March 5, 1968 J. K. STEWART 3,371,619

MEANS FOR DETERMINING TRACK ALIGNMENT

Original Filed Oct. 10, 1963 3 Sheets-Sheet 1

FIG. 1

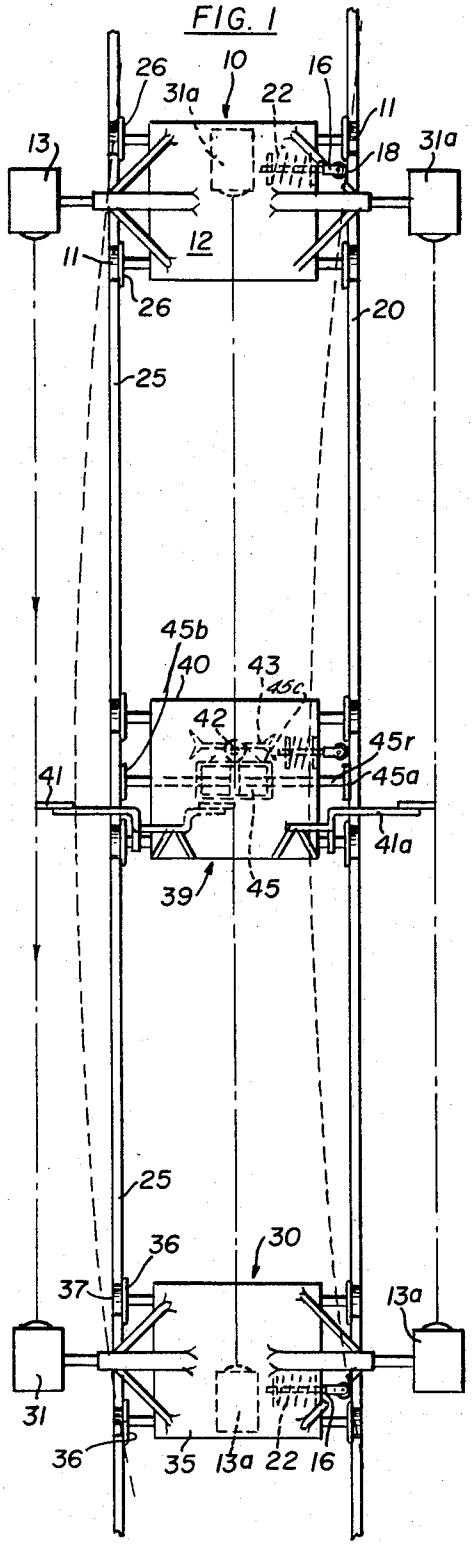
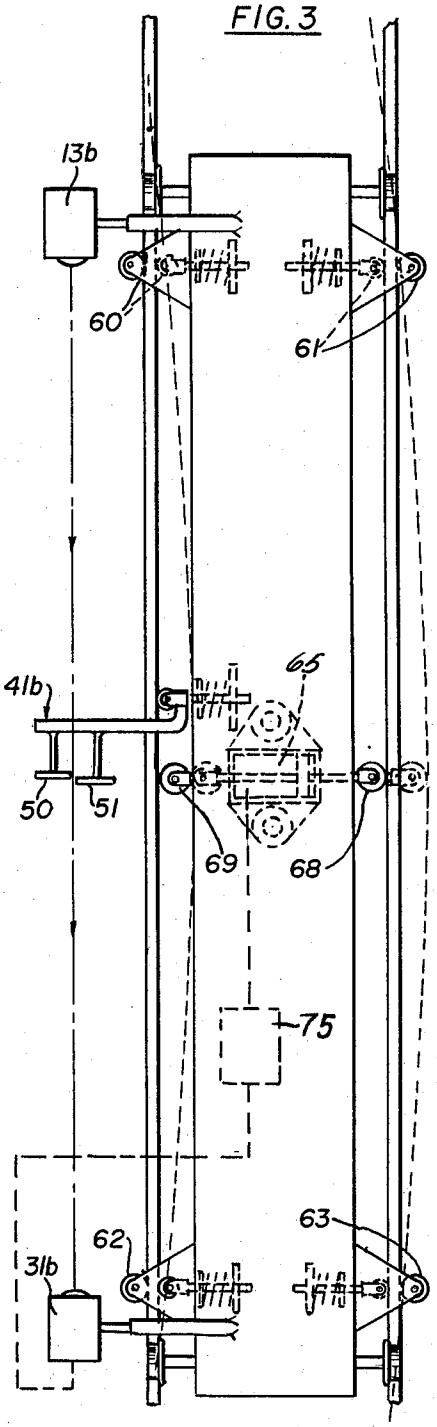


FIG. 3



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MEANS FOR DETERMINING TRACK ALIGNMENT

