AUSTRALIA

Patents Act

APPLICATION FOR A (b) STANDARD/PATENT

We (c) FRANZ Plasser Bahnausmaschinen
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of (d) Johannesgasse 3,
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Austria

hereby apply for the grant of a (e) Standard/Patent for an invention entitled
(f) A TRAVELLING ON-TRACK MACHINE FOR MEASURING
AND RECORDING OR CORRECTING THE POSITION
OF A TRACK USING LASER BEAMS OR PLANES

which is described in the accompanying (g) complete
specification.

(Note: The following applies only to Convention applications)

Details of basic application(s)

<table>
<thead>
<tr>
<th>Application No.</th>
<th>Country</th>
<th>Filing Date</th>
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<tbody>
<tr>
<td>85890188.7</td>
<td>Europe</td>
<td>22 August, 1985</td>
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</tbody>
</table>

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Dated (i) 11th July, 1986

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Attorneys for:
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Signature: [Signature]

Note: No legalization or other witness required.
DECLARATION FOR A PATENT APPLICATION

In support of the (c) CONVENTION application made by

FRANZ PASSER BAHNBAUMASCHINEN-INDUSTRIEGESSELLSCHAFT m.b.H.

(b) Insert "Conventio" if applicable

(c) Insert FULL name(s)

of applicant(s)

(d) Insert "of addition" if applicable

(e) Insert TITLE of invention

(f) Insert FULL name(s)

of actual inventor(s)

(g) Insert FULL name(s)

of declarant(s)

(h) Enter how applicable deriving title from actual inventor(s)

(See headnote*)

(i) Insert country, filing date and basic applicant(s) for each basic application

(Note: Paragraphs 3 and 4 apply only to Convention applications)

3. The basic application(s) for patent or similar protection on which the application is based is/are identified by country, filing date, and basic applicant(s) as follows:

(a) European Patent Office

22nd August, 1985

Franz Plasser Bahnbaumaschinen-Industriegesellschaft m.b.H.

4. The basic application(s) referred to in paragraph 3 hereof was/were the first application(s) made in a Convention country in respect of the invention the subject of the application.

(k) Insert PLACE of signing

(1) Insert DATE of signing

(m) Signature(s) of declarant(s)

Notes: No legalization or other witness required.

To: The Commissioner of Patents

PHILLIPS ORMONDE & FITZPATRICK
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Claim

1. A travelling on-track machine for measuring and recording and/or even for correcting the position of a track comprising a transmitter designed to emit laser beams or planes and arranged on a buggy which travels under its own power along the uncorrected track and further comprising a laser receiver provided on the machine equipped with track measuring reference systems for determining various track parameters, such as longitudinal level, direction and the like, characterized in that, for continuous determination and/or correction of the actual position of the track over at least relatively long sections in relation to the lateral and/or vertical deviation of the specified position of the track, the buggy connected to the laser transmitter is designed as a self-propelled satellite buggy for drive-powered or automatic raising and lowering from the front end of the machine and in that, at its front end in the working direction, the machine is equipped to accommodate the entire satellite buggy, more especially with a parking space for the entry and exit of the buggy.
APPLICANT'S REF.: E 6 Ing. Ha/Ba
Name(s) of Applicant(s): FRANZ PLASSER BAHNBAUMASCHINEN-INDUSTRIEGESELLSCHAFT m.b.H.
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Complete Specification for the invention entitled:

A TRAVELLING ON-TRACK MACHINE FOR MEASURING AND RECORDING OR CORRECTING THE POSITION OF A TRACK USING LASER BEAMS OR PLANES

The following statement is a full description of this invention, including the best method of performing it known to applicant(s):
This invention relates to a travelling on-track machine for measuring and recording and/or even for correcting the position of a track comprising a transmitter designed to emit laser beams or planes and arranged on a buggy which travels under its own power along the uncorrected track and further comprising a laser receiver provided on the machine equipped with track measuring reference systems for determining various track parameters, such as longitudinal level, direction and the like.

A travelling on-track machine of the type in question in the form of a tamping machine with tamping and correcting tools for correcting the position of the track is already known from Applicants' Australian Patent No. 450,692.

