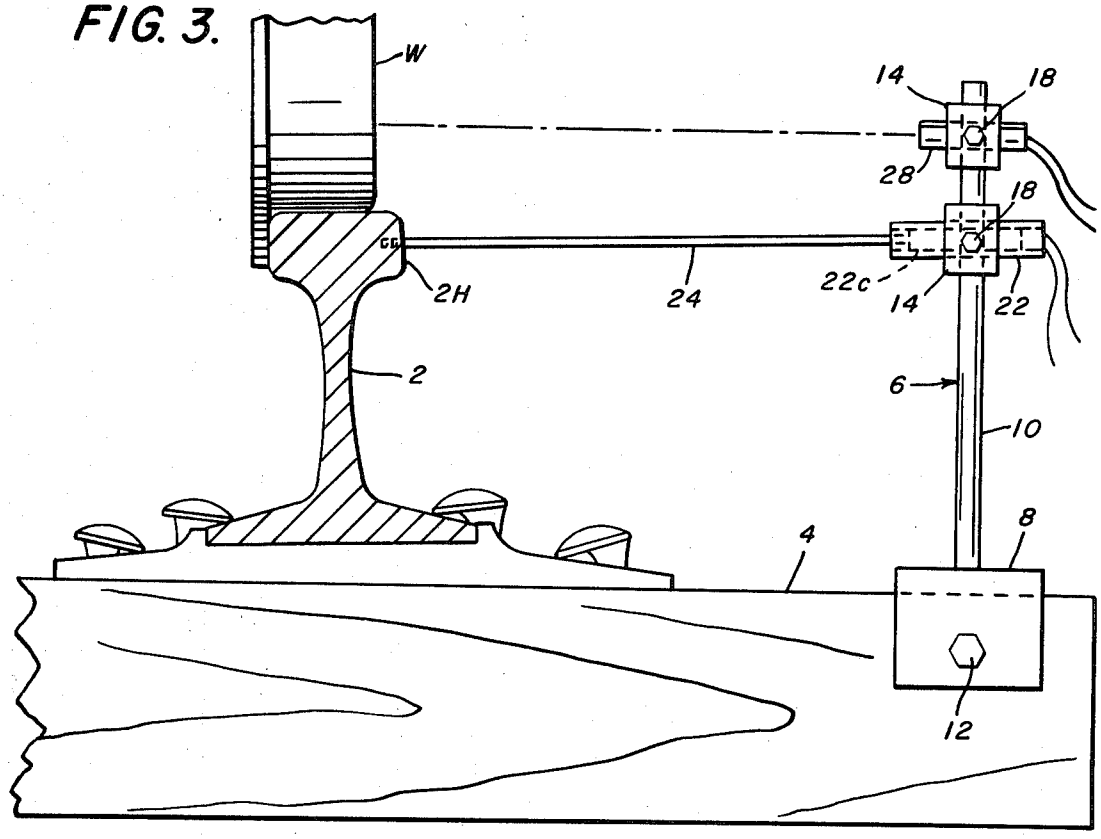

FIG. 4.