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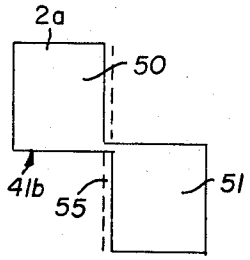

FIG. 2A

FIG. 2

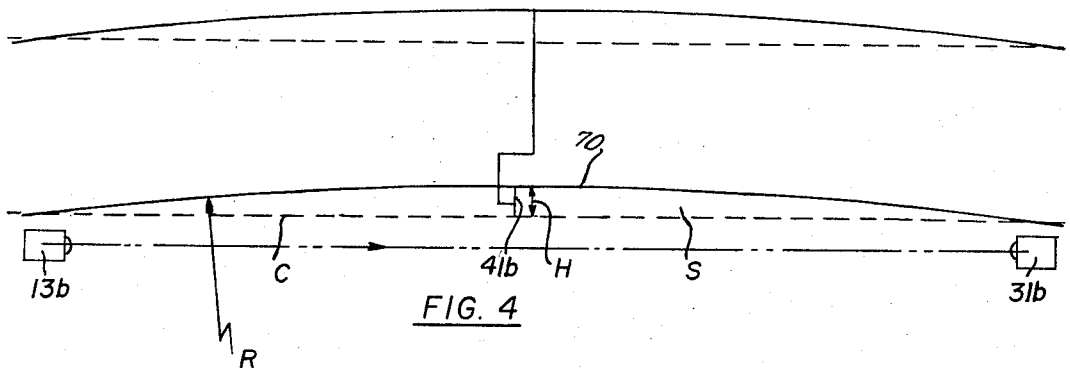

FIG. 4

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MEANS FOR DETERMINING TRACK ALIGNMENT

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FIG. 5

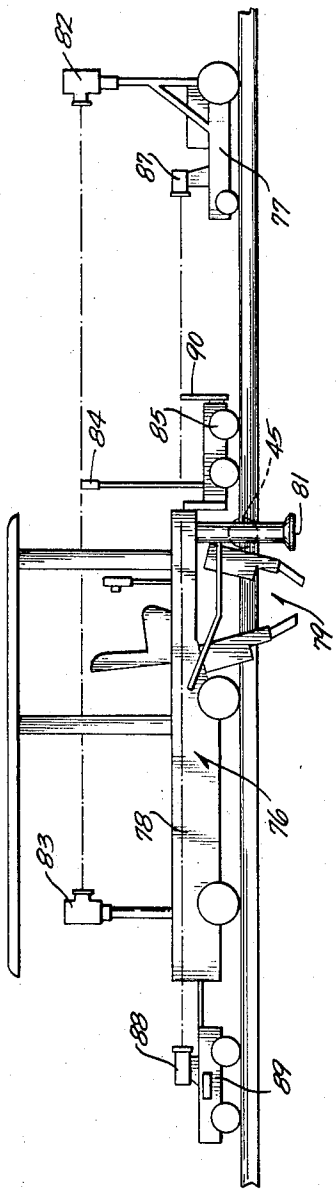
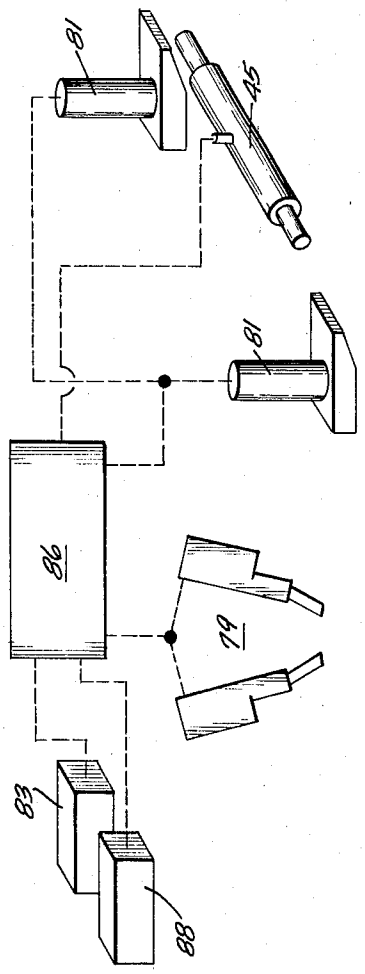


FIG. 6



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3,371,619

MEANS FOR DETERMINING TRACK ALIGNMENT

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Continuation of application Ser. No. 526,946, Jan. 20, 1966, which is a continuation of application Ser. No. 315,239, Oct. 10, 1963. This application Jan. 24, 1967, Ser. No. 611,470

Claims priority, application Canada, Oct. 15, 1962, 860,141

21 Claims. (Cl. 104—8)

This application is a continuation application based on United States application Ser. No. 526,946, filed Jan. 20, 1966, now abandoned, which application is, in turn, a continuation application based upon United States application Ser. No. 315,239, filed Oct. 10, 1963.

