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Helgemeir

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[54] TRACK LEVELLING AND TAMPING MACHINES

[72] Inventor: **Heinrich Helgemeir,** Munich, Germany

[73] Assignee: **Robel & Co.,** Munich, Germany

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[51] **Int. Cl.** **E01b 27/17,** E01b 29/04

[58] **Field of Search** ....104/7, 8, 6, 7 B, 12

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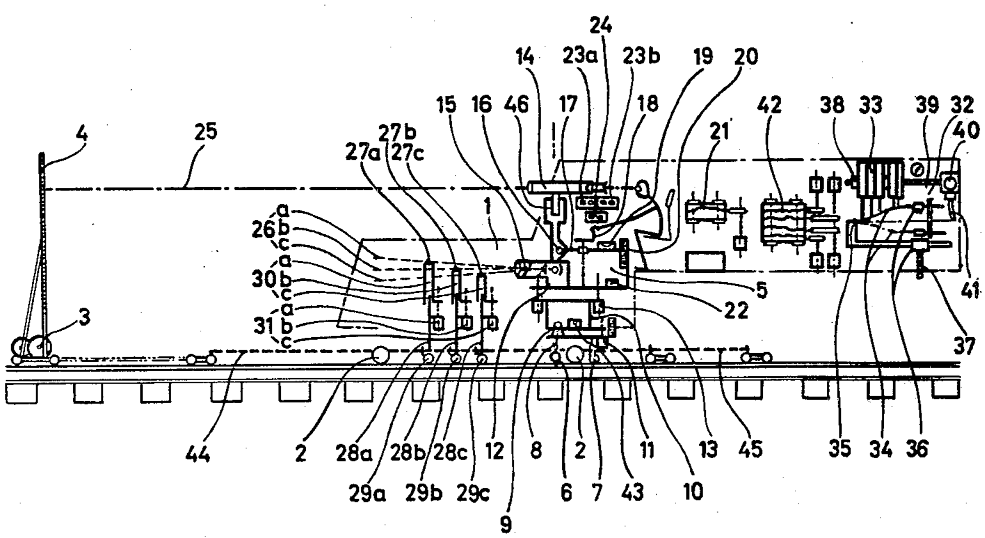
Primary Examiner—Arthur L. La Point
Assistant Examiner—Richard A. Bertsch
Attorney—Fred L. Witherspoon, Jr.

[57] **ABSTRACT**

A track levelling and tamping machine having an optical sighting device for sighting elevation marks on a vertical graduated staff on a front vehicle, for alignment of an optical reference sighting system controlling the height of the track-lifting means on a main vehicle of the machine by means of a light transmitter which is associated with the reference sighting system.

