United States Patent

[11] **3,562,419**

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[21] Appl. No **692,566**
[22] Filed **Dec. 21, 1967**
[45] Patented **Feb. 9, 1971**

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[54] **INSPECTION METHOD AND APPARATUS FOR TRACK ALIGNMENT**
12 Claims, 8 Drawing Figs.

[52] **U.S. Cl.** **178/6,** 33/60
[51] **Int. Cl.** **E01b 29/04,** E01b 35/00; H04n 7/18
[50] **Field of Search** 33/60; 178/6IND

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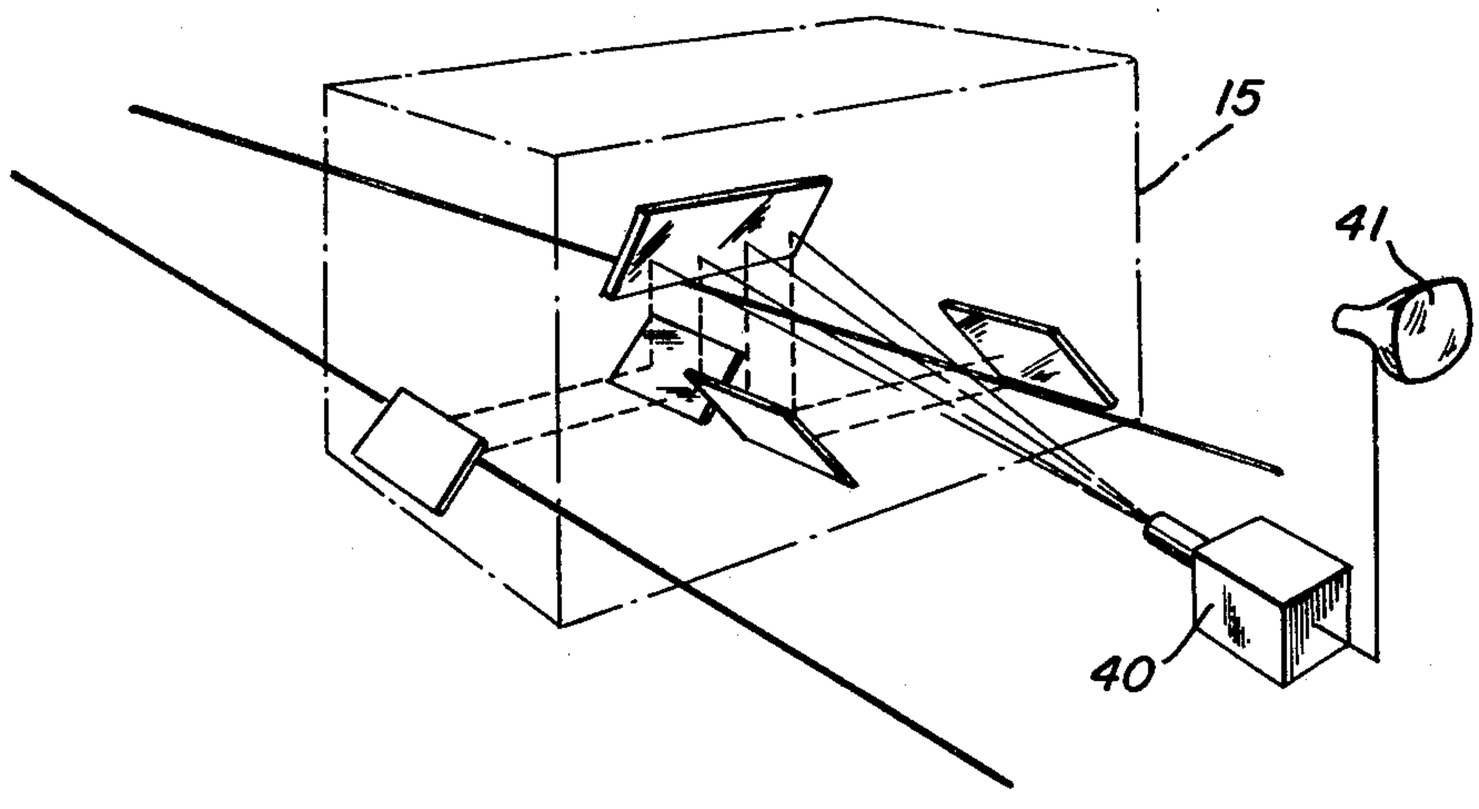
ABSTRACT: An inspection method and apparatus for observing the instantaneous horizontal and vertical alignment of a railroad track by optically comparing scales on a subframe of the vehicle which is referenced to and follows the longitudinal contours of the track with a datum line extending longitudinally of the track and providing on a single screen, preferably a television screen, a pictorial representation, which may be recorded on tape for reproduction, of the track vertical and horizontal alignment condition, and also in a preferred embodiment, the gauge condition or tie plate or rail anchor and tie condition.