This invention relates to apparatus for lining, surfacing and tamping track on a railroad.

In my copending application No. 121,075, now United States Patent No. 3,144,834, issued Aug. 18, 1964, I have referred to my earlier United States application Ser. No. 55,071, filed Sept. 9, 1960, now United States Patent No. 3,177,813, issued Apr. 13, 1965, and I have described and claimed an apparatus for surveying a railroad track with regard to the railroad track surface that is, the vertical curves in the track. In my earlier applications, the apparatus comprised, in part, a tamping machine including tamping means and a control system for coordinating tamping and track surfacing. In connection with the track surfacing, I utilized a high frequency beam transmitter and receiver which, when used with a sensing element in the form of a shadow board and means responsive to beam interference by the shadow board or sensing element, produced an indication of track surface condition which was employed by the control system to effect track jacking and tamping.

I have now found that by biasing a high frequency transmitter carrying carriage against the grade rail, by spacing therefrom a beam receiver on a second carriage which is also biased against a grade rail and by interposing therebetween a sensing device which is itself biased against the grade rail and carries a beam interference means or shadow board, I can, by providing means responsive to beam interception, obtain an indication of track alignment, that is the horizontal curves in the track, and can utilize a control system to employ said indication to effect lateral track displacement in coordination with the track surfacing and tamping functions provided by the apparatus disclosed in my United States Patents 3,177,813 and 3,144,834.

Preferably I use an infra red beam transmitter and receiver and in practice I prefer to project the infra red beam immediately adjacent the grade rail.

The device according to my present invention may be used to measure the alignment in tangent track utilizing the commonly used civil engineering principles to obtain an accurate indication of track alignment.

In the accompanying drawings I have indicated one manner of putting my invention into effect.

FIGURE 1 is a schematic plan view showing the arrangement of my apparatus on tangent track.

FIGURE 2 is a diagrammatic illustration of possible respective positions for transmitter and receiver units and a shadow board;

FIGURE 2A is an illustration of a suitable shadow board configuration;

FIGURE 3 is a plan view of an alternative construction;

FIGURE 4 is a diagram showing a working arrangement for curved track;

FIGURE 5 is a side elevational view of apparatus similar to that disclosed in my United States Patent 3,144,834; and

FIGURE 6 is a schematic showing of a control system incorporated in an apparatus in accordance with the invention.

There is shown in FIG. 1 apparatus for working railroad track which comprises three wheeled vehicles **10**, **30**, and **39** and which includes means for determining the state of track lateral alignment and track throwing jacks operative to laterally displace the tracks in response to a command generated as a result of the operation of the means for determining the state of track lateral alignment. More particularly, the first wheeled vehicle **10** is provided with flanged wheels **11** and frame **12** carrying high frequency beam transmitter means. In the disclosed construction such means is in the form of an infra red beam transmitter **13** which is mounted at about rail level. The vehicle has a spring biased push rod **16**. The push rod carries a wheel **18** which is pressed against the rail **20** (known as the other rail hereinafter) and the whole frame **12** is urged by the spring **22** against the grade rail **25** until the flanges **26** of the wheels **11** engage firmly against the grade rail.

The second vehicle **30** carries a high frequency beam receiver means, which, in the disclosed construction is in the form of an infra red receiver **31** located near rail level. The vehicle **30** is similarly provided with a push rod **16** and spring **22** to resiliently bias its frame **35** against the grade rail **25** so that the flanges **36** of the wheels **37** engage the grade rail in exactly the same manner as the flanges **26** on the first vehicle.

Interposed between the first and second vehicles is a wheel mounted carriage or vehicle **39** which comprises a frame **40** spring biased against the grade rail **25** in exactly the same fashion as the first and second vehicles and which is provided with a beam interception means accordingly associated with the track and therefore adapted to follow the location of the track and to sense horizontal track misalignment. In the construction disclosed in FIG. 1, such beam interception means is in the form of a shadow board **41** located near rail level, which shadow board acts to interfere with the infra red beam transmitted from the transmitter **13** to the receiver **30**.

