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APPARATUS FOR ALIGNING CURVES

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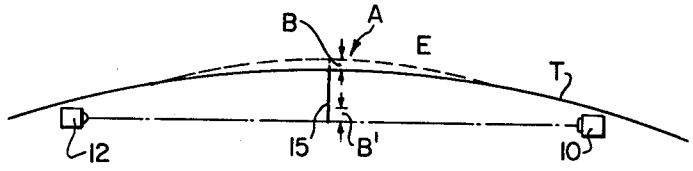

Fig.1.

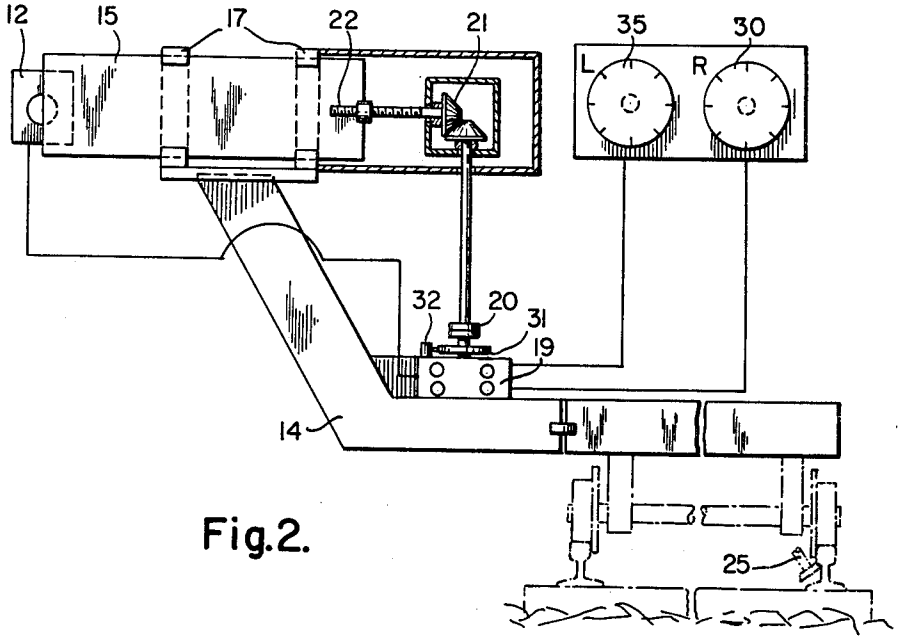

Fig.2.

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APPARATUS FOR ALIGNING CURVES

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ABSTRACT OF THE DISCLOSURE

A method and apparatus for aligning curves between tangent and circular track in which a reference line is formed generally longitudinally of the track and to one side thereof by means of; a light beam transmitter mounted for movement along the track; a light beam receiver spaced therefrom and oriented to receive the transmitted beam, transmitter and receiver being arranged at fixed spacings from and at the same side of the track and referenced thereto, and; a shadow board mounted on the track between transmitter and receiver and referenced to the track, the shadow board being transversely extended outwardly of the track or retracted to optically align transmitter, receiver and shadow board to produce the reference line and, after forming the reference line, superposing a further positive or negative motion on the shadow board to move the shadow board out of alignment by a predetermined track correction factor and thereafter operating a jacking means to throw the track in a sense determined by the beam receiver to re-align the shadow board, transmitter and receiver and thereby correct the error.

BACKGROUND OF THE INVENTION

In the past, attempts have been made to align circularly curved track by means of the so-called string lining method and, in U.S. Patent No. 3,371,619, there is shown a device which may be used to take advantage of this principle with a light beam transmitter, a light beam receiver and a shadow board. In co-pending U.S. application Ser. No. 471,285, now Patent No. 2,411,455, there is shown an automatic device utilizing a light transmitter, a light receiver and a shadow element to form a reference line and a second system of light transmitter, light receiver and shadow board to align the track to the reference line so established. This device produced smooth transition curves in accordance with principles preprogrammed into the system. Certain railroads require the lining of transition curves to a staked reference and will not accept any fluctuations from the staked curve making it very difficult to pre-program for the curve.