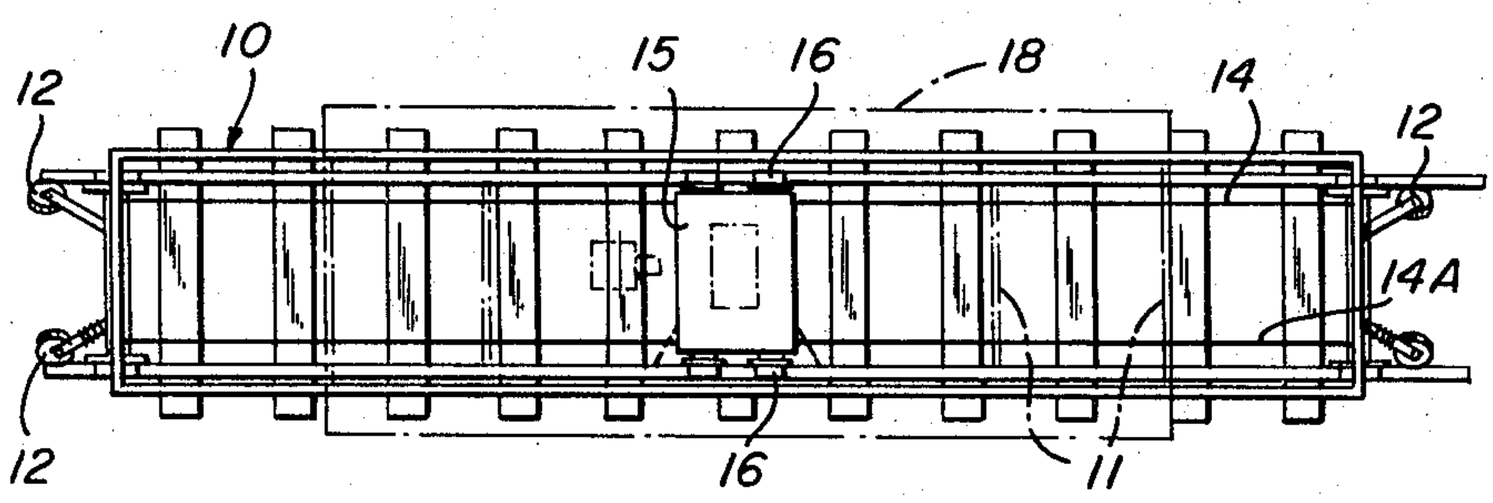


FIG. 1

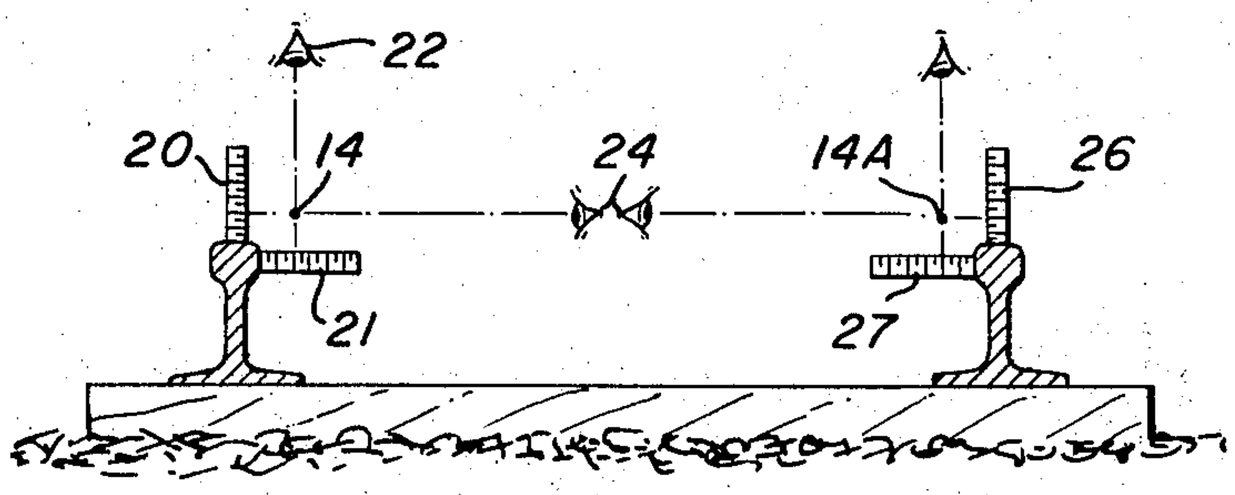


FIG. 2

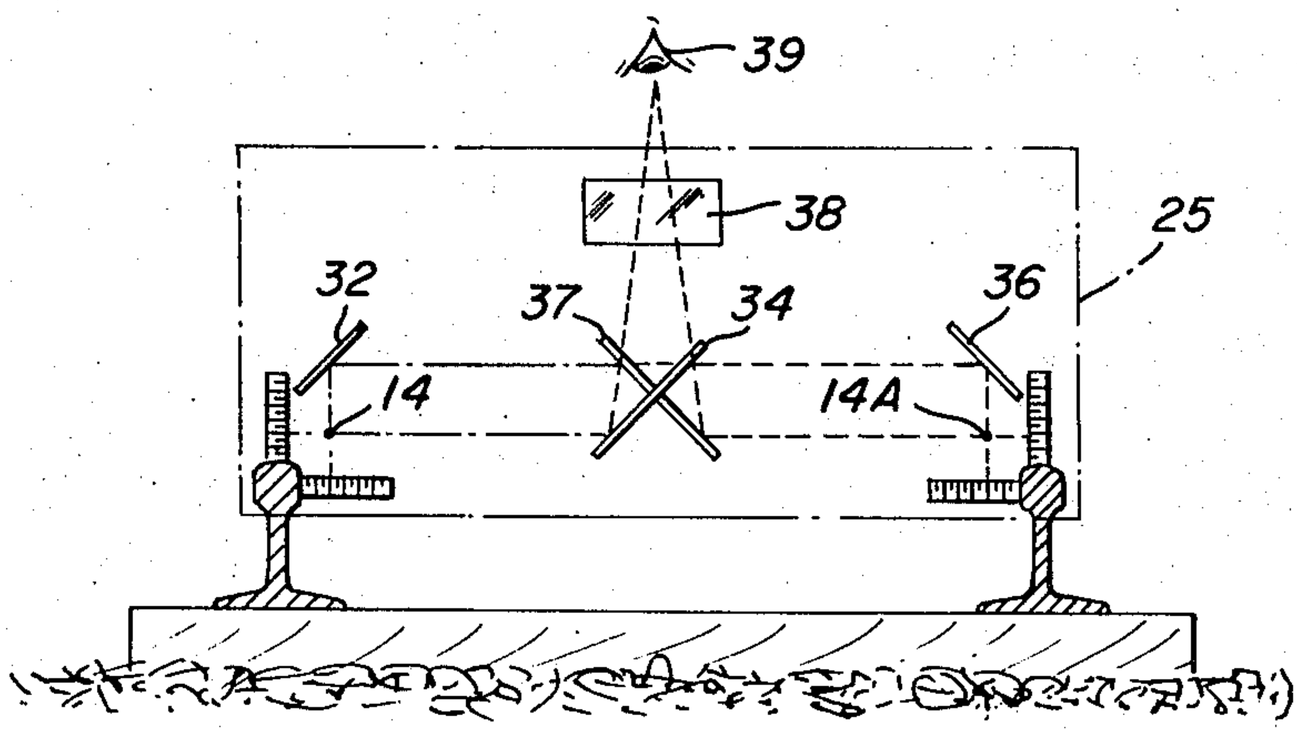