When the apparatus comprising the first and second vehicles and the intermediate shadow board **41** proceeds along tangent track the condition of the track alignment at the point where the shadow board **41** is located, is indicated by interference with the transmitted beam between transmitter and receiver in a manner similar to that described in my aforementioned Patent No. 3,144,-834 for indicating the track surface condition. That is to say, if the track is out of alignment at the point where the shadow board **41** is located (in the manner indicated by the greatly exaggerated dotted lines) the receiver **31** does not receive the signal from the transmitter **13** since the shadow board, being biased with the frame **40** against the grade rail, interferes with the transmitted signal. This failure on the part of the receiver **31** to receive the transmitted beam may be utilized to operate an acceptable indicating means or to trigger the operation of a control system. For example a photoelectric cell in the receiver **31** could be caused, when it has the transmitted beam cut off therefrom, to permit a solenoid to drop out and light an indicating lamp or to initiate, through the control system, track correcting action such as the operation of the aligning jack **45**.

To this end, there is provided the previously mentioned track throwing jacks which, in the disclosed construction, comprises a hydraulic jack **45** which is of the conventional type and which is actuated by the control system in response to operation of the beam receiver **31**. Such a

jack could conveniently have a vertically arranged hydraulic cylinder **42** capable of pushing a ballast engaging anchor **43** into the ballast and a transversely arranged hydraulic cylinder **45***c* in which a double-acting piston is arranged having a transversely extending piston rod **45***r* with rail engaging shoes **45***a* and **45***b* at the ends of the rod. The failure of the receiver **31** to receive the transmitted beam may, by conventional means in the form of the control system shown schematically at **75** in FIG. 3 for actuating or governing a mechanical, electrical, or hydraulic operation of the jacks or tamping means, cause the operation of the cylinder **42** to drive the anchor **43** into the ballast and to operate the hydraulic cylinder **45***c* to cause the shoe **45***a* to engage the rail **20** and throw the track against the reaction of the anchor **43** until such time as the receiver **31** is once more opened to the transmitted beam by the sideways movement with the track of the shadow board **41** on the frame **40**. As soon as the shadow board is moved out of the line of the transmitted beam the jacking operation is discontinued by the control system **75**.

A second transmitter and receiver **13A**, **31A** which can, if desired, be reversed in order, is provided as indicated in FIGURE 1 either on the right or opposite side, or generally between the tracks and is used in the same manner with a second shadow board **41***a* to operate when the track is out of alignment in the direction opposite to that indicated by the dotted lines. Suitable arrangements will of course need to be used for biasing the device against the grade rail and to operatively connect the receiver **31A** to the control system **75**.

In FIGURES 2, 2A an alternative apparatus is shown. Here one transmitter **13***b* is used with two receivers **31***b* and **31***c* mounted one on top of the other. A shaped shadow board **41***b* such as shown in FIGURE 2A having upper and lower transversely spaced shadow panels **50**, **51** is mounted on an intermediate wheeled vehicle or sensor carriage and the shadow board operates to exclude light from one or the other of the receivers **31***b*, **31***c*. When the track is aligned, both receivers **31B**, **31C** receive the transmitted beam through what practically speaking amounts to a slot **55** (FIGURE 2A) the width of which is determined by the permissible tolerance of error in alignment. The receiver **31***b* and **31***c* transmit their track alignment correcting signals to a control system which operates the jack **45** in a conventional manner.

Clearly the system would also be capable of operation in reverse, that is to say, when the receiver acts to give an "out of alignment" indication while receiving the transmitted beam, merely by reshaping the shadow board.

If the distance between the vehicle **10** and the vehicle **30** is selected to be 100 ft. then use can be made of standard railroad surveying tables and standard surveying techniques can be utilized.

In practice the spacing of the three vehicles is selected to give the best results for the particular working conditions obtaining.

A further alternative construction is seen in FIGURE 3. Here the three vehicles of the embodiments of FIGURES 1, 2 and 2A have been replaced by single long rigid frame vehicle. The rigid frame is for the purpose of simplicity shown as a plate. The shadow board and transmitter receiver system may be as seen in FIGURES 2 and 2A with the shadow board being mounted for relative transverse movement on the vehicle and biased against the grade rail. In this construction the shadow board assembly acts as the beam interception means. However the jack **65** differs in operation from the track aligning jack **45** in that no ballast anchor is provided rather, rollers **68**, **69** are provided at the ends of the jack rods and the track throwing signals originated by the receivers **31***b*, **31***c* and transmitted by the control system act to cause the jack to push against one of the rails of the track and by the reaction to this push by rollers **60**, **61**, **62**, **63** tend to straighten the rail and thus to throw the track. This latter system has the advantage that the track aligning process is a continuous one, the vehicle moving slowly substantially all the time.

FIGURE 4 shows how the device may be used on curved track. The curved track has a radius of curvature R. The width H of segment S on the cord C can be predetermined mathematically or obtained from existing railroad surveys. By having the shadow board preadjusted to extend beyond the grade rail by an amount equivalent to the width H of segment S the condition of tangent track is reproduced as indicated in dotted lines and the shadow board senses the errors of the curved track.