It is an object of the present invention to provide a system which can have predetermined corrections applied thereto, after forming a reference line, so that a precomputed positive or negative correction factor can be applied to cause the alignment of the transition curve to pre-staked requirement.

SUMMARY OF THE INVENTION

Accordingly, the present invention provides a method of correcting the horizontal misalignment of railway transition curves comprising forming a reference line to the curve by optically aligning a transversely movable shadow board positioned at a track correcting station between a light beam transmitter and a light beam receiver spaced therefrom; superposing a predetermined positive or negative correction factor on the shadow board to move it out of alignment; and correcting the track by horizontally shifting it in a sense determined by the beam receiver to re-align shadow board, transmitter and receiver.

The present invention also provides apparatus for correcting the horizontal misalignment of railway transition curves comprising light beam transmitter means, horizontally referenced to the track and mounted for movement along the track and adapted to project a light beam generally longitudinally of the track; a light beam receiver spaced from the transmitter, horizontally referenced to the track and mounted for movement along the track and oriented to receive the light beam; a shadow board, horizontally referenced to the track and mounted for movement along the track between the transmitter and the receiver; means for moving the shadow board transversely of the track which means is controlled from the receiver to move the shadow board in one direction or another transversely of the track in a sense determined by reception at the receiver; and means to further move the shadow board transversely of the track to apply a track correction factor to the shadow board.

BRIEF DESCRIPTION OF THE DRAWING

The following is a description, by way of example, of an embodiment of the present invention, reference being had to the accompanying drawings, in which:

FIGURE 1 is a diagrammatic representation of the mode of operation of the device, and

FIGURE 2 is a schematic representation of one means of applying a correction factor to the shadow board.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

Referring now to the drawings, in FIGURE 1, the solid line T indicates the desired configuration of a transition curve, or spiral. The dotted configuration E is an exaggerated indication of misalignment of the track in the horizontal plane, at a point A, the error being in a positive sense, that is to say, in a sense which increases the radius of curvature, the extent of the error being indicated by B.

It is to be assumed that the transition curve has been previously measured to stakes and that the error of the track positively or negatively (that is to say, in a sense which reduces the radius of curvature) at each staked point, such as A, has been marked either on the stake or a desired correction has been indicated at a particular tie. An averaging of the errors to the staked absolute may also have been conducted and appropriately marked on the ties.

A light beam transmitter, such as the infra-red transmitter **10**, directs a beam of light generally longitudinally of the track where it is picked up by a receiver **12**. Transmitters and receivers of this type are well known in the art and preferably the transmitter is mounted for movement independently of the receiver **12** on a self-propelled satellite car. The receiver **12** may conveniently be located for movement along the track behind, or at the rear of, a track aligning vehicle of standard configuration carrying a track throwing jack to move the track horizontally to the left or to the right. The transmitter **10** and the receiver **12** can conveniently be mounted so as each to be at a fixed spaced distance transversely of one side of the track, and referenced thereto.

Mounted on a frame **14** (FIGURE 2) adjacent the track aligning jack is a transversely extending shadow board **15**. The shadow board may be arranged in guides **17** and driven so as to be extended transversely outwardly, or retracted back towards, the track by means of an electric motor **19** driving through a clutch **20**, a bevel gear **21** and lead screw **22**. The frame, and consequently the shadow board, is referenced to the track in the usual fashion as indicated by the referencing wheel **25**.