FIG. 3

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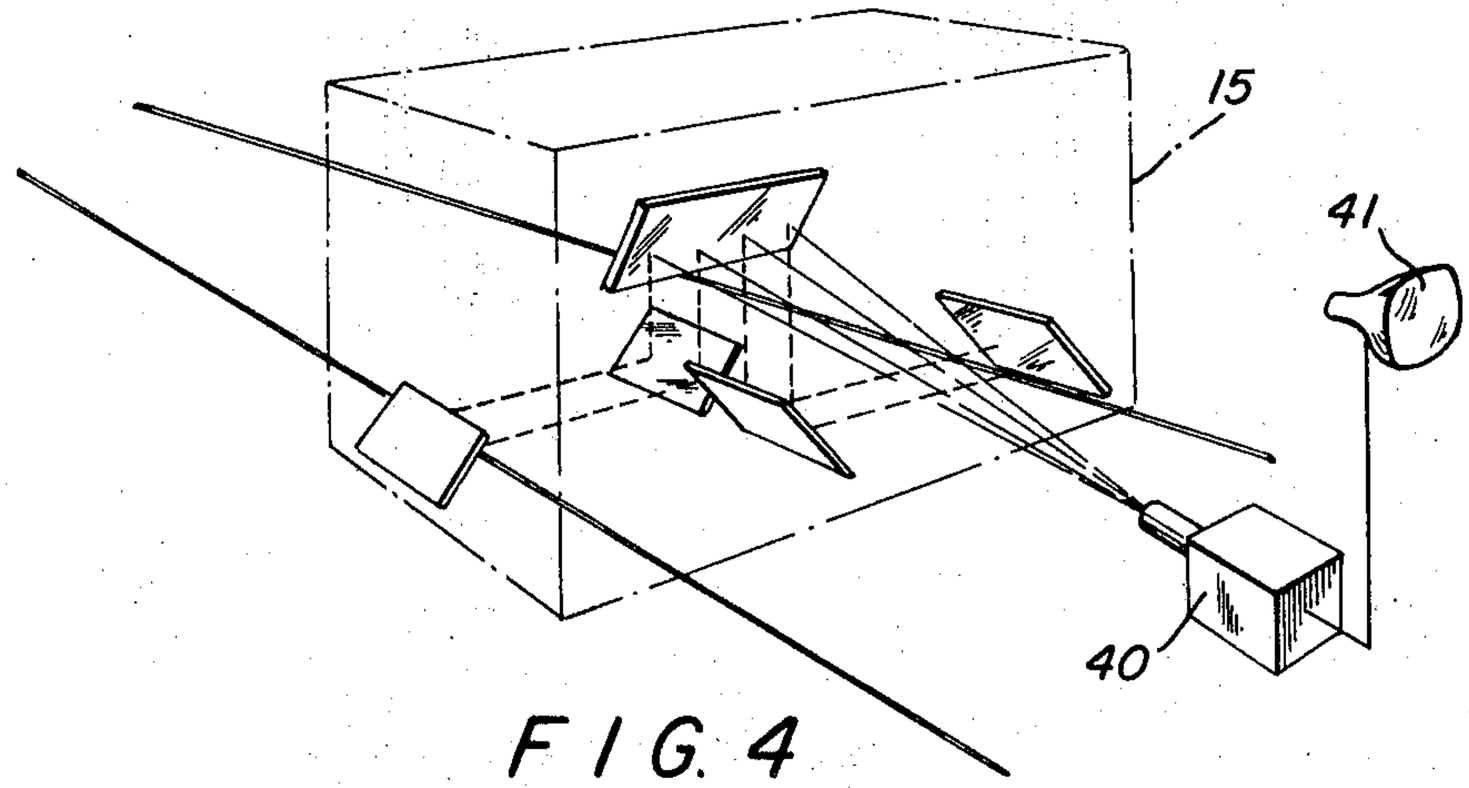

