# United States Patent [19]

**Plasser, deceased et al.**

[11] **3,875,865**

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[54] **APPARATUS FOR CORRECTING THE POSITION OF A TRACK**


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[52] **U.S. Cl.**..... **104/7 R;** 33/287; 104/8

[51] **Int. Cl.**..... **E01b 33/02**

[58] **Field of Search**..... 33/60, 287; 104/7, 7 B, 104/8, 7 R



[56] **References Cited**

UNITED STATES PATENTS

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|---|---|---|---|
| 3,604,359 | 9/1971 | Doorley et al. | 104/8 |
| 3,659,345 | 5/1972 | Plasser et al. | 104/7 R |
| 3,662,687 | 5/1972 | Helgemeir | 104/7 R |



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[57] **ABSTRACT**

In the correction of a track point in relation to a reference extending past this point along the track from a corrected into an uncorrected track section, wherein a basic parameter indicates the position of one track point and the correction of the uncorrected track point is determined by a set ratio of the basic parameter, the correction ratio is selectively changed, preferably increased, and the track is moved at this track point until the changed correction ratio has been reached. The apparatus includes track position and track position correction indicators at the one track point and the track point in the uncorrected track section, respectively, a control establishing a set ratio between signals emitted from the indicators, which ratio determines the desired track position, and means for selectively changing the set ratio while the reference remains constant.