For convenience of description, the infra red transmitted signal has been hereinbefore described as a beam. In practice, the transmitted signal is actually in the nature of a cone and the shadow board acts to cut down the intensity of the received beam rather than to cut a transmitted pencil beam.

Turning once more to FIGURE 3 and to its use in conjunction with the device of my aforementioned Patent No. 3,144,834, it will be understood that any suitable form of roller device **60**, **61**, **62**, **63** may be provided which possibly need not be in constant contact with the rails but would only contact the rails at the actual track aligning jacking cycle. Furthermore, it is also to be understood that the track aligning operation performed by the means for determining the state of lateral track alignment and the jack **45** or roller device **60**, **61**, **62**, **63** could be tied into the track lifting jacking system of my Patent 3,144,834 so that the control system operates to effect jacking and aligning, together with tamping, in a predetermined sequence at each tie. That is to say, by conventional means, the hydraulic system for the jack **45** could be coordinated with the track lifting jacks of the device of my aforementioned Patent No. 3,144,834 in such a manner that in addition to raising the track at each tie, the track could be aligned at each tie. In addition the tamping operation can be coordinated with the lining and surfacing. It may, under certain circumstances, be desirable to position the jack **45** somewhat more forwardly of the vehicle than is shown in FIGURE 3, and indeed the jack may well be positioned so far forward that the track aligning by the jack **45** is performed on track which has been raised by the track lifting jacks.

A considerable advantage is obtained when a system according to the present invention is used in conjunction with the device of my aforementioned Patent No. 3,144,834 in that a system for correcting the vertical and horizontal curves of the track and tamping is thereby produced. In this regard there is shown in FIG. 5 an apparatus **76** generally according to U.S. Patent No. 3,144,834 and including a forward carriage **77** and a tamping machine or carriage **78** which carries tamping means in the form of a suitable tamper **79** of conventional construction, and a pair of track surfacing or lifting jacks **81** located adjacent to the rails. Incorporated on the apparatus **76** is means for determining the state of vertical track alignment including high frequency beam transmitter means in the form of a light beam transmitter **82** mounted on the forward carriage **77**, beam receiver means in the form of a receiver **83** mounted on the rearward end of the tamping machine **78**, and a shadow board **84** which is carried on a wheeled carriage **85** immediately adjacent to and in front of the tamping machine **78** and which follows the vertical height of the track. The track lifting or surfacing jacks **81** are operatively connected to the beam receiver **83** through a control system **86** (shown schematically in FIG. 6) to afford vertical aligning of the rails in accordance with commands from the beam receiver **83**.

Also included in the apparatus **78** shown in FIG. 5 is means for determining the state of track lateral alignment including high frequency beam transmitter means in the form of a transmitter **87** on the carriage **77**, beam receiver means in the form of a receiver **88** which can

be located either on the tamping machine **78** or on a dolley **89** pulled by the tamping machine **77** as shown in FIG. 5. Such means also includes a shadow board **90** which can be carried on the carriage **85** and which, as already explained, can be biased with respect to one of the rails, and interrupt the beam from the transmitter **87** to the receiver **88**. Cooperating with the means for determining track lateral alignment and operating in response to signals therefrom, is a track throwing device or means such as the jack **45** or the rollers **60, 61, 62, 63.**

Shown in FIG. 6 is a schematic representation of the control system **86** which coordinates the lining features of the invention with the device of my Patent 3,144,834. As previously indicated the lining and surfacing receivers **88** and **83**, respectively, are operatively connected to the control system **86** which is a generally conventional electrical and hydraulic construction of the general type referred to in my earlier Patents 3,144,834 and 3,177,813. As also previously indicated, the control system **86** is connected to the track throwing jacks **45** and to the track lifting jacks **81** and to the tamper **79** and functions to afford coordinated action in predetermined sequence of the tamper and of the lifting and throwing jacks in response to signals and commands from the surfacing and lining receivers **83** and **88** respectively. Thus, the control system **86** operates to automatically and selectively displace the tracks in opposing lateral directions and to effect raising of the tracks by governing operation of the track throwing and track raising jacks and to automatically operate the tamping means, all in prearranged sequence. Preferably the track lining operation is sequenced to occur subsequent to track raising operation and the tamping operation occurs subsequent to commencement of the track surfacing and lining operation.

Conceivably also a single shadow element **50** could be provided between a single transmitter and a single receiver and the double acting jack **45** would receive signals to "throw right" or "throw left" depending upon whether or not the receiver was exposed to the transmitter or shadowed therefrom, or vice versa. That is to say, a conventional switching arrangement could be employed to cause the jack to work in one direction or the other depending on whether or not the misalignment of the track caused that shadow element to obscure the receiver from the transmitted beam or allow it to be received. Thus jack **45** would be maintained more or less in a "hunting" condition.