FIG. 4

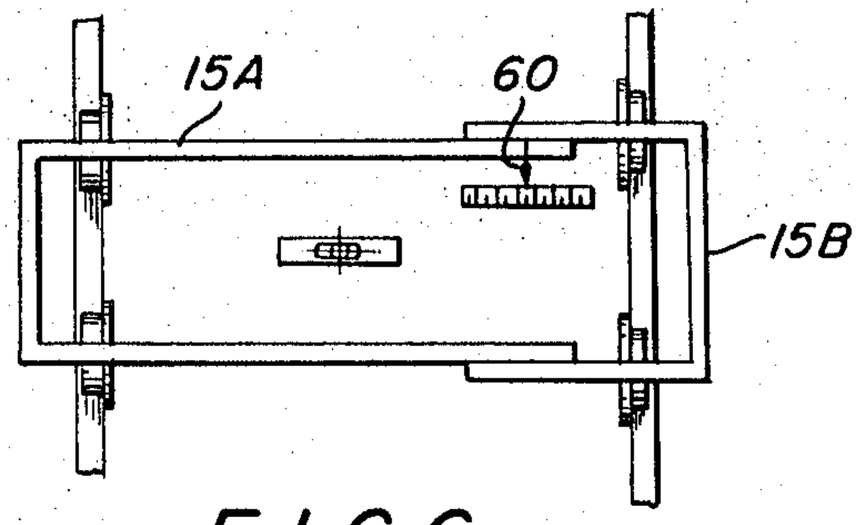

FIG. 6

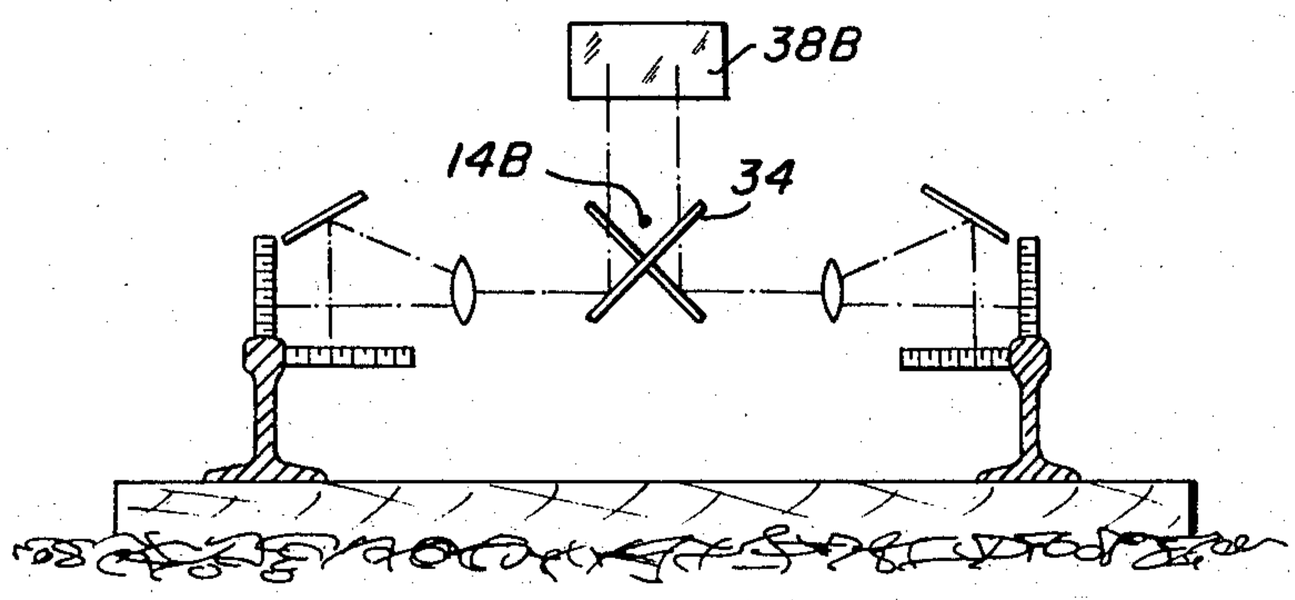