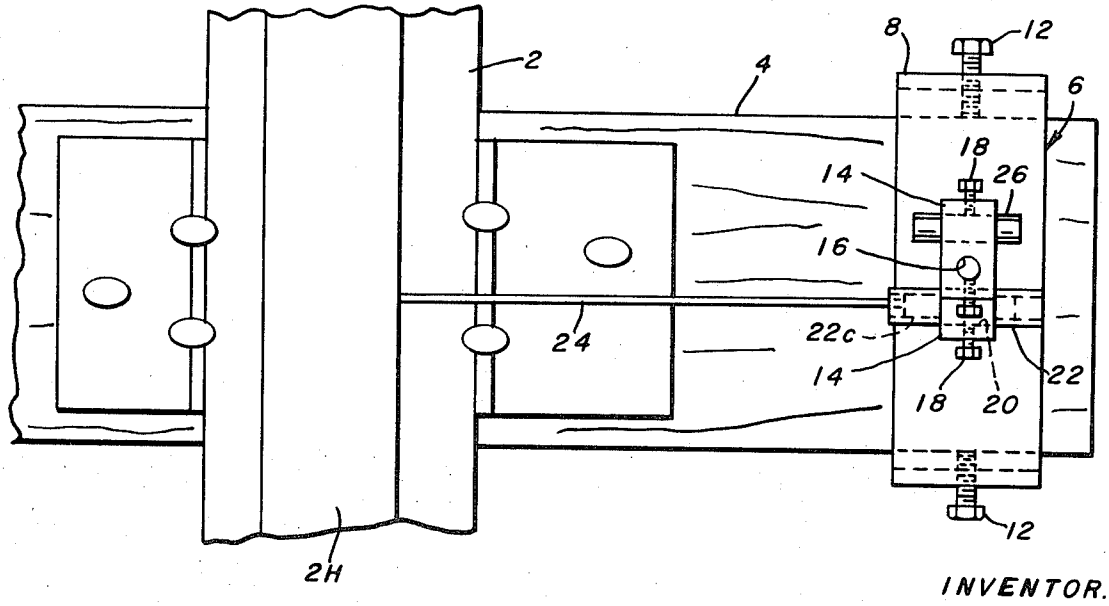

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FIG. 5.