4 Claims, 3 Drawing Figures



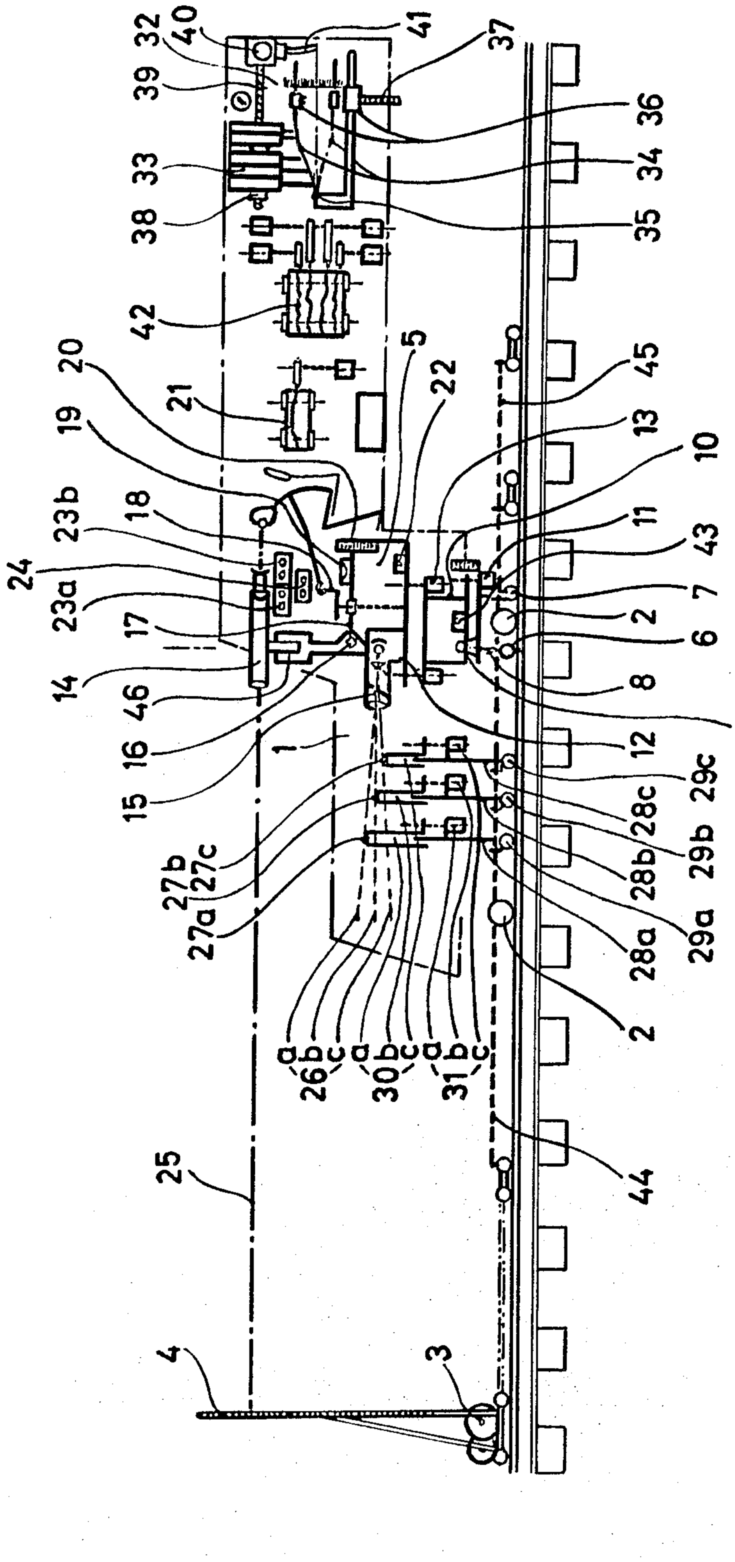

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FIG. 1

FIG. 2

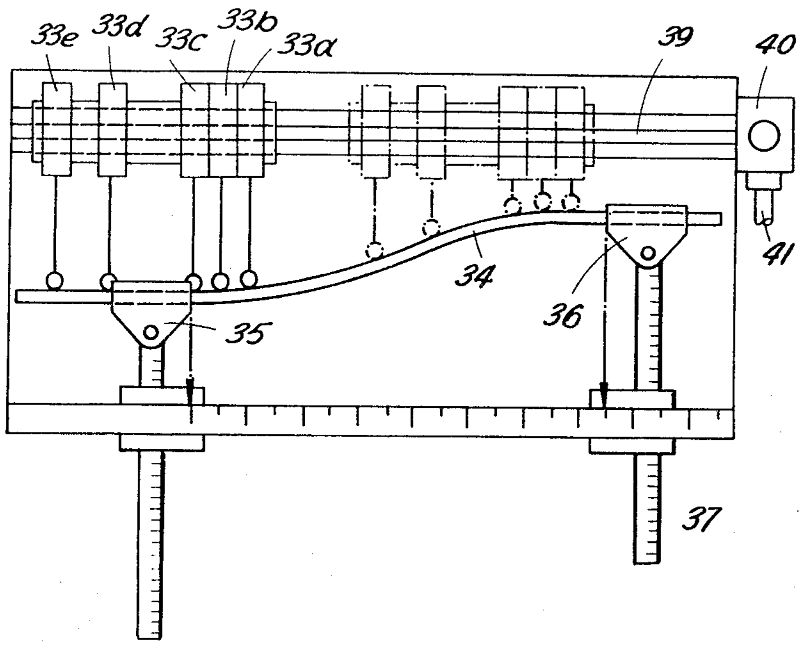
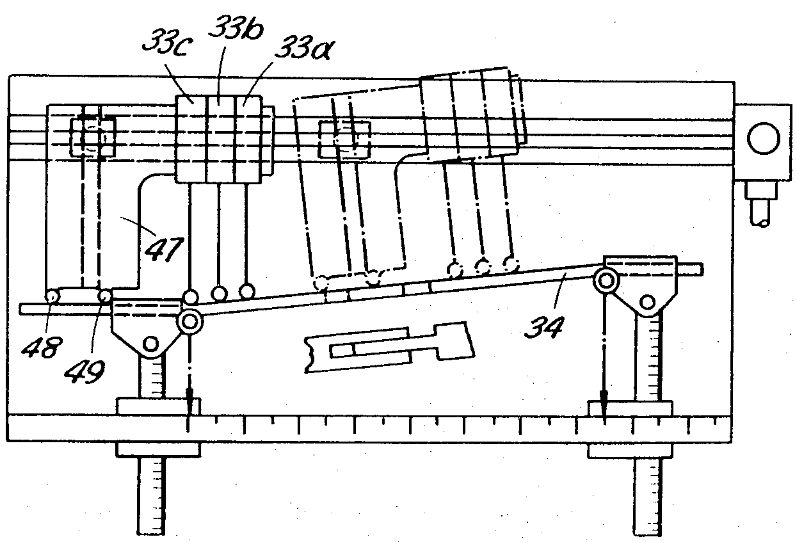