FIG. 5

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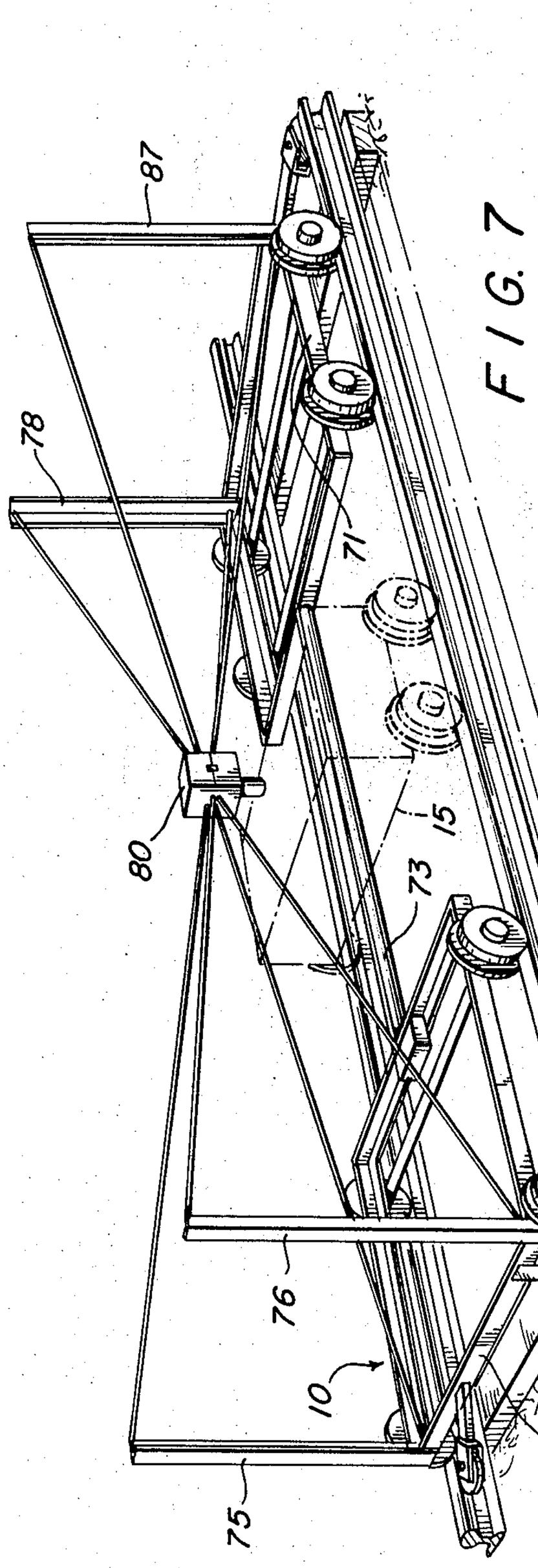