**5 Claims, 4 Drawing Figures**

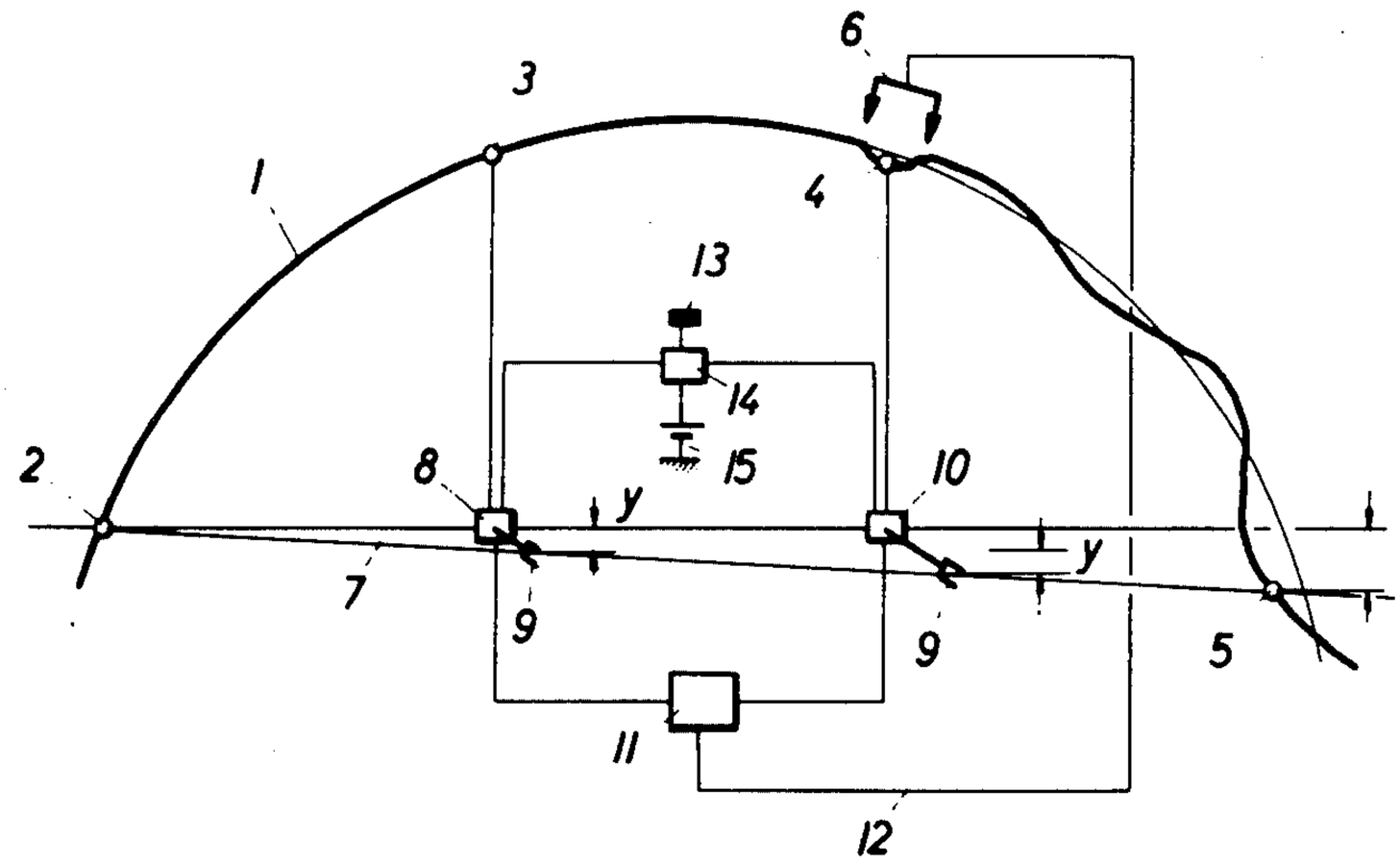

FIG. 1

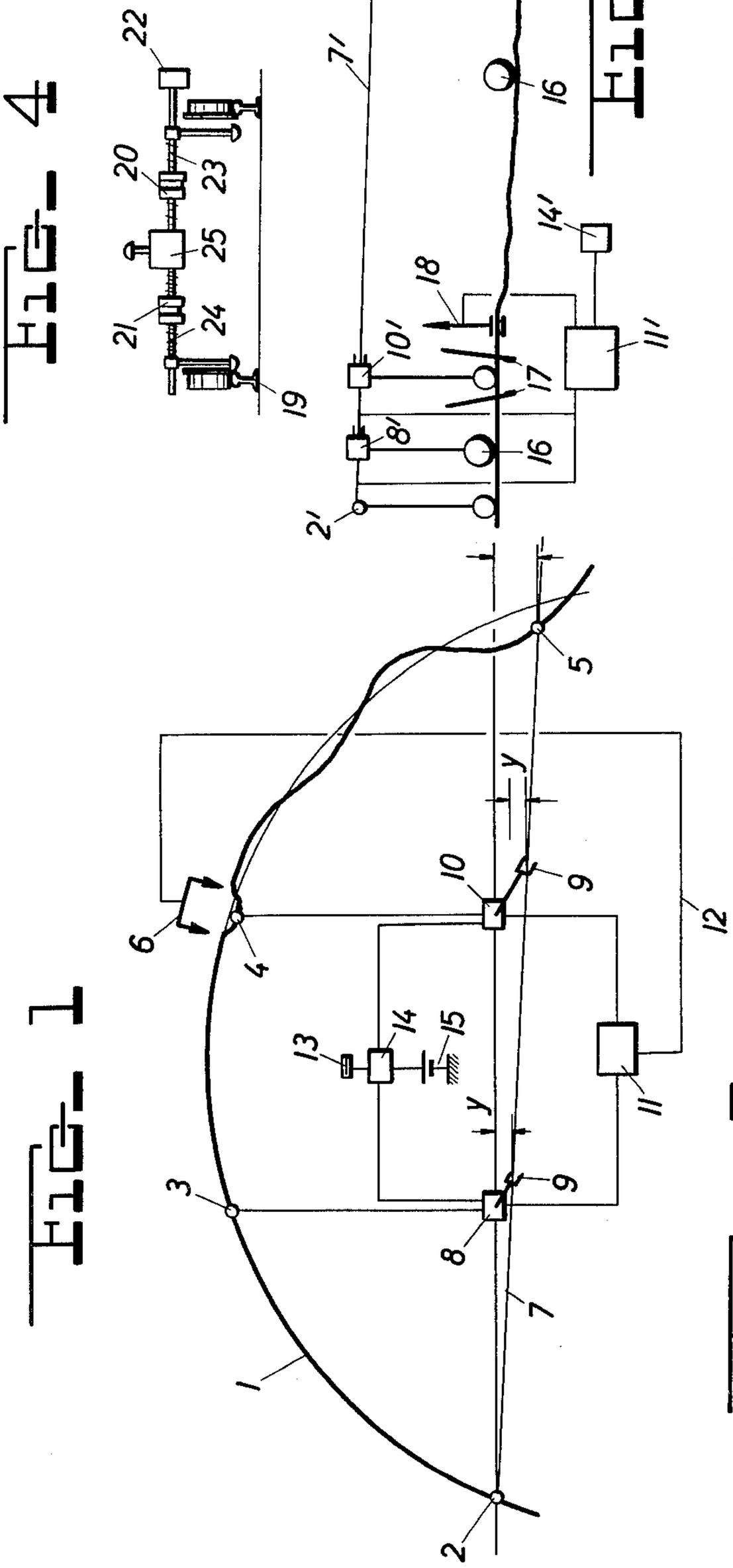


FIG. 2

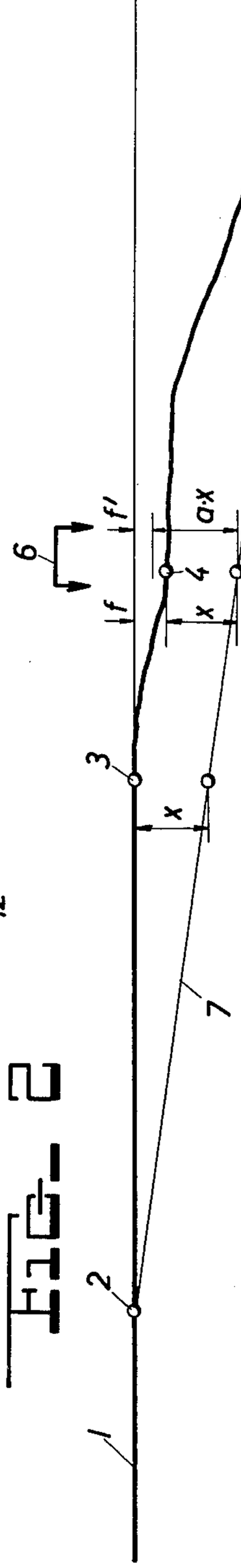


FIG. 3




FIG. 4

# APPARATUS FOR CORRECTING THE POSITION OF A TRACK

The present invention relates to improvements in a system of correcting the position of a track point in an uncorrected track section in relation to a reference extending past this track point along the track from a corrected track section into the uncorrected track section, wherein a basic or characteristic parameter indicating the position of one track point is produced and the correction of the position of the track point in the uncorrected track section is determined by a set ratio of this parameter,

Track correction systems of this general type are known. For instance, U.S. Pat. No. 3,314,154, dated April 18, 1967, describes a so-called two-chord system wherein a first, longer chordal reference line is extended between two end points of a track section, the position of a first track point is measured and indicated in relation to this reference line to provide a basic parameter and an analogous parameter is derived therefrom for the same point in relation to a second, shorter reference line extended between one of the end points and a second point of the track section to be corrected, the analogous parameter being a function of the set ratio between the lengths of the reference lines. The second track point is then moved until it has reached the analogous parameter in relation to the second reference line.

U.S. Pat. No. 3,343,496, dated Sept. 26, 1967, describes a so-called one-chord track correction system wherein the height of the arc or ordinate of a first track point in a corrected track section in relation to a reference line is measured and indicated, and the ordinate of a second track point in the uncorrected track section is then derived as a set ratio of the measured ordinate to obtain the correction ratio, the second track point then being moved until the correction ratio has been reached.

Both systems are inherently inaccurate since one of the end points of the reference is in the uncorrected track section, thus causing a deviation of the reference, the extent of inaccuracy depending solely on the deviation of this one reference end point from the desired track position. The farther this reference end point is removed or spaced from the desired track position, the greater the residual correction error due to the correspondingly incorrect position of the reference. This applies to track lining as well as track leveling or grading.

It is the primary object of this invention to reduce this residual correction error in track correction systems of the indicated type to a minimum.

This object is accomplished by selectively changing the correction ratio and moving the track at the track point in the uncorrected track section until the changed correction ratio has been reached. Preferably, the correction ratio is increased.