What is claimed is:

1. Apparatus for determining the horizontal misalignment of a railway track comprising a system adapted to run on the track; means for biasing the system against a reference rail; high frequency beam transmitter means mounted on the system to transmit longitudinally of the track; a pair of beam receivers on the system spaced from the transmitter and aligned to receive the transmission from said transmitter means; and beam interference means on the system and associated with each of said beam receivers and adapted to be responsive to discrepancies in horizontal track alignment; said beam interference means being located between said transmitter means and said receivers; one of said receivers being operative to produce a signal when the track is out of horizontal alignment in one direction and the other of said receivers being operable to produce a signal when the track is out of horizontal alignment in the opposite direction.

2. Apparatus for determining the horizontal misalignment of a railway track comprising a system adapted to run on the track; means for biasing the system against a reference rail; high frequency beam transmitter means mounted on the system to transmit longitudinally of the track; a pair of beam receivers mounted one above the other on the system spaced from the transmitter, and aligned to receive the transmission from said transmitter means; and a pair of spaced shadow panels on the system and located between the transmitter means and the receivers, one above the other in transversely spaced relationship; the upper shadow panel being operatively associated with the upper receiver and adapted to sense horizontal track misalignment in one direction; the lower shadow panel being operatively associated with the lower receiver and adapted to sense track misalignment in the opposite direction; said receivers being respectively operable to produce a signal in response to the interruption of the beam.

3. Apparatus as claimed in claim **2** wherein said system comprises three wheeled vehicles, said transmitter means being mounted on a first of said vehicles; the pair of receivers being mounted on a second of said wheeled vehicles; and said shadow panels being mounted on a third of said vehicles located intermediate said first and second vehicles.

4. Apparatus for determining the horizontal misalignment of a railway track comprising a system adapted to run on the track; means for biasing the system against a reference rail; high frequency beam transmitter means mounted on the system to transmit longitudinally of the track; a pair of beam receivers on the system spaced from the transmitter and aligned to receive the transmission from said transmitter means; and an adjustable shadow board carried by the system to be extended beyond the grade rail by any predetermined amount, said shadow board being adapted to be responsive to discrepancies in horizontal track alignment; said shadow board being located between said transmitter means and said receivers; said receivers being operative to provide a signal in response to interruption of the beam by said shadow board as a result of horizontal track misalignment.

5. Apparatus for determining and correcting for the horizontal misalignment of a railway track comprising a system adapted to run on the track; means for biasing the system against a reference rail; high frequency beam transmitter means mounted on the system to transmit longitudinally of the track; a pair of beam receivers on the system spaced from the transmitter and aligned to receive the transmission from said transmitter means; an adjustable shadow board carried by the system so as to be extended beyond a datum point by any predetermined amount, said shadow board being adapted to be responsive to discrepancies in horizontal track alignment; said shadow board being located between said transmitter means and said receivers; and jack means connected to said pair of beam receivers for aligning the track horizontally in response to signals received from the beam receivers.

6. Apparatus for determining and correcting for the horizontal misalignment of a railway track comprising a system adapted to run on the track; means for biasing the system against a reference rail; high frequency beam transmitter means mounted on the system to transmit longitudinally of the track; a pair of beam receivers mounted one above the other on the system spaced from the transmitter, and aligned to receive the transmission from said transmitter means; and a pair of spaced shadow panels on the system and located between the transmitter means and the receivers, one above the other in transversely spaced relationship; the upper shadow panel being operatively associated with the upper receiver and adapted to sense horizontal track misalignment in one direction; the lower shadow panel being operatively associated with the lower receiver and adapted to sense horizontal track misalignment in the opposite direction; and jack means connected to said pair of beam receivers for aligning the track horizontally in response to signals received from the beam receivers.

7. Apparatus for determining and correcting for the horizontal misalignment of a railway track comprising a system adapted to run on the track; means for biasing the system against a reference rail; high frequency transmitter means mounted on the system to transmit longitudinally of the track; beam receiver means on the system spaced from the transmitter means and aligned to receive the transmission therefrom; beam interference means on

the system spaced from the transmitter means and aligned to receive the transmission therefrom; beam interference means on the system adapted to be responsive to discrepancies in horizontal track alignment, said beam interference means being located between said transmitter means and said receiver means; and transversely extending jack means mounted on the system for shifting the track horizontally in one direction in response to interruption of the transmission from the transmitter means to the beam receiver means and for shifting the track horizontally in the opposite direction in response to reception of the transmission from the transmitter means by the beam receiver means so as to maintain the jack means in a hunting condition when the apparatus is in operation.