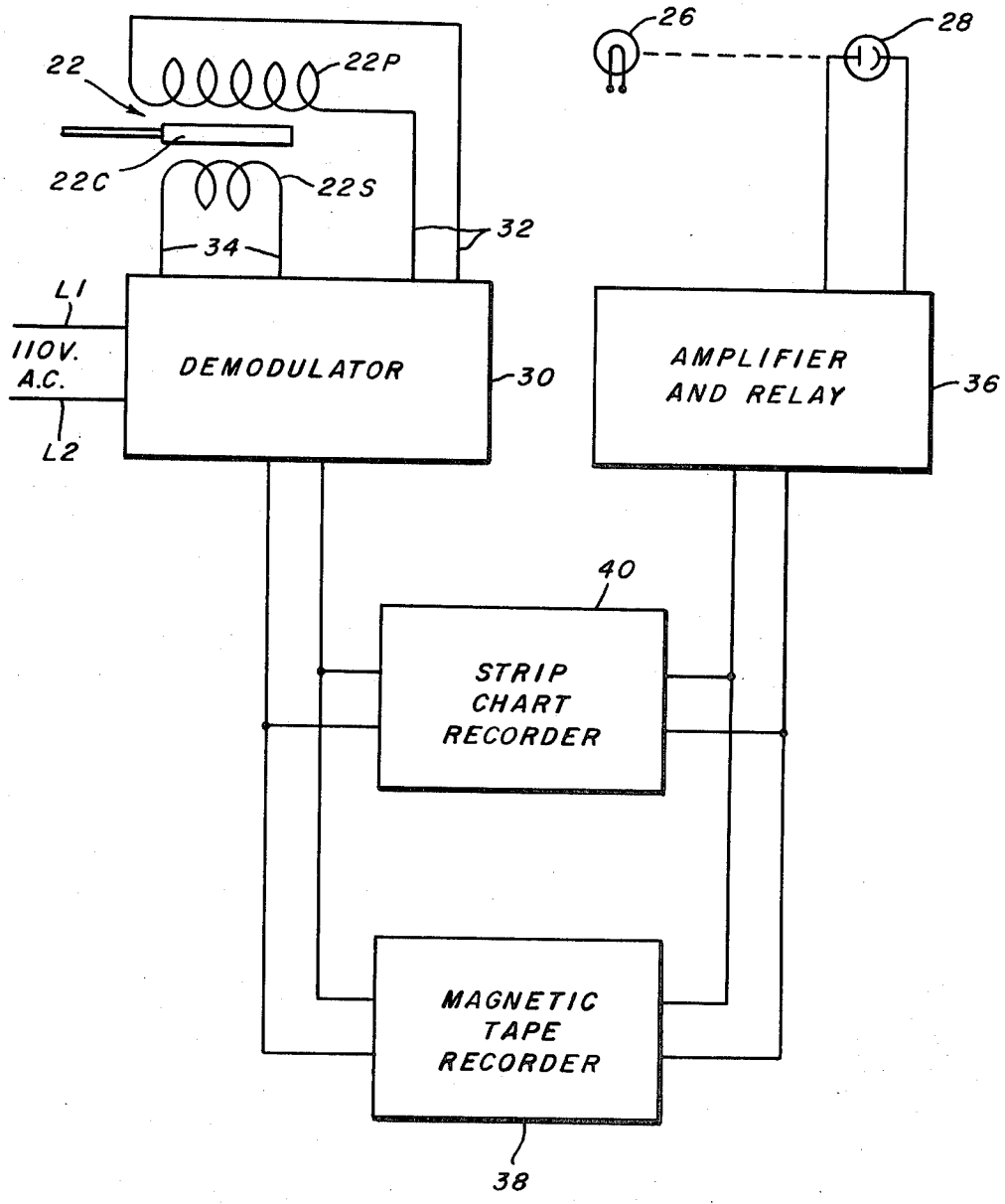

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FIG. 6.

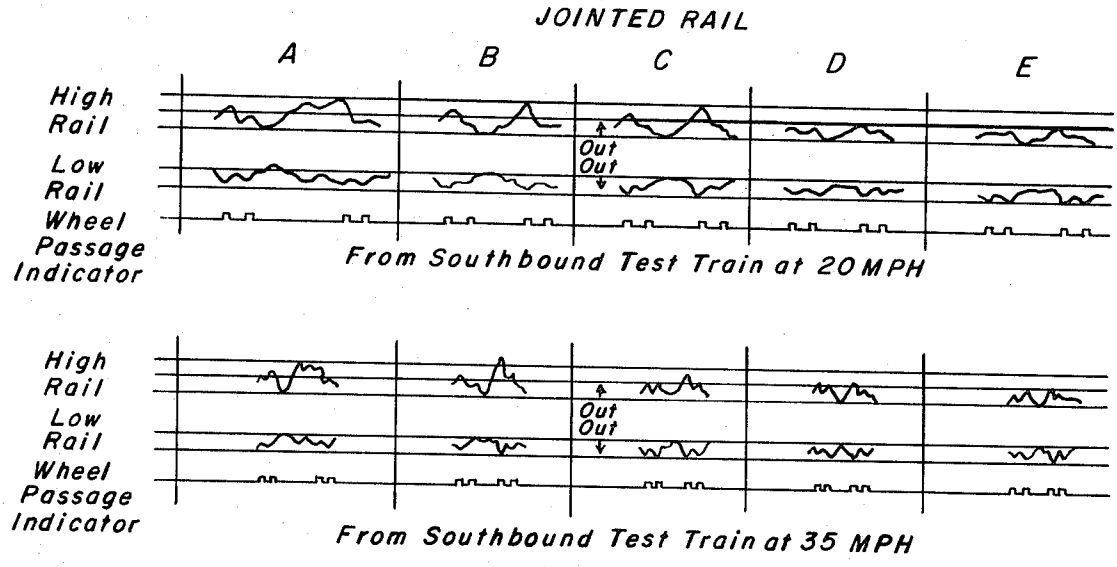
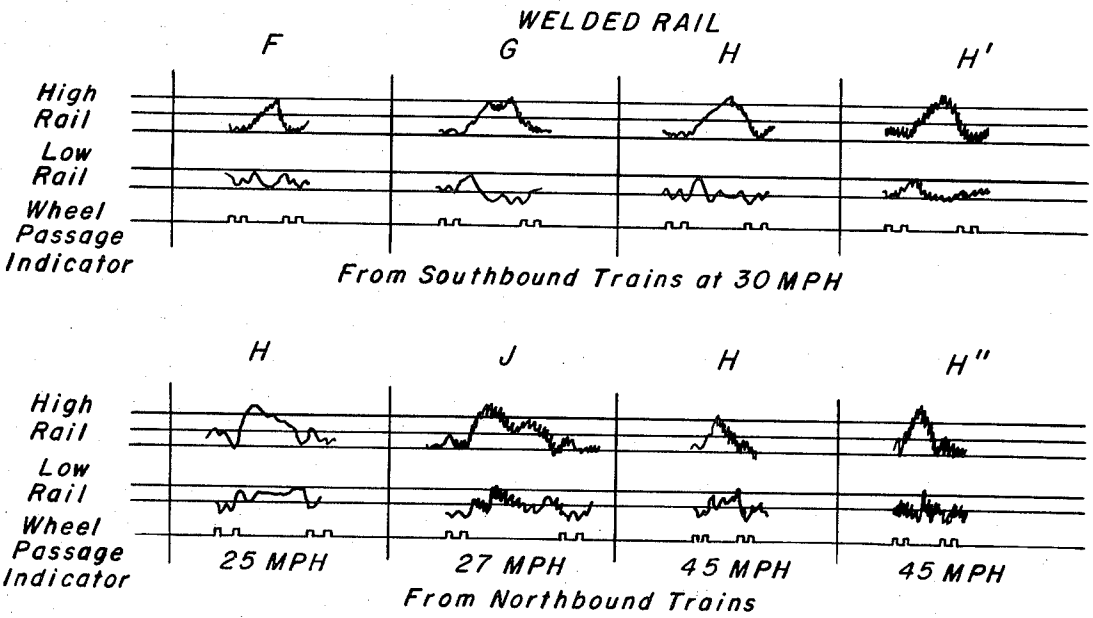