This makes it possible to reduce the correction error considerably and to come quite close to an ideally correct track position when a track section is corrected which has points deviating in opposite directions from the desired correct position.

It has been found useful to begin track correction operations along an extended length of track by using the conventional systems to provide a first, previously corrected track section, and then proceed with the system of the invention for the rest of the operation.



The apparatus comprises a reference line having one end in the uncorrected track section and another end in a previously corrected track section, a track position indicator associated with a track point in the corrected track section and cooperating with the reference line to produce a signal corresponding to the position of the track in the corrected track section, and a track position correction indicator associated with the track point in the uncorrected track section and cooperating with the reference line to produce a signal corresponding to the desired correction of the position of the latter track point. Track correction means is positioned at the track point in the uncorrected track section, which is responsive to the signal produced by the track position correction indicator and which moves the track point to the desired position in response to the latter signal, and a control establishes a set ratio between the signals of the track position indicator and the track position correction indicator, which ratio determines the desired position.

In accordance with the present invention, the operator of such an apparatus has the possibility of carrying out the above-described method therewith by providing on the apparatus a means for selectively changing the set ratio while the reference line remains in a constant position. This means is associated with the control.

The above and other objects, advantages and features of the present invention will become more apparent from the following detailed description of certain now preferred embodiments thereof, taken in conjunction with the accompanying drawing wherein

FIG. **1** schematically illustrates lining of a track curve with a single chordal reference;

FIG. **2** similarly shows lining of a straight or tangent track section;

FIG. **3** schematically illustrates leveling of a track section; and

FIG. **4** is a schematic side view of the measuring spindle of a track measuring carriage working with two chordal references.

Referring now to the drawing, wherein like reference numerals designate like parts functioning in a like manner, FIG. **1** shows an arcuate or circularly curved track section or track curve **1** defined by track points **2, 3, 4** and **5.** Points **2** and **3** are in the previously corrected track section, point **2** constituting one of the end points of track curve **1.** Point **4** constitutes the track correction point, i.e., the point of the track whose position is being corrected in accordance with the present invention by schematically indicated track correction tool **6.** Point **5** constitutes the other end point of the track curve in an uncorrected section thereof. Chordal reference line **7,** which may be a tensioned wire, extends between end points **2** and **5** of the track curve.

It is, of course, possible to use other means than tensioned wires for the chordal references, for instance a reference beam of radiated energy emitted at one of the end points and received at the other end point. As is well known in track correction operations of this type, track measuring carriages or bogies are mounted on the track rails at each of the track position defining points **2, 3, 4** and **5,** and these carriages are pressed against the grade rail to fix these points accurately in the established reference system.

A track position indicator **8** is mounted at corrected track point **3** at a fixed distance from the grade rail. In-

dicator **8** comprises a forked member **9** receiving and engaging chordal reference **7** in a manner permitting free movement of the reference in the forked member, and a potentiometer connected to the forked member so as to indicate the position of the reference at this point and to emit a signal corresponding to the measured track position.

A track correction indicator **10** is mounted at track position correction point **4,** also at a fixed distance from the grade rail and similarly comprising a forked member **9** receiving and engaging chordal reference **7** in a like manner, the potentiometer connected to forked member **9** indicating the position of the reference at point **4** and emitting a signal corresponding to the required correction of the track position at this point.

In the illustrated embodiment, corrected track point **3** and correction track point **4** are symmetrically positioned in respect to the center point of the circularly curved track section **1** so that the heights of the arc or ordinates at indicators **8** and **10** should be the same after correction, i.e., the ratio of the parameters indicating the corrected track position and the track position to be corrected is 1:1.

A track correction control **11** is connected to the potentiometers of indicators **8** and **10** to receive the signals therefrom, the electrical control circuit including a control line **12** connecting the control **11** to a drive for track correction tool **6** to move the tool, which grips the track rails, until the ordinates *y* at points **3** and **4** are the same, i.e., have a ratio of 1:1.

However, since the end point **5** of the chordal reference **7** is in the uncorrected track section, this correction procedure involves a residual error, as will be more fully explained in connection with FIG. **2.**

While FIG. **2** shows lining of a straight track section, the procedure is, in principle, identical with that for a track curve since a straight track section is merely a tangent track, i.e., a circularly curved track section of infinite radius. For this reason, identical numerals in FIG. **2** refer to identical parts, thus avoiding redundancy in the description.