FIG. 7

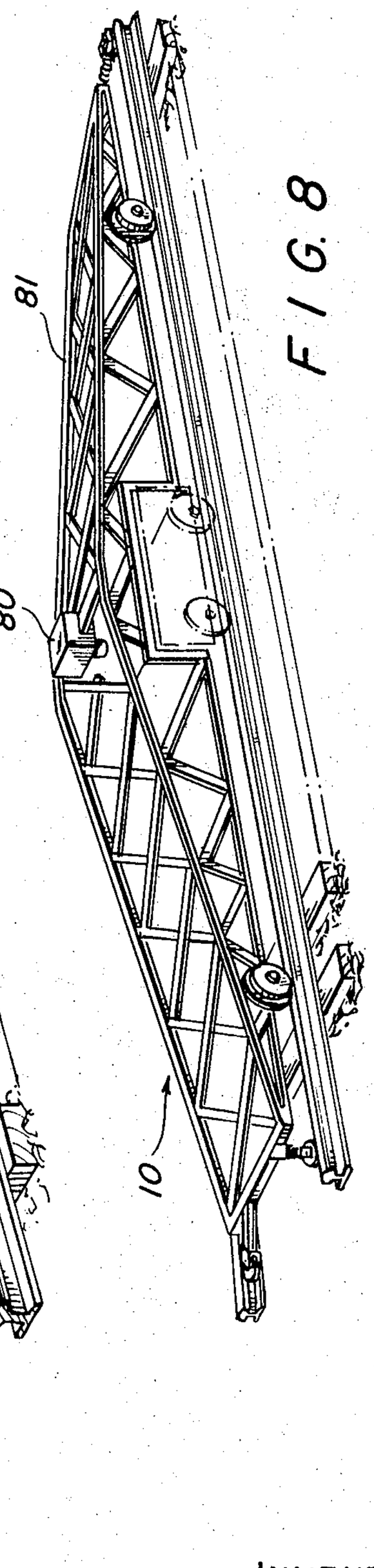

FIG. 8

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INSPECTION METHOD AND APPARATUS FOR TRACK ALIGNMENT

BACKGROUND OF THE INVENTION

The present invention relates to a system for observing the horizontal and vertical alignment of a railroad rail or track and more particularly a device for providing pictorial representation and/or record of such condition.

Heretofore, it has been proposed to provide recording vehicles which pass over a section of railroad track and record graphically the track condition of that section, that is to say, to record the vertical and horizontal alignment of the track relative to a datum. This provides to an engineer responsible for the maintenance of the track, a graphical record of the track condition so that he may determine at his office whether the track condition has deteriorated beyond an acceptable minimum standard and requires maintenance, or whether it is still acceptable. After an analysis of the graphical records, if the engineer decides that corrective operation is required, he orders the necessary measures taken. However, the maintenance machines which operate to perform such corrective measures as vertically aligning and horizontally aligning the track operate to their own individual datum-providing systems which cannot be absolutely referenced to the datums of the track recording vehicle. Furthermore, the datum-providing systems that are available on the market which control the horizontal and vertical corrective operations of the maintenance vehicles are only capable of exerting control at the time of the actual operation of correction and cannot provide a permanent record of the track condition.

SUMMARY OF THE INVENTION

The present invention provides an inspection method for the control of the condition of a railroad track which method comprises the steps of:

a. traversing a portion of railroad track to be inspected with a vehicle;
b. recording on tape by means of a television camera a record of the track condition; and
c. screening the picture so recorded to compare the results with a standard.

The camera may record such data as the condition of the ballast rail anchors and tie plates, tie and rail, the track level and alignment and gauge.

The present invention also provides a system for observing the horizontal and vertical alignment of a railroad track comprising a track travelling vehicle; datum-providing means for the track; a subframe connected to the vehicle, adapted to ride on the rail and referenced thereto; horizontal and vertical scale means on the subframe; and optical means for providing on a screen means a comparative picture of the instantaneous horizontal and vertical alignment of the horizontal and vertical scale means relative to the datum, whereby to provide a picture of the instantaneous horizontal and vertical alignment of the track.

It is a feature of the invention that the picture can be presented on a single screen.

The optical means may include a television camera which may be provided by mounting the camera on a longitudinal track travelling frame, a hairline reference being provided in the camera optical system and longitudinally extending of the tracks.

In an alternative arrangement the datum may be provided by a wire or wires extending longitudinally of the track.

It is a feature of the invention that the apparatus can be used as a control reference system for a maintenance of way vehicle, say, a jacking and tamping vehicle.

The picture of the instantaneous horizontal and vertical alignment of the track provided by the present invention may be recorded for consideration at an engineering office or may be used for actual on-the-spot track corrective operations. Thus the present invention provides in one system the individual facilities found separately in the systems of the prior art.

BRIEF DESCRIPTION OF THE DRAWINGS

The following is a description by way of example of certain embodiments in accordance with the present invention, reference being had to the accompanying drawings in which:

FIG. 1 is a schematic plan view of apparatus in accordance with the invention, two reference wires being diagrammatically shown;

FIG. 2 is a diagram showing the nature of the observations desired to be made when two wires are used to measure alignment and surface;

FIG. 3 is a schematic illustration of an optical system suitable for providing that observation;

FIG. 4 is a diagrammatic representation of the optical system of FIG. 3 including a television camera;

FIG. 5 is a view similar to FIG. 3 indicating the configuration used when a single wire system is provided;

FIG. 6 is a schematic detail of a subframe capable of providing observations of track cross level and track gauge condition; and

FIGS. 7 and 8 are perspective diagrammatic representations of alternative arrangements, a television camera being referenced to the track by a track running frame and in the absence of wire references, an index mark being provided in the camera optical system.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

Referring now to the drawings:

In FIG. 1 a light metal frame 10, comprising six 8 ft. long sections 11 mechanically coupled together, is referenced to the track by means of spring biased rollers 12. Strung between the ends of the frame 10 adjacent and immediately above each rail of the track is a reference wire 14, 14A. Because of the length of the frame 10 the wires 14 and 14A can be considered to be referenced to the track and since over this length track errors would be averaged the wires can be considered to be referenced datum wires. Mounted on the frame 10 but suspended independently thereof on the track and referenced to the track by means of sprung rollers 16 is a subframe. The subframe carries horizontal and vertical scales for each of the wires and an optical system as will presently become apparent. A comparison of the scales on the subframe with the reference wires 14 and 14A provide an indication of the instantaneous track condition at the point at which the subframe 15 rests.