FIG. 7.



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METHOD AND APPARATUS FOR DETERMINING THE OPERATING PERFORMANCE OF WHEELED VEHICLES ON A TRACK

This invention relates to apparatus for measuring the lateral movement of the rails of curved tracks as the vehicle passes thereover and to a method of using the information obtained to determine the operating performance of the vehicle. During the service life of railroad rolling stock such as locomotives and various types of railroad cars, components of the car trucks may wear excessively or become damaged to the extent that they must be repaired or replaced. Such conditions have been normally detected by periodic visual inspection at terminals or inspections prompted by reports from workmen who have observed or heard indications of abnormal performance. Early detection and repair of defects is desirable to prevent failure of other parts and/or derailment of a train.

It is therefore an object of my invention to provide a method of determining the operating performance of moving vehicles on a railroad track to detect those having defective truck components.

Another object is to provide apparatus to measure the lateral movement of rails as the train passes thereover.

These and other objects will be more apparent after referring to the following specification and attached drawings, in which:

FIG. 1 is a schematic view of rails with the apparatus of my invention incorporated therewith;

FIG. 2 is an exploded view of apparatus of my invention;

FIG. 3 is an enlarged end view of the apparatus of FIG. 2 mounted on a rail and tie;

FIG. 4 is a top plan view of the apparatus of FIG. 3;

FIG. 5 is a schematic wiring diagram of the apparatus of my invention;

FIG. 6 is a view of charts showing the movement of rails caused by various cars traveling at different speeds on jointed rails; and

FIG. 7 is a view, similar to FIG. 6, showing the movement of welded rails.