FIG. 3



TRACK LEVELLING AND TAMPING MACHINES

This invention relates to a track levelling and tamping machine having an optical sighting device for sighting the elevation marks on a vertical graduated staff disposed on a front vehicle, for alignment of an optical reference sighting system controlling the height of the track-raising means on a main vehicle of the machine.

The rails of correctly laid track on the flat should lie flush and horizontal and straight. On a gradient the rails must take up a corresponding inclination to the horizontal plane, and the rails of curved track must take up a predetermined curvature with superelevation. The term "superlevation" denotes that the outer rail of the curve is higher than the inner rail of the curve by an amount which depends upon the radius of curvature, the normal practice being for the inner rail to continue horizontally in the plane of the track — i.e., without any alteration in height. This leads to the paradox that the outer rail of a curve determines lateral alignment whereas the inner rail of the curve determines the vertical position. In reverse curves the vertical positions of the two rails reverse.

Measuring and aligning machines are used to determine and correct lateral errors in track laying, while levelling and tamping or packing machines are used to determine and correct vertical errors. Recently, it has become the practice to produce combined machines of this kind.

By means of the track-levelling measuring system serving for tamping, a reference line can be formed for each rail from a measuring station behind the area being aligned, and the track rails can be lifted (by lifting means on the machine) up to the reference line until they are at the required height, whereafter ballast-tamping means on the machine pack or tamp the track bed ballast below the track sleepers so that the track remains in the required vertical position into which it has been raised.

As a rule, one of three procedures are used in track levelling:

1. The harmonization procedure requires no previous pegging-out or geometric levelling of the areas to be aligned. The basis for levelling is usually a light optical electronic sighting line formed by a transmitter via a diaphragm to a receiver, the sighting line extending from the levelled track on which the levelling machine is standing to a front vehicle rigidly connected to the levelling machine. The cessation of lifting is controlled by the levelling light beam (constituting an optical measuring cord) which is formed in this way and which, when the rails are raised to the correct height relatively to the beam, is interrupted by the diaphragm on the path of the receiver, so that the same initiates a signal. Since the position of the front vehicle is of undefined elevation, in this system the elevation error of the still unaligned track is included, but on a reduced scale, in the levelling operation. The reduction of the elevation error depends upon the relationship between the distances between the front vehicle, the diaphragm and the base point of the levelling machine.

In other systems of this kind, the aligning beam impinges on the opposite side of the transmitter on photocells which adjust the height of the light beam or the height at which the track-raising means interrupt the beam. This can be done, e.g., by means of four centrally arranged photocells. When any one photocell is illuminated more than the others, a corresponding correction is started servomechanically and continues until the photoelectric circuits return to an equilibrium condition. Difficulties arise as distances increase due to decreasing light beam intensity.

2. In the geometric levelling procedure the light transmitters of the front vehicle are adjusted to the correct elevation on the basis of previously ascertained track errors which a surveyor has indicated on the sleepers previously. The light beam which has been brought to the set position in this way and which extends to the receiver is interrupted, once the set position has been reached, by the diaphragms associated with the lifting means.

3. In the high-point levelling procedure, the front vehicle position and the machine position are set at places which are at maximum elevation as compared with the adjacent zones; a sighting line which is either horizontal or at a predetermined inclination is then formed between these positions to a fixed point on a grade staff in the front vehicle. Lifting means on the machine then raise the rails of the intermediate portion of track stepwise to the elevations determined by the sighting line and the positions of the two vehicles. As in procedure 2, a surveyor is required, in this case to determine the position of the high points. A front vehicle with the grade staff or with photoelectric transmitters is set up manually at the appointed place. Another procedure uses an optical sighting facility set up at the high point; the facility is directed towards the machine and an operator at the facility remotely controls the raising given by the packing machine.

In every case the reference means which control track elevation and which determine the cessation of lifting and which act as measuring cords take up a position somewhere between the set position and the actual position — i.e., a position between the position of the unaligned track and that of the track which has already been aligned.