8. Apparatus for working railroad track comprising a wheeled vehicle, means for determining the state of vertical track alignment, a pair of track lifting jacks on the vehicle, said pair of jacks being respectively located adjacent to the rails and operatively connected to said means for determining the state of vertical track alignment for respectively vertically aligning the rails of the track in accordance with a command from said means, means for determining the state of lateral track alignment and including a high frequency beam transmitter means, a high frequency beam receiver means, and a beam interception means associated with the track, a second jack attached to the vehicle and operatively connected to said beam receiver means for laterally aligning the tracks in accordance with a command from said beam receiver means, and tamping means on the vehicle to tamp the track in addition to vertical and lateral track alignment by said jacks.

9. Apparatus for working railroad track comprising a wheeled vehicle, means for determining the state of vertical track alignment and including a first high frequency beam transmitting means, a first high frequency beam receiving means and a first beam interception means associated with the track, a pair of track lifting jacks on the vehicle, said pair of jacks being respectively located adjacent to the rails and operatively connected to said first beam receiver means for respectively vertically aligning the rails of the track in accordance with a command from said first beam receiver means, means for determining the state of lateral track alignment and including a second high frequency beam transmitter means, a second high frequency beam receiver means, and a second beam interception means associated with the track, a second jack attached to the vehicle and operatively connected to said second beam receiver means for laterally aligning the tracks in accordance with a command from said second beam receiver means, and tamping means on the vehicle to tamp the track in addition to vertical and lateral track alignment by said jacks.

10. Apparatus for working railroad track comprising a wheeled vehicle, at least one other wheeled carriage, means for determining the state of vertical track alignment and including a first high frequency beam transmitting means supported on one of said wheeled carriages, a first high frequency beam receiving means, and a first beam interception means associated with the track, a pair of track lifting jacks on the vehicle, said pair of jacks being respectively located adjacent to the rails and operatively connected to said first beam receiver means for respectively vertically aligning the rails of the track in accordance with a command from said first beam receiver means, means for determining the state of lateral track alignment and including a second high frequency beam transmitter means supported on one of said wheeled carriages, a second high frequency beam receiver means, and a second beam interception means associated with the track, a second jack attached to the vehicle and operatively connected to said second beam receiver means for laterally aligning the tracks in accordance with a command from said second beam receiver means, and tamping means on the vehicle to tamp the track in addition to vertical and lateral track alignment by said jacks.

11. Apparatus for determining and correcting horizontal misalignment of a railway track, said apparatus comprising a system adapted to run on the track; means for biasing the system against a reference rail; high frequency beam transmitter means mounted on the system to transmit a beam longitudinally of the track; beam receiver means on the system spaced from the transmitter means and aligned to receive the transmission therefrom; a pair of spaced surfaces on the system adapted to be responsive to discrepancies in horizontal track alignment, said pair of spaced surfaces being located between said transmitter means and said receiver means, and transversely extending jack means mounted on the system for shifting the track horizontally in one direction in response to a first signal generated by the beam receiving means as a consequence of one relation of the surfaces relative to the beam and for shifting the track horizontally in the opposite direction in response to another signal generated by the beam receiving means as a consequence of another relation of the surfaces relative to the beam.

12. Apparatus for working railroad track comprising a wheeled vehicle, tamping means attached to said vehicle for tamping the track, means attached, at least in part, to said vehicle for determining the state of track lateral alignment, track throwing jacks attached to said vehicle for laterally displacing the track, and a system operatively connected to said means for determining the state of track lateral alignment and to said track throwing jacks for automatically and selectively displacing the track in opposing lateral directions and for automatically operating said tamping means and said track throwing jacks in pre-arranged sequence.

13. Apparatus in accordance with claim 12 wherein said means for determining the state of track lateral alignment comprises a light beam transmitter, receiver means located to sense the receipt of light from said transmitter and operatively connected to said system, and a shadow board located intermediate said light beam transmitter and said shadow board and adapted to follow the location of the track.

14. Apparatus for working railroad track comprising a wheeled vehicle, means attached, at least in part, to said vehicle for determining the state of track lateral alignment, track throwing jacks attached to said vehicle for laterally displacing the track, track lifting jacks attached to said vehicle for vertically raising the track, means attached, at least in part, to said vehicle for determining the state of track vertical alignment, and a system operatively connected to said track throwing and lifting jacks and to said means for determining the state of lateral and vertical track alignment for automatically raising the track and for automatically selectively displacing the track in opposing lateral directions.

15. Apparatus in accordance with claim 14 wherein said means for determining the state of track lateral alignment comprises a first light beam transmitter, first receiver means located to sense the receipt of light from said first transmitter and operatively connected to said system, and a first shadow board located intermediate said first transmitter and said first receiver means and adapted to follow the location of the track, and wherein said means for determining the state of track vertical alignment comprises a second light beam transmitter, second receiver means located to sense the receipt of light from said second transmitter and operatively connected to said system, and a second shadow board located intermediate said second transmitter and said second receiver means and adapted to follow the location of the track.