A reference system in the form of a conical light beam with a receiver arranged on the machine and a transmitter arranged on a buggy is provided for monitoring the degree of lift of the track-correcting tools. This first buggy, which is connected to the machine at a constant distance by a distance rod, is preceded by a second buggy which is provided with its own drive and which is designed for remote control, preferably by radio, being connected to a laser transmitter for emitting a laser beam which fans out conically (as seen from above). A laser receiver arranged in the vicinity of the first receiver is associated with this laser transmitter on the machine. In an alternative embodiment, however, the laser transmitter may also be directed onto a fixed point situated adjacent the track. On completion of the work involved, known buggies of this type, which travel along the track ahead of the machine during the correcting process, have to be manually suspended from hooks arranged at the front of the machine and taken down again before the next phase by at least two people. Particular attention has to be paid to the sensitive laser transmitter which, in fact, is best removed from the buggy before it is suspended from the machine.
In addition, a track lining machine comprising a laser transmitter and receiver for correcting the position of a track is known from AU-PS 485,150. The laser transmitter is mounted for rotation about a vertical axis on a transmitter trolley travelling along the track ahead of the machine and, in the same way as the laser receiver arranged at the front end of the machine and connected to a reference system in the machine, is aligned with a fixed point of the track. When the machine is moved towards the transmitter on completion of the lining work, the laser transmitter is turned through an angle corresponding to the change in versine so that, before another part of the track is lined, the receiver following the rotation of the laser beam is situated in the specified position. In this case, too, the trolley has to be suspended from the machine by hand by the machine operator for in-transit runs and then taken down again.

In addition, AT-PS 256 159 describes a tamping machine for correcting the vertical position of a track, comprising an on-track buggy with its own drive and a seat for an operator. A receiver is provided on the buggy above each rail for recording the light beams, waves or the like emitted by transmitters arranged on the machine. Both the transmitters and the receivers are fixed to supports which are mounted for rotation in a horizontal plane and which are connected to one another by a cable under tension. The supports are thus always forced into a position in which they exactly face one another frontally. A construction such as this is also attended by the above-mentioned disadvantage.

GB-PS 2093 308 B relates to a travelling on-track machine for contactless determination of the lateral position of a track relative to the adjacent track. This distance measuring arrangement in the form of a laser transmitter and receiver with the same optical axis extending in a plane perpendicular to the track axis is mounted for vertical
displacement on a travelling on-track track measuring car with its own drive. The optical axis is directed onto the nearer of the two rails of an adjacent track of which the lateral distance from the track on which the track measuring car is travelling is being measured by taking numerous individual measurements in accordance with the pulse frequency of the laser transmitter and storing the measured data compared with the specified data. However, this distance measuring arrangement may also be used for other distance measurements, for example for measuring tunnel profiles or for determining the profile of rails.

In addition, Applicants' Australian Patents 438,717 and 438,693 describe track measuring cars for determining the lateral and vertical position and also the twist of a track, its gauge and other track parameters, the measurement always being carried out under load with continuous advance of the measuring car in order to create the same conditions which are actually experienced by rail traffic.

To this end, the track measuring car in question comprises sensors which are provided in the immediate vicinity of the axles or bogies. Track measuring cars of this type have been successfully used in practice for some time.

Finally, a concept for automatically correcting curves is known from an Article in the journal "Eisenbahntechnische Rundschau", No. 11, 1982, pages 811-821. In this case, the machine's own reference system (the machine being a tamping machine equipped with track-correcting tools) is controlled by a laser beam which is positioned in relation to fixed points arranged on overhead-line poles. To this end, a laser transmitter is arranged on a trolley travelling along the track ahead of the machine which, at a fixed point situated ahead of the tamping machine, is moved by an electronic roll tape measure into exactly that specified position in which the laser beam directed onto an associated
laser receiver of the tamping machine corresponds to the chord of an arc marked on the track plan. The tamping machine comprises a storage and computing unit in which the specified track data previously recorded by surveyors are stored on magnetic tape. Accordingly, the exact deviations of the actual position of the track from its specified position can be determined and immediately corrected by the reference system - brought by the laser beam onto the specified line - of the tamping machine continuously advancing towards the trolley and tamping the track.

Now, the object of the present invention is to provide a travelling on-track machine of the type described at the beginning with which it is possible to obtain high machine performance for the same high accuracy of measurement.

This object is achieved by the machine described at the beginning in that, for continuous determination and/or correction of the actual position of the track over at least relatively long sections in relation to the lateral and/or vertical deviation of the specified position of the track, the buggy connected to the laser transmitter is designed as a self-propelled satellite buggy for drive-powered or automatic raising and lowering from the front end of the machine and in that, at its front end in the working direction, the machine is equipped to accommodate the entire buggy, more especially with a parking space for the entry and exit of the buggy. A machine such as this provides for the first time for substantially continuous (