In the levelling of curved track, a transition curve is provided as a transition between the straight track and the curve proper; as a rule, the transition curve is parabolic, having a straight part to begin with and having at its end a radius of curvature corresponding to the full radius of the curve. Since the superelevation at any part of a curve must correspond to the radius of curvature at such part, the outer rail of the transition curve has a superelevation ramp or inclination which extends continuously or undulatingly from the horizontal track up to the final elevation of the outer rail, corresponding to the curved track. Special levelling conditions apply to reverse curves such as a curve, for instance, on winding sections of track; for first one and then the other of the two rails is the outer superelevated rail, and so neither rail can form a basis for a reference plane.

The alignment of reverse curves is at present carried out virtually exclusively on the basis of surveyed values which are indicated on the sleepers or at the very most on the basis of tabular values indicating the angle of transverse track inclination appropriate for the section of line. These angles of inclination are checked by means of a pendulum. It is also the usual practice to check on the required superelevation by continuous comparison with the superelevation values of the portion of track just completed. Unfortunately, misalignments enter the system and are cumulative as the operation proceeds, and no accurate measurement of the track is made by the machine itself in the form of a recording in synchronism with the track. A basic lack in all alignment operations is the possibility of checking whether the alignment just made is correct.

To obviate the lengthy and high-labor-content measuring work, the separate steps of ascertaining and marking track high points and track elevation errors need to be replaced by mechanical procedure which makes errors in the track ahead due to long distance negligible.

The present invention relates to a track packing and levelling machine which can perform the measuring, aligning and working procedures hereinbefore set forth.

According to this invention, in a track levelling and tamping machine having an optical sighting device for sighting elevation marks on a vertical graduated staff on a front vehicle, for alignment of an optical reference sighting system controlling the height of the rack-lifting means on a main vehicle of the machine by means of a light transmitter which is associated with the reference sighting system and which serves to produce a control light beam, there is provided a measuring structure associated with the main vehicle of the machine and mounted on running axles running on the track rails, which measuring structure bears a frame tiltable by a motor about a transverse axis extending transversely of the direction of the track; and said tilting frame carries a platform which, through controllable lifting means operating vertically above the track rails, can be adjusted relatively to the horizontal plane and which can be raised to a required sighting height; and the platform has above each rail of the track an optical sighting device for defining a reference direction and an associated light beam transmitter for forming lift control light beams which are fixedly associated with the reference direction and which control the lifting means.

Preferably, the platform has disposed on it a level indicating device which has control contacts and which defines a horizontal direction disposed in the track direction and which can be adjusted by being pivoted about an axis extending transversely of the track.

Also, the platform can have a level indicating device with controls contacts and which defines a horizontal direction extending transversely of the track.

Conveniently, photocells are disposed on the rail-lifting facilities to control the height thereof, which photocells upon entering into the light beams limit the lift height; the photocells may be vertically adjustable by motor relatively to the lifting claws of the lifting means by motors.

Conveniently, the running axles of the measuring structure run on the portion of track which has already been aligned, preferably on both sides of a vehicle axle providing a heavy loading. In this case, of the four wheels associated with the axles of the measuring structure, three may serve as reference points for means for tilting the tiltable frame and for the means for raising the platform and for the control means for controlling the platform-raising means, whereas the fourth wheel serves only to keep the measuring structure on the track.

Conveniently, the angular position of the front running axle of the measuring structure relatively to a device defining a horizontal direction transversely of a track direction is measured continuously and recorded on a recorder.

Another feature of the invention which greatly facilitates operations with a machine as described above comprises means for ascertaining measured values for ramps or inclinations, both of the kind characteristic of increasing superelevation of the outer rail in transition curves and of the kind characterizing the transition from a straight horizontal section of track to a straight horizontal section of track at a higher or lower level, said means consisting of a template providing measured values. One such means comprises a rigid or bindable or flexible template strip whose length is adjustable and whose ends can be raised in a manner suitable for measurement; and potentiometer type sensors are moved along the template strip by a drive in synchronism with the movement along the length of track and are responsible for vertical adjustment of the lift means for the photocell supports.

The template strip may have running on it other sensors whose distance from the sensors controlling vertical adjustment of the lift means for the photocell supports corresponds to the distance between, on the one hand, the photocell supports, and, on the other hand, the running axles of the said measuring support, such further sensors serving for vertical adjustment of the platform-lifting means, and for the means for lifting the tiltable frame.

In a means of this kind for calculating rail levelling set values in transition inclinations, the sensors which are guided on the template strip and which serve to control the vertical adjustment of the lift means for the photocell supports may be arranged on an arm of a slider which runs on the template strip in a tangential bearing relationship therewith; and the relative distance between, on the one hand, the last-mentioned sensors and, on the other hand, the two support rollers of the slider corresponds to the distance between, on the one hand, the photocell supports and, on the other hand, the running axles of the measuring structure.