16. Apparatus for working railroad track comprising a wheeled vehicle, means attached, at least in part, to said vehicle for determining the state of track lateral alignment, track throwing jacks attached to said vehicle for laterally displacing the track, track lifting jacks attached

to said vehicle for vertically raising the track, means attached, at least in part, to said vehicle for determining the state of track vertical alignment, and a system operatively connected to said track throwing and lifting jacks and to said means for determining the state of lateral and vertical track alignment for automatically raising the track, for automatically selectively displacing the track in opposing lateral directions, and for automatically operating said track lifting jacks and said track throwing jacks so that said track throwing jacks operate to laterally displace the track subsequent to track raising by said track lifting jacks.

17. Apparatus in accordance with claim **16** wherein said means for determining the state of track lateral alignment comprises a first light beam transmitter, first receiver means located to sense the receipt of light from said first transmitter and operatively connected to said system, and a first shadow board located intermediate said first transmitter and said first receiver means and adapted to follow the location of the track, and wherein said means for determining the state of track vertical alignment comprises a second light beam transmitter, second receiver means located to sense the receipt of light from said second transmitter and operatively connected to said system, and a second shadow board located intermediate said second transmitter and said second receiver means and adapted to follow the location of the track.

18. Apparatus for working railroad track comprising a wheeled vehicle, tamping means on the vehicle for tamping the track, means attached, at least in part, to said vehicle for determining the state of track lateral alignment, track throwing jacks attached to said vehicle for laterally displacing the track, track lifting jacks attached to said vehicle for vertically raising the track, means attached, at least in part, to said vehicle for determining the state of track vertical alignment, and a system operatively connected to said tamping means, to said track throwing and lifting jacks, and to said means for determining the state of lateral and vertical track alignment for automatically raising the track, for automatically selectively displacing the track in opposing lateral directions, and for automatically operating said tamping means, said track lifting jacks, and said track throwing jacks in pre-arranged sequence.

19. Apparatus in accordance with claim **18** wherein said means for determining the state of track lateral alignment comprises a first light beam transmitter, first receiver means located to sense the receipt of light from said first tranmsitter and operatively connected to said system, and a first shadow board located intermediate said first transmitter and said first receiver means and adapted to follow the location of the track, and wherein said means for determining the state of track vertical alignment comprises a second light beam transmitter, second receiver means located to sense the receipt of light from said second transmitter and operatively connected to said system, and a second shadow board located intermediate said second transmitter and said second receiver means and adapted to follow the location of the track.

20. Apparatus for working railroad track comprising a wheeled vehicle, tamping means attached to said vehicle for tamping the track, means attached, at least in part, to said vehicle for determining the state of track lateral alignment, track throwing jacks attached to said vehicle for laterally displacing the track, track lifting jacks attached to said vehicle for vertically raising the track, means attached, at least in part, to said vehicle for determining the state of track vertical alignment, and a system operatively connected to said tamping means, to said track throwing and lifting jacks, and to said means for determining the state of lateral and vertical track alignment for automatically raising the track, for automatically selectively laterally displacing the track in opposing directions, and for automatically operating said tamping means, said track lifting jacks, and said track throwing jacks in pre-arranged sequence at each tie of the track such that said track throwing jacks operate to laterally displace the track subsequent to track raising by said track lifting jacks.

21. Apparatus in accordance with claim **20** wherein said means for determining the state of track lateral alignment comprises a first light beam transmitter, first receiver means located to sense the receipt of light from said first transmitter and operatively connected to said system, and a first shadow board located intermediate said first transmitter and said first receiver means and adapted to follow the location of the track, and wherein said means for determining the state of track vertical alignment comprises a second light beam transmitter, second receiver means located to sense the receipt of light from said second transmitter and operatively connected to said system, and a second shadow board located intermediate said second transmitter and said second receiver means and adapted to follow the location of the track.

No references cited.

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UNITED STATES PATENT OFFICE

CERTIFICATE OF CORRECTION

Patent No. 3,371,619 March 5, 1968

John Kenneth Stewart

It is certified that error appears in the above identified patent and that said Letters Patent are hereby corrected as shown below:

Column 6, line 75, cancel "beam interference means on". Column 7, lines 1 and 2, cancel "the system spaced from the transmitter means and aligned to receive the transmission therefrom --.

Signed and sealed this 17th day of February 1970.

(SEAL)
Attest:

Edward M. Fletcher, Jr.
Attesting Officer

WILLIAM E. SCHUYLER, JR.
Commissioner of Patents