The track position indicator at track point **3** (not shown in FIG. **2**) shows an error *x* of the position of the reference **7** in respect of the grade rail, which is due to the deviation of the reference end point **5** from the straight track. Thus, with a correction ratio of 1 : 1 at point **4,** if the track correction tool **6** moves the track at point **4** the same distance *x*, a residual positional error *f* will remain at point **4** after correction. This residual error may be reduced to distance *f'* if the correction ratio is increased in accordance with this invention so that track point **4** is moved by distance *ax* instead of distance *x*.

This arbitrary change in the correction ratio may be obtained, for instance, in the manner schematically shown in FIG. **1.** As illustrated, the correction control circuit comprises a voltage source **15** delivering electric current to the potentiometers at forked members **8** and **10,** and resistors **14** operable by rotary head **13** in the current delivery line so as to reduce the voltage delivered to the potemtiometer at forked member **10** associated with the track point to be corrected. If the voltage delivered to the potentiometer at forked member **8** associated with the corrected track point remains constant, the correction ratio or the ratio of the voltage of the signals emitted by the potentiometers will be so changed that the voltages will balance again only when the track point **4** is moved a longer distance.

FIG. **3** shows the system of this invention applied to track leveling or grading. It will be understood that this does not differ, in principle, from track lining since, in track leveling, the plane of correction is merely turned by 90°, i.e., the track is moved in a vertical instead of a horizontal plane.

As shown if FIG. **3,** the reference **7'**, which is illustrated as a tensioned wire, extends from corrected end point **2'** to forward end point **5'** in the uncorrected or ungraded track section. In the schematically illustrated embodiment, the track leveling is effected in a generally well known manner by a mobile track leveling and tamping machine which runs on the track rails, the machine being represented in the schematic showing only by axle **16** supporting the machine in the corrected track section, track tamping unit **17** and track lifting tool **18.** A track position correction indicator **8'** is mounted on the machine in the range of the track tamping unit **17,** which is mounted at the track correction point, i.e., where the raised or graded track is fixed in its corrected position. In this manner, indicator **8'** will signal the corrected position of the track at unit **17.** In the same manner as explained hereinabove in connection with FIGS. **1** and **2,** the track correction indicator **10'** cooperates with track position indicator **8'**, the potentiometers of the two indicators sending their signals to control unit **11'** which controls the movement of track lifting tool **18.** The correction ratio is again changeable by variable resistor **14'** in the electrical control circuit.

FIG. **4** shows an apparatus useful for track alignment with the use of two chordal references, as more fully described and claimed, for instance, in U.S. Pats. Nos. 3,314,154, 3,314,373, both dated Apr. 18, 1967, whose disclosures are incorporated herein by reference. As is well known and, therefore, not illustrated, the measuring carriage or bogie, which runs on the track rails, is pressed into a fixed relationship against grade rail **19,** spring, magnetic or pressure fluid jack means having been proposed for this purpose, for instance. As is more fully described in the above-identified patents, the long chord of the reference system passes between a pair **20** of electrical contacts while the short reference chord passes between pair **21** of electrical contacts. Each pair of electrical contacts is mounted on a nut respectively engaging a threaded spindle section **23** and **24** of different pitch. The two spindle sections are interconnected by a gearing **25** and are thus rotatable in unison by motor **22** which drives spindle section **23.** As has been fully described in U.S. Pat. No. 3,314,373, the ratio of the pitches of threaded spindle sections **23** and **24** corresponds to the ratio of the ordinates of the long and short chords, which is the same as the ratio of the chord lengths, the pitch of section **24** being smaller than that of section **23.** During rotation of the spindle sections by motor **22,** each pair of contacts travels through a path which is a function of the ordinate of the longer chord, i.e., its distance from the track point being corrected. On this manner, the ordinate of the shorter chord is automatically indicated and fixed, the end point of this chord being used for lining the track point. In the usual two-chord method, the ratio between the ordinates is 1 : 3. If the transmission ratio of gearing **25** is 1 : 1, the two pairs of contacts will move at distances of a ratio 1 : 3.