The invention also includes the use of template members of physically and geometrically fixed shape and of a particular length. The measurement relationships to the measured data of the portion of track to be dealt with would then be prepared by observed-value converters such as, for example, analogue computers. The distances between the sensors would have to be given a similar form of proportional conversion.

Advantageously, as a step useful in the preparation and checking of the levelling and tamping performed by the machine, to determine the high point of a section of track, the front vehicle or main vehicle has on it height difference measuring means which determines the differences in height between the ends of consecutive track length corresponding to the axle spacing of the measuring support in relation to the horizontal (supplied by the means defining the horizontal axis extending in the track direction) and, on a continuously adding and subtracting basis, supplies such values as a recorder for recording a measured curve.

Conveniently, the front vehicle has a drive controllable from the main vehicle, and the remote control for such drive is preferably such that, when the front vehicle has reached a maximum distance from the machine, the front vehicle drive can be controlled only in the sense of a return of the front vehicle towards the main vehicle.

The aforementioned measuring means on a front vehicle, which is independently driven, makes possible track surveying independently of the main vehicle and enables an auxiliary graduated rule frame to be set up on the track high points for the reference of the optical remote aiming line of the machine. The front vehicle can be used in an even simpler way to discover high points by moving away from the stationary main vehicle under optical observation, the vertical movements of the front vehicle being determined as it moves so that the high points of the track can be determined. Since the front vehicle has its own drive remotely controlled from the main vehicle, the remote control must have means which operate fully automatically to stop the front vehicle after the same has travelled over a predetermined number of safety section lengths, whereafter the front vehicle is compelled to return to the main vehicle.

An embodiment of the invention is described in the following description with reference to the accompanying drawings wherein:

FIG. **1** is a diagrammatic side elevation of the complete apparatus according to the invention, and

FIGS. **2** and **3** are enlarged views of template control facilities.

Referring to FIG. **1**, a main vehicle **1** of a levelling and packing machine runs on vehicle wheels **2**; the wheel **2** which is on the right in FIG. **1** is on a portion of track which has already been levelled.

At a distance from main vehicle **1** is a front vehicle **3** which can either be directly connected to main vehicle **1** or have independent drive and thus be free to move on its own. Disposed on front vehicle **3** are graduated staffs **4** which extend above each of the two rails forming the track and which have sighting graduations.

A measuring running frame **5** is connected to main vehicle **1** but runs on its own axles — a front axle **6** and a rear axle **7**. The frame **5** carried by these axles **6**, **7** has a chassis **8** on which is mounted a platform **10**, which platform is adapted to be adjustably tilted about a transverse axis **9** by a tilt motor **11** which is supported on the rear axle **7**. A carrier platform **12** is mounted on the platform **10** and is vertically adjustable by lifting motors **13**.

In a changing curve, the two rails of the track are not horizontal relatively to one another, and so the two wheels of the front axle **6** and the two wheels of the rear axle **7** do not together define a plate; instead, the front axle **6** and the rear axle **7** must be able to take up a skewed position relatively to one another. The rear axle **7** must therefore have a floating mounting on a chassis **8** of the frame **5** to be able to take up an inclined position relatively to chassis **8** and front axle **6**. The lifting of platform **10** is effected by the tilt motor **11**. The tilting of platform **10** results relatively to the plane defined by the contact points of the wheels of the front axle **6** and by the inner-rail wheel of the rear axle **7**. Accordingly, the chassis **8**, on which the front axle 6 if fixedly mounted and on which the rear axle 7 is adjustably mounted, is so devised as to be connectably fixed to the wheel of the rear axle 7 running on the inner rail of the curve, the other wheel thereof being free to move vertically relatively to the chassis 8.

One lifting motor 13 is provided at each of the four corners of platform 12; there are two such motors disposed above each rail, such motors being controlled simultaneously and co-operating to adjust platform 12 vertically or to tilt the platform 12 transversely. On the platform 12 fixed positions above each rail are an optical sighting device 14 and a light beam sender 15. Also mounted on platform 12 is a table 17 which can pivot on a transverse axis 16 and which can be adjusted into the horizontal position by a hand wheel 18 according to the indication given by a level 19 extending lengthwise of the track. The angle of table 17 relatively to the track are determined by a potentiometer 20 and transmitted to a recorder 21.

Another electrolytic spirit level 22 is provided for transverse orientation of platform 12. The lifting motors 13 are controlled via their associated switches 23*a*, 23*b* either from the driver's cab or from means to be described later for automatically giving the measured value to be described hereinafter. The tilt motor 11 for adjusting the platform 12 is also either driver-controlled, by way of an associated switch 24, or automatically controlled.

The chain line 25 indicates the sight line to a remote distant sighting facility. The dashed lines 26*a*, 26*b*, 26*c* represent light bands from the light beam senders 15 which are broad in the horizontal direction but narrow vertically and which are adapted to control the lifting means. The light bands 26*a*, 26*b*, 26*c* serve for photoelectric limiting of the lift provided by the track-lifting means. Limit control photocells 27*a*, 27*b*, 27*c* mounted on support members 28*a*, 28*b*, 28*c* are associated with the lifting tools which engage a rail at three different places; the support members 28*a*, 28*b*, 28*c* are mounted on measuring wheels 29*a*, 29*b*, 29*c* which run on the rail. The heights of the photocells 27*a*, 27*b*, 27*c* above each rail are set by sliders 30*a*, 30*b*, 30*c* which are vertically adjusted either automatically or manually through the agency of electronically controlled motors 31*a*, 31*b*, 31*c*.

The three light bands 26*a*, 26*b*, 26*c* lie one above another and are focussed in the planes of the photocells 27*a*, 27*b*, 27*c* by fine horizontal slots in an inclined diaphragm plate in the object plane of the lens of the light beam sender 15. When the operation of raising the rails of the track causes a photocell to enter the corresponding beam path of the sender 15, the raising being performed by the particular raising tool concerned eases.

Depending upon the nature of the section of track, the limit control heights of the photocells 27*a*, 27*b*, 27*c* are adjusted to different levels. Continuously varying control levels are required, more particularly for the production of sudden changes or continuously varying inclinations in curves. This kind of adjustment is provided fully automatically by a template control system 32 which, through the agency of five feelers 33 (in this particular embodiment), calculates adjustment settings for the three adjusting motors 31*a*, 31*b*, 31*c*, the lifting motors 13 and the platform-tilting motor 11. The scannable part of the system 32 is a flexible template strip 34 which is placed on clamping heads 35, 36, adjustable in relative height and distance from one another and is there clamped inclinedly or horizontally at such stations. In the example illustrated in FIG. 1, only the right-hand head 36 is vertically adjustable, through the agency of a spindle 37 which operates perpendicularly to the head 36. The vertical adjustment provided by spindle 37, in co-operation with the clamping of the template strip 34, imparts thereto a shape from which the required superelevations of a straight or varying superelevation inclination can be derived proportionally. The two strip-supporting places of the clamp heads 35, 36 can be adjustable vertically and for distance. Two such systems 32 of this kind can be used simultaneously — i.e., a separate system 32 for each rail — as is necessary, e.g., for the alignment of reverse curves where the superelevation changes over from one rail to another. The adjustable distance between the two heads 35 and 36 is proportional to the length of track to be aligned. The distances between the feelers 33 are proportional to the distances between the measuring wheels 29*a*, 29*b*, 29*c* associated with the control facilities for the lifting means and to the spacings between the axles 6 and 7 of the frame 5. By means of a support 38, lead screw 39, gearbox 40 and speedometer drive 41, the feelers 33 move over the template strip 34 in accordance with the movement along the track length. The feelers 33 operate potentiometers and gave output signal voltage values which produce commands for the motors hereinbefore referred to in the manner necessary to produce inclinations of the required heights.

A superelevation-simulating template strip 34 according to the invention of this kind can be, for example, a flat wood strip such as a drawing rule, one of whose edges is kept flat while the other side is twisted with increasing steepness from the flat position.

FIG. 2 is a view to an enlarged scale of the template control system. The feelers 33*a*, 33*b*, 33*c* serve for vertical adjustment of the motors 31*a*, 31*b*, 31*c* associated with the support members 28*a*, 28*b*, 28*c* for the photocells 27*a*, 27*b*, 27*c*. To keep the platform 12 horizontal and at a constant elevation, the platform-tilting motor 11 and the platform-raising motors 12 are controlled by the feelers 33*d*, 33*e*; the distance thereof from the feelers 33*a*, 33*b*, 33*c* corresponds to the distance of the axles 6, 7 from the wheels 29*a*, 29*b*, 29*c* associated with the photocell support members 28*a*, 28*b*, 28*c*. The template strip 34 shown in FIG. 2 is flexible. In FIG. 2, both the clamp heads are adjustable in height.