The frame 10 with its associated reference wires 14, 14A and subframe 15 may be propelled by any suitable means, for example the frame could be mounted beneath an inspection car 18 or, where it is desired to inspect track under load conditions the front and rear sections 11 of the frame 10 could be attached to the front and rear portions of a locomotive and the wires 14 and 14A strung beneath the locomotive; subframe 15 with its scales and optical system also being positioned beneath the locomotive independent thereof but propelled thereby. Yet again the frame 10 and its associated members and the subframe 15 could be provided beneath a jacking and tamping machine and the observations obtained from the system could be used to control the operation of the jacking and tamping machine.

In FIG. 2 there is seen the nature of the observations which it is desired to make in order to present a picture of the track condition. centerline on the subframe 15 and associated with the reference wire 14 is a vertical scale 20 and a horizontal scale 21. In the diagram the scales 20 and 21 are shown facing outwardly from the plane of the paper but, of course, in actual practice the scale 21 will lie horizontally so that an optical system which provides an observation point 22 will look down directly on the wire 14 and measure the scale 21 position thereagainst. Similarly, the scale 20 will be vertically arranged and inwardly directed so that from an observation point 24 the wire 14 can be directly compared against the scale 20.

Similar scales 26, 27 are provided for the wire 14A.

In FIGS. 3 and 4 there is illustrated an optical system mounted on the subframe whereby the track alignment and surface condition can be projected onto a single screen. The

observation position 22 of FIG. 2 is provided by means of a mirror 32 which reflects onto a mirror 34, which mirror also provides the observation point 24 and, similarly, mirrors 36 and 37 provide the observation points for the reference wire 14A. Mirrors 37 and 34 then project onto a single mirror 38, which provides the observation position 39 so that an observer looking into the plane of the paper at the angled mirror 38 is provided with a view which he would have had had he taken a downwardly observing position from the observation position 39.

In FIG. 4 the mirror 38 has a television camera 40 focused thereon and the television camera records the picture displayed on the mirror 38 for either instantaneous reproduction on a television screen 41, which television screen may be directly coupled on a closed circuit with the television receiver 40 or may be at a remote point, for example the engineering office of the railroad, on which the picture may be received on the railroad's own microwave system or may be used for analysis and comparison from a tape at a later date.

In FIG. 5 there is shown an optical system mounted on the subframe 15 which is similar to the optical system of FIG. 3 but in this instance it will be observed that a single centrally located reference wire 14B is provided in place of the reference wires 14 and 14A. In view of the long optical path between the reference wire 14B and the scales 20B and 21B as reflected in the mirror 34B and thence the mirror 38B, a corrective lens system 32C and 36C may be provided.

In FIG. 6 the subframe 15 beneath the mirror 38 is shown to be made in two sections 15A and 15B telescopic one to the other. A reference marker 60 on the portion 15B when read against the portion 15A provides an immediate picture of the gauge condition of the track. Also a cross-level bubble provided on the section 15A provides in the screen 38 an immediate picture of the cross-level condition of the track.

In FIG. 7 there is shown an arrangement in which the frame 10 is split into two sections 70 and 71 connected by a rigid link 73. The frame 10 is again referenced to the track. Standing upright from the rear corners of the section 70 and from the leading corners of the section 71 are upright posts 75, 76, 77 and 78. Four cables are cross-connected, one from the top of the post 75 to the base of post 77, one from the top of the post 78 to the bottom of post 76, one from the top of post 77 to the bottom of post 75 and one from the top of the post 76 to the bottom of post 78. Mounted on these cables is a camera lens system diagrammatically indicated at 80. This camera observes a mirror and scale system on subframe 15 but in this embodiment the reference wires 14, 14A and 14B are replaced by a hairline or hairlines inscribed on the optical screen of the television camera. Preferably one hairline is provided extending in the longitudinal direction of the track and a second hairline is positioned transversely of the track to form a cross-wire arrangement. Thus, the camera will be able to observe the relation to the scales to the cross-wires and to provide a picture of the track condition.