Referring more particularly to the drawings, reference numeral 2 indicates the rails of a railroad track, the rails being mounted on spaced apart ties 4 in the usual manner. The rails are of a standard type having a head 2H. The apparatus of my invention includes a fixture 6 having a U-shaped base 8 and an upstanding vertical bar 10 secured to the base thereof. One fixture 6 is secured to one of the ties 4 on the outside of each rail 2. This is done by placing the U-shaped base 8 over the tie and securing it thereto by means of set screws 12 which are threaded through holes in the legs of the base. A sleeve 14 has a vertical hole 16 therethrough which receives the bar 10 and is fastened in vertical position thereon by means of a set screw 18. A hole 20 is provided in the sleeve at right angles to hold 16 for receiving a standard electrical linear differential transformer 22 which is clamped in position by means of another set screw 18. The transformer 22 (FIG. 5) includes an axially movable magnetic core 22C surrounded by primary winding 22P and secondary winding 22S. A non-magnetic rod 24 has one end secured to the core 22C and the other end secured to the rail head 2H in any suitable manner such as an adhesive bonding. A second sleeve 14 is secured to each bar 10 above the first sleeve. A lamp 26 is supported by one of the top sleeves 14 and a photocell 28 by the other top sleeve. Power is supplied to a standard demodulator 30 from an A.C. 110 volt power source L1, L2. The power for primary 22 is supplied from demodulator 30 through electrical leads 32 and the secondary 22S is connected to demodulator 30 by means of leads 34. The output from the photoelectric cell 28 is connected to a standard amplifier and relay 36. The demodulator 30 demodulates the signal from secondary 22S for input into an electrically powered tape recorder 38 and/or a standard strip chart recorder 40. The output voltage of the photoelectric cell is connected to the recorders 38 and 40 through the amplifier and relay 36. The transformer 22 may be an Atcotran Differential Transformer, Type 6324 as shown in Bulletin 6234 of Automatic Timing and Controls, Inc. of King of Prussia, Pa. The demodulator 30 may be an Automatic Timing and Controls' Series 6101E demodulator shown in their Bulletin 6101E. The recorder 40 may be a Brush 260 Model as shown in Bulletin 94220 of Gould Inc., 3631 Perkins Avenue, Cleveland, Oh.

The inventor has discovered that when his device is connected to the head of the rail at a selected curved portion thereof, the vehicles of a given type in first class condition passing over the curved rail will produce a graph having the same form, but that this form, while having the same general form at all speeds, will vary somewhat as the speed varies. The amplitude of the lateral movement of the rail will be different when the car is empty and when it is filled. Applicant has also found that when a defective truck passes over the same track in the same selected location a similar graph will be obtained, but with modifications. Thus, by passing various types of cars and locomotives over the track a series of first graphs are obtained. Then by comparing graphs of similar cars or vehicles in passing trains any defective cars can be picked out. I have found that for best operation the track must have a radius of no more than 2,000 ft. which is approximately a 3° curve as designated in the United States. Such degree of curves are discussed on Page 47, Volume 1 of "Railroad Engineering"]by William W. Hay copyrighted in 1953 by John Wiley and Sons.

As each pair of wheels W breaks the light beam from lamp 26, a signal from photocell 28 causes the amplifier and relay 36 to transmit an event occurring signal to the magnetic tape 38 and/or multi-channel strip chart recorder 40. At this time the movement of the rail heads 2H is recorded to provide a graph. FIG. 6 shows displacement signatures or graphs for five types of cars A, B, C, D and E obtained from track instrumentation at a fixed location on a 6° curve in jointed track. All of these cars were in good condition. Two graphs for each of the cars are provided, one at 20 miles per hour and the other at 35 miles per hour. The high rail is the outer rail and the low rail is the inner rail. Four event occurring signals or wheel passage indicators are shown for each graph as rectangular curves. Reading from left to right the signals indicate when the first, second, third and fourth pair of wheels are passing the apparatus.

FIG. 7 shows another series of displacement signatures or graphs for four different types of cars F, G, H and J taken at a fixed location on welded rails in a 5° curve. The top set of graphs are taken with the train

traveling south at 30 miles per hour. The bottom set of graphs are taken with may apparatus at the same location, but with the train traveling north at the speeds indicated. Cars H' and H'' are the same type as car H, but with their wheels being flattened to different degrees. It will be seen that the graphs for cars H' and H'' are very ragged which indicates that the wheels are in bad shape.