FIG. 3 shows another template control system providing control in a transition incline or transition curve where both rails of the track rise at the same inclination to the horizontal. The template strip 34 in FIG. 3 takes the form of a straight telescopic member. A similar kind of template strip could also be used in the system shown in FIG. 2, and a resilient template strip could be used in the template control system now to be discussed. The function of the template control system is to control the adjusting motors 31*a*, 31*b*, 31*c* for the photocell support members 28*a*, 28*b*, 28*c* via the feelers 33*a*, 33*b*, 33*c*. The control is required to come into effect, for example, when the vehicle is just leaving the horizontal section of track and when the measuring wheels 29*a*, 29*b*, 29*c* are already on the inclined portion of the slope whereas the axles 6, 7 are still on the horizontal portion of the track. The control system therefore always comes into operation whenever the plane determined by the measuring wheels 29*a*, 29*b*, 29*c* is inclined, the system then acting on the means for adjusting the heights of the photocells 27*a*, 27*b*, 27*c* to compensate for differences due to the different orientation of the two planes. The feelers 33*a*, 33*b*, 33*c* are disposed on an arm of a slider 47 guided on the template strip 34 by way of a tangential support surface; the relative distance of the feelers 33*a*, 33*b*, 33*c* from the two support rollers 48, 49 of the slider 47 corresponds to the distance of the photocell support members 28*a* 28*b*, 28*c* from the running-frame axles 6 and 7.

In the case of a track position in which incline formations of the kind shown in FIGS. 2 and 3 are superimposed upon one another, the sensed values can be added or subtracted accordingly.

Depending on the capability of the machine, these facilities can be used singly or in pairs or in any number. The means used for adapting their length proportionally to track measurements can be as required. It is immaterial whether the elements used are purely mechanical, as in the foregoing example, or electric or electronic or hydraulic.

A recorder and supervisory apparatus 42 serves to record the track position produced by the machine. In addition a transverse pendulum 43 and measuring cords 44, 45 serve for deriving versine recordings. A recorder 21 is controlled by level 19 or by potentiometer 20. This recorder is used to determine high points of the track by retaining height differences between the ends of successive track lengths, in this case, the length of a track section corresponds to the distance between the front axle **6** and rear axle **7** of the frame **5**. The level **19** is a device which produces an artificial horizon for table **17** and which measures the position thereof relatively to the track inclination by means of potentiometer **20**. The recorder **21** records the measure height difference either additively or subtractively, according to the height difference actually measured at one end of the planes which are inclined to one another at an acute angle. The drive of the recording tape is synchronized with the movement along the length of track. The high points of the track can readily be seen from the automatic gradation-form recording. On hilly sections of line where the angle of inclination stays the same for a long time, the recording would run inclinedly over the edge of the paper; in such cases the general angle of inclination is noted on the recording strip and compensated for by adjustment of the potentiometer.

On flat track the front vehicle **3** is stopped as a distant objective at a track high point which is as far away from the main vehicle as possible and which has been found by the procedures hereinbefore described by means of the facilities of the machine and without employing an extra surveyor. The machine operator then looks through the optical distant sighting apparatus **14** to sight a mark on the graduated staff **4** of the front vehicle **3**. Sighting adjustment is by means of the tilting motor **11**, thus motor aligning the platforms **10** and **12** together. The light beam senders **15** and the radiated light bands **26*a***, **26*b***, **26*c*** are therefore aligned too. Hand wheel **18** and level **19** are then used to make the table **17** accurately horizontal. Horizontal accuracy is within a few seconds of an angle and is indicated by a highly sensitive measuring device.

The adjustment of the three instruments just mentioned prepares the machine for its aligning work, in which the track-lifting means are operated until the photocells **27*a***, **27*b***, **27*c*** enter the light bands **26*a***, **26*b***, **26*c*** so that lifting ceases. When the machine advances after alignment by an amount such that the frame **5** has its front axle **6** and rear axle **7** exactly over the portion of track just aligned, there should have been no change in the optical sighting line **25** nor in the horizontal indication of the spirit level **19**. If this immediate check on the alignment just carried out discloses no errors, aligning can proceed further. However, if the steps of stopping the lifting means were performed inaccurately, with the result that the track position was inaccurate, e.g., due to mechanical or electrical or hydraulic inertia, realignment is necessary but must not change the reference sighting datum line. With due allowance for the error just produced in track position, the levelling planes are readjusted — but only for the next alignment — by the tilting motor **11** being operated by the machine operator. The main instrument of observation in this event is the very accurate angular indication given by the level **19**. If a check on subsequent alignment operations reveals a consistent error of the same inclination and value, for instance, if the machine is cold and the hydraulic lifting mechanism cuts out with delay, the photocells **27*a***, **27*b***, **27*c*** should be adjusted by the adjusting motors **31*a***, **31*b***, **31*c*** being operated to raise the sliders **30*a***, **30*b***, **30*c***. Similarly, a horizontal correction in the level of the complete platform **10** might shift the planes in which the track-lifting means ease operating. The alternate checks on the results of aligning operations by optical means and spirit levels reveal the origin of any error in track elevation, something which cannot be found by known kinds of optical and photo-optical equipment not providing an artificial horizon. For instance, if the errors after each aligning operation were to be compensated for merely by readjustment of the sighting line **25**, the adding-together of the errors would originate a trough or a peak which would be "carried forwards" to the position where the front truck **3** is situated. The horizontal basis for alignment provided by the level **19** is very important when dealing with the superelevation inclination of curved track. In reverse curves, where the superelevation height increase alternates between the two rails, neither rail can form a datum level; the superelevation at the beginning of a reverse curve is oppositely directed to the superelevation at the end of a reverse curve. The datum planes for the longitudinal and transverse levels must therefore be adjusted very carefully before alignment begins and they must be observed over the whole section, to ensure correct connection at the end of the aligned section. Of course, it is often necessary to make a check through the optical sighting device **14** at the vertical graduated staff **4** of the front vehicle **3** which is positioned at the end of the section to be aligned.