In operation, the operator will move the pair of contacts **20** until the longer chord of the reference system is out of contact with the two contacts, i.e., until it is centered therebetween and touches neither contact. This establishes the determining ordinate. As the spindle sections **23** and **24** are rotated in unison to move the pair of contacts **20** to this desired lateral position, the pair of contacts **21** are automatically moved at a ratio of 3 : 1 of the distance of movement of contacts **20,** due to the different pitch of spindle section **24.** This automatically establishes the desired ordinate of the track point to be corrected, and this point is, therefore, laterally moved until the short chord is centered between the contacts of pair **21,** i.e., no longer touches either one of these contacts. This completes the lining at this point.

As explained hereinabove, since one end point of the longer chord is in the uncorrected track section, this procedure involves a residual correction error, due to the incorrect positioning of the long chord at the correction point. This error is reduced or substantially avoided in accordance with this invention by changing the transmission ratio between the two spindle sections of different pitch, which may be done by a transmission **25** having a ratio other than 1 : 1, preferably an infinitely variable speed transmission. This will automatically change the ratio of the ordinates of the long and short chords otherwise determined by the different pitches of the two spindle sections.

While the invention has been specifically described and illustrated in connection with specific lining and leveling methods and apparatus, it will be clearly understood that it is not limited to these specific examples but is applicable to other types of track lining and grading methods involving the correction of the position of a track point by a distance which is in a predetermined ratio to the measured distance of a correctly positioned track point from a reference.

We claim:

**1.** In an apparatus for correcting the position of a track point in an uncorrected track section in relation to a reference extending past said track point along the track from a previously corrected to an uncorrected track section, comprising

1. a reference line having one end in the uncorrected track section and another end in a previously corrected track section,
2. a track position indicator cooperating with the reference line to produce a comparison correction signal,
3. a track position correction indicator associated with the track point in the uncorrected track section and cooperating with the reference line to produce a signal corresponding to the desired correction of the position of the latter track point,
4. track correction means at the track point in the uncorrected track section,
   a. the track correction means being responsive to the signal produced by the track position correction indicator and moving the track point to the desired position in response to said latter signal, and
5. a control establishing a set ratio between the signals of the track position indicator and the track position correction indicator,
   a. said ratio determining the desired position, the improvement of providing

means for selectively changing the set ratio while the reference line remains in a constant position.

**2.** In the apparatus defined in claim **1** wherein the indicators are potentiometers, and the control comprises an electrical control circuit including a voltage source delivering a voltage to the potentiometers, the means comprising variable resistance means between the voltage source and at least one of the potentiometers to change the voltage delivered thereto.

**3.** In the apparatus of claim **1** arranged to correct the position of the track point in the uncorrected track section vertically to level the track, further comprising a track tamping unit at the latter point, the track position correction indicator being supported on the track at the track tamping unit and the track position indicator being supported on the track in the corrected track section.

**4.** In an apparatus for correcting the position of a track point in an uncorrected track section in relation to a reference extending past said track point along the track from a previously corrected to an uncorrected track section, comprising

1. two reference lines having one end in the uncorrected track section and another end in a previously corrected track section,
   a. one of the reference lines being longer than the other reference line,
2. two threaded spindles,
3. a reference line engaging member threadedly mounted on each of the spindles and movable thereon upon rotation of the spindles,
   a. each of the members engaging a respective one of the reference lines,
4. a track position indicator cooperation with the reference lines to produce a comparison correction signal,
5. a track position correction indicator associated with the track point in the uncorrected track section and cooperating with the reference line to produce a signal corresponding to the desired correction of the position of the latter track point,
6. track correction means at the track point in the uncorrected track section,
   a. the track correction means being responsive to the signal produced by the track position correction indicator and moving the track point to the desired position in response to said latter signal, and
7. a control establishing a set ratio between the signals of the track position indicator and the track position correction indicator,
   a. said ratio determining the desired position, the improvement of providing a transmission between the spindles for selectively changing the ratio of the speeds of rotation of the spindles while the reference lines remain in constant position.

**5.** The apparatus of claim **4,** wherein the transmission is an infinitely variable speed transmission.

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