It is possible by the use of my apparatus to determine the type of car, the condition of wheels or trucks, the direction of travel, and the speed of travel. Other conditions may also be determined.

The demodulated output signals from the differential transformers can also be used for input into a computer, and the electronic wave form signatures converted into mathematical representations. Normal mathematical representation signatures for locomotives and cars of different types can be stored in the memory banks or disc files of a locally or remotely located computer, and a computer program can then be used to electronically compare the stored signatures with signatures of the locomotives and cars under surveilance so that those vehicles performing abnormally are recognized and indicated. It will be seen that the computer in this system is the recorder of the charts or signatures obtained by the use of my apparatus and these terms as used in the claims are intended to include this system.

While one embodiment of my invention has been shown and described, it will be apparent that other adaptations and modifications may be made without departing from the scope of the following claims.

I claim:

1. Apparatus for measuring lateral movement comprising a rail of a curved track for supporting a wheeled vehicle passing thereover, a support positioned adjacent said rail, a linear differential transformer carried by said support, said transformer including an axially movable core and primary and secondary windings surrounding said core, a non-magnetic rod having one end connected to the core, means connecting the other end of said rod to the rail head for movement therewith in both inward and outward directions, and means for measuring and recording the lateral movement of said rail head as a wheel of the vehicle passes thereover.

2. Apparatus according to claim 1 in which said means for measuring and recording the lateral movement of said rail head includes a demodulator, electrical power leads between said demodulator and primary winding, electrical leads between said demodulator and secondary winding, and a recorder connected to the output of said demodulator.

3. Apparatus according to claim 1 including a second rail of said curved track, a second support positioned adjacent the second rail of said track, a second linear differential transformer carried by said second support, said second transformer including an axially movable core and primary and secondary windings surrounding said core, a non-magnetic rod having one end connected to the core, means connecting the other end of said rod to the second rail for movement therewith in both inward and outward directions, and means for measuring and recording the lateral movement of said second rail as a wheel of the vehicle passes thereover.

4. Apparatus according to claim 3 in which each support includes a fixture having a U-shaped base and an upstanding bar, means securing each base to the same tie one outside of each rail, and a hollow sleeve secured to said bar at the height of the rail head, said transformers being secured in said hollow sleeves.

5. Apparatus according to claim 4 in which each of said means for measuring and recording the lateral movement of each rail includes a demodulator, electrical power leads between said demodulator and primary winding, electrical leads between said demodulator and secondary winding, and a recorder connected to the output of said demodulator.

6. Apparatus according to claim 5 including a light connected to one of said bars above said sleeve, a photocell connected to the other of said bars above said sleeve, an amplifier and relay connected to said photocell, and means connecting the output of said amplifier relay to said recorder to record the lateral movement of the associated rail as a car wheel passes thereover.

7. The method of determining the operating performance of a wheeled vehicle which comprises passing a first wheeled vehicle known to be in first class shape over a curved track, measuring the lateral movement of the head of a rail of said curved track as a wheel of said vehicle passes thereover to obtain a first chart, then passing another wheeled vehicle of the same type over the same curved track, measuring the lateral movement of the head of said rail at the same location as the first vehicle as the corresponding wheel passes thereover to obtain a second chart, and then comparing the said charts.

8. The method of claim 7 which includes measuring the lateral movement of the head of each rail as each wheel passes over the tracks to obtain a first chart for each wheel, obtaining a second chart for each wheel as the second vehicle passes over the rails, and comparing the corresponding first and second charts.

9. The method of claim 8 which includes obtaining first charts for a number of different types of wheeled vehicles known to be in first class shape, obtaining second charts for each wheel of the different types of vehicles, and comparing the corresponding first and second charts of each vehicle.

10. The method of claim 9 which includes obtaining first and second charts for said wheeled vehicles traveling at different speeds, and comparing the first and second charts of each vehicle traveling at the same speeds.

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