Horizontal adjustment of the platform **12** as controlled and indicated by the electrolytic spirit level **22** is very important for satisfactory alignment, for on this adjustment depends an accurate horizontal or superelevated position of the rails relatively to one another. As already stated, on curves having superlevation inclines, this adjustment is the responsibility of the template control system **32** which controls the vertical adjustment of the photocells **27*a***, **27*b***, **27*c*** and acts on the motors **13** and **11**. The datum rail for the longitudinal plane can be any rail on straight sections; on simple transition curves the datum rail is usually the inside one. On the inner rail of the curve run the wheels of the front axle **6** and rear axle **7** of the frame **5**, which are responsible for keeping the frame **5** positioned perpendicularly to the plane of the rails. The second wheel of the rear axle **7** has no effect on angular guidance of the frame **5**. The wheels of the rear axle can follow the pattern of the non-guiding rail while guiding the frame **5** along the track. When the platform **12** is adjusted horizontally, the light bands **26*a***, **26*b***, **26*c*** of the light beam sender **15** remain in the level control planes, which therefore remains constant when curves are negotiated despite deviations of the measuring wheels **29*a***, **29*b***, **29*c*** bearing the support members **28*a***, **28*b***, **28*c*** for the photocells **27*a***, **27*b***, **27*c***. The optical sighting device **14**, in cooperation with a vertical pivot bearing **46**, enables the front field to be scanned in a dead horizontal plane to pick up distant targets at the end of curved sections of track. A particular general advantage is that all the means for measuring, sighting, adjusting, checking, etc., are mounted on or in the machine and can be operated and adjusted thereon and can be used to refer to the section of track just aligned, except for the front vehicle which is equipped only with fixed graduated sighting staffs.

What I claim is:

1. In a track levelling machine, a main vehicle including a front vehicle mounted on track rails, said front vehicle mounting a vertical staff for each rail, each staff having sighting elevation marks thereon, a measuring unit associated with the main vehicle and mounted on the track rails independently of said main vehicle, the measuring unit including a platform tiltably carried by an axle transverse to the track rails, motor means for tilting the platform transversely to the track rails, a carrier platform supported by the platform, power means for lifting and tilting said carrier platform, an optical sighting device supported by the carrier platform above each track rail for sighting the elevation marks on the respective vertical staff on the front vehicle, a light beam transmitter in fixed relation with each optical sighting device, track adjusting members mounted on the main vehicle for engagement with the track rails to lift same, vertically adjustable control means for each track adjusting member adapted to respond to the light beam projected from the light beam transmitter to control the lifting action of each track adjusting member, power means for raising and lowering the aforesaid vertically adjustable control means, and measured valve control and transmitting means for transmitting signals to the power means for raising and lowering the vertically adjustable control means to determine the height at which the projected light beam strikes said control means to control the action of the track adjusting members.

2. The invention as set forth in claim **1** and wherein the measured value control and transmitting means for transmitting signals to the power means for raising and lowering the vertically adjustable control means also includes means for

transmitting a control signal to the motor means for tilting the platform so as to tilt same transversely to the track rails.

3. The invention as set forth in claim 2 and wherein the measured value control and transmitting means for transmitting signals to the power means for raising and lowering the vertically adjustable control means also includes means for transmitting a control signal to the power means for lifting and tilting the carrier platform to lift and tilt same.

4. The invention as set forth in claim 3 and wherein the measured value control and transmitting means for transmitting signals to the power means for raising and lowering the vertically adjustable control means, to the motor means for tilting the platform, and to the power means for lifting and tilting the carrier platform includes template means with feelers riding thereon to furnish variable control signals to the power means for raising and lowering the vertically adjustable control means, to the motor means for tilting the platform and to the power means for lifting and tilting the carrier platform.

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