In FIG. 8 a trussed structure 81 which is made of a light rigid metal braced in a manner to give maximum rigidity, forms the frame 10. Again the frame is referenced to the track and a subframe 15 floats therebetween and is itself referenced in the manner aforementioned. Again a camera 80 is rigidly mounted on the structure 81 and its optical screen is provided with longitudinally extending hairline or hairlines. Although camera 80 and subframe 15 are shown positioned at the center of the longitudinal span of the frame 10, it will be clear that it could occupy any other position on the frame if certain ratios were desired.

In operation it will be observed that the system of the present invention can be made to pass over the track and record for immediate or later use the state of the track condition. If desired, the quite well-known method of "stringlining" could be performed with the device and where it is desired to perform such method, the frame could suitably be made the conventional 66 feet long so that the mid-ordinate of the scale, measured in inches, could be referenced directly to the radius of the curve. Measurements can be conventionally taken at joint and centers, i.e. quarter rail lengths, and a suitable counting mechanism referenced to a track engaging wheel, and driving counterrecorded by the camera, could be provided where more precise, condition data is desired.

As has been stated, the present method and apparatus provides a system which can be used on the spot to control a track maintenance function or could be used to make long term records of track conditions. Suitably, where a camera is used, a grid or other scale device could be employed in the optical system and an engineer observing an inspection tape could, at a glance, by comparing against the grid, observe the precise spots at which work was required to maintain the track to the standards set by the grid. Inspection films could be made before and after tamping operations and could be compared on side by side monitors or on the same screen in order to get an instantaneous impression of the success of the track-working operation which had been performed.

As before, some suitable counting mechanism could show a distance reference on the screen.

It is also contemplated that audio channels could be provided for any one function of the system and could be used, for example, by the track-working foreman to advise that at this point the jacking and tamping machine had to stop and wait the arrival of further ballast, tie plates or the like, or record any other useful information which would assist in the planning of future operations.

It is to be understood that the invention also contemplates a situation where the reference wire or wires are not attached to the frame but are tagged to the track at a predetermined reference position prior to the arrival of the remainder of the system of the invention.

We claim:

1. A system for observing the horizontal and vertical alignment of a railroad track comprising a track-travelling vehicle; datum providing means for the track; a subframe connected to the vehicle, adapted to ride on the rail and referenced thereto; horizontal and vertical scale means on the subframe; and optical means for providing on a single screen means a comparative picture of the instantaneous horizontal and vertical alignment of the horizontal and vertical scale means relative to the datum, whereby to provide a picture of the instantaneous horizontal and vertical alignment of the track.

2. A system as claimed in claim 1 in which the optical means includes a television camera; and wherein the datum is provided by mounting the camera on a long track-travelling frame and providing a hairline reference longitudinally extending of the track in the camera optical screen.

3. A system for observing the horizontal and vertical alignment of a railroad track comprising a track-travelling vehicle; datum wire means extending longitudinally of the track; a subframe connected to the vehicle, adapted to ride on the rail and referenced thereto; horizontal and vertical scale means on the subframe; and optical means for providing on a single screen a comparative picture of the instantaneous horizontal and vertical alignment of the horizontal and vertical scale means relative to the datum wire means, whereby to provide a picture of the instantaneous horizontal and vertical alignment of the track.

4. Apparatus as in claim 3 wherein the optical means includes a television camera and wherein the screen is a television screen.

5. A system as claimed in claim 3 in which the datum wire means comprises two datum wires extending longitudinally of the track one adjacent each rail, the subframe being referenced to the track; and in which the horizontal and vertical scale means comprise horizontal and vertical scales for the grade rail and for the other rail; the optical means providing on said single screen a comparative picture of the instantaneous horizontal and vertical alignment of each of the horizontal and vertical scales relative to its appropriate datum wire.

6. Apparatus as claimed in claim 5 in which the subframe is in two sections telescoped one to the other transversely of the

track, scale means being provided on one section and marker means being provided on the other section whereby to provide, by comparison of marker and scale, the instantaneous gauge condition of the track.

7. Apparatus as in claim 3 wherein the datum wire means is attached to the track-travelling vehicle and moves therewith.

8. A system as claimed in claim 7 in which the track-travelling vehicle has separate carriages mechanically connected together.

9. A system as claimed in claim 3 in which the datum wire means comprises a single wire and in which the horizontal and vertical scale means comprise horizontal and vertical scales for the grade and for the other rail; said optical means providing on said single screen a comparative picture of the instantaneous horizontal and vertical alignment of both horizontal and both vertical scales relative to the datum wire.

10. Apparatus as claimed in claim 9 wherein the datum wire is located substantially centrally of the track.

11. A system as in claim 12 wherein indicator means is provided in the horizontal plane on the subframe, movable transversely and referenced to the track to further provide a pictorial indication on the screen of the instantaneous gauge condition of the track.

12. A system for observing the horizontal and vertical alignment of a railroad track having at least one rail comprising a track travelling vehicle, datum-providing means for the track, a subframe connected to the vehicle, adapted to ride on the rail and referenced thereto and means for optically displaying on a single screen the movement of the subframe relative to the datum-providing means.