In order to establish a reference line for the transition curve T, it is necessary to know three points on the curve. Since the transmitter **10** and the receiver **12** are at a fixed spacing to one side of the track, the third point is established by extending the shadow board into the path of the beam until its tip is aligned with the transmitter and the receiver. In practice, this is preferably performed as a hunting operation. That is to say, when the shadow board **15** is not in the path of the receiver **12**, it, in conventional fashion, sends a command signal to the motor **19** to drive the lead screw **22** to extend the shadow board **15** outwardly until it reaches a point where it obscures the receiver **12** from the transmitter **10**. As soon as the transmitted beam is cut off, the receiver **12** sends a command signal to the motor **19** to retract the shadow board **15** towards the track. Almost instantly the receiver **12** will again see the transmitted light and will, once more, send a command signal to move the shadow board forward to a point where it will, once again, obscure the receiver from the transmitter. At the termination of this hunting operation, the shadow board is automatically, in conventional form, locked in its position and the reference line is established.

It will be clearly seen from FIGURE 1 that the shadow board, which is now at point A, needed to be extended by the error distance B more than the distance which would be necessary to provide the versine to the curve Γ had the curve T been in its ideal position. Indicated on the tie at point A, or on the stake at point A, will be the magnitude and direction of the error B, in this instance, say, an error of +5. The operator, by operating the rotary switch **30**, which is of standard configuration, causes the application of a series of calibrated pulses to the motor **19** to retract the shadow board. The rotary switch **30** is conveniently calibrated so that the operator can apply a −5 indication on the switch **30** and the shadow board will be retracted by an amount which agrees with the error marked on the tie or stake. A standard servo follow-up loop including a cam **31** and a counting switch **32**, ensures that the shadow board is moved the required distance.

The shadow board is now retracted by a distance B′, which is the same as B, and the stage is set for a track correcting operation. Now the receiver **12** sees the transmitted beam from the transmitter **10** and calls, in standard fashion, upon the track throwing jack to move the track from the dotted position E to the full line position Γ. As the track is moved, the locked shadow board **15** is moved with it until the shadow board obscures the transmitted beam from the receiver **12** at which point the jacking terminates and the track has been corrected.

Had the error been in the negative sense, then the superposition of the correcting factor would have been through switch **35** which would have caused the extension of the shadow board **15** by the required amount and, in this instance, when the correcting step is initiated, the receiver **12**, not seeing the transmitted beam, orders the track throwing jack to move the track, with the shadow board thereon, so that the error is corrected. As before,

as soon as the shadow board has been moved far enough with the track, the receiver **12** observes the transmitted beam and jacking is terminated.

It is to be understood, of course, that any other suitable means could be utilized to superpose the correction factor on the shadow board, for example, a mechanical lead screw may be provided which is suitably calibrated and hand operated.

What I claim as my invention is:

1. Apparatus for correcting the horizontal misalignment of railway curves comprising light beam transmitter means, horizontally referenced to the track and mounted for movement along the track and adapted to project a light beam generally longitudinally of the track; a light beam receiver spaced from the transmitter, horizontally referenced to the track and mounted for movement along the track and oriented to receive the light beam; a track condition sensor including a frame, horizontally referenced to the track and mounted for movement along the track between the transmitter and the receiver; a shadow board mounted on said frame; motor means for moving the shadow board on the frame transversely of the track which motor means is controlled from the receiver to move the shadow board inwardly or outwardly transversely of the track in a sense determined by reception at the receiver, whereby to establish a reference line; and means for superposing a command signal on the motor means to further move the shadow board transversely of the track to apply a track correction factor to the shadow board.

2. Apparatus as claimed in claim **1** in which the transmitter and receiver are arranged at one side of the track at a fixed transverse spacing therefrom.

3. Apparatus as claimed in claim **1** in which the means for moving the shadow board transversely of the track comprises an electric motor connected to extend the shadow board transversely outwardly of the track in response to beam reception by the receiver and to retract the shadow board when the receiver is obscured from the transmitter.

4. Apparatus as claimed in claim **3** in which the means for further moving the shadow board to apply the track correction factor, comprises a rotary switch operable to cause the motor to extend the shadow board and a second rotary switch operable to cause the motor to retract the shadow board, the switches operating through a servo follow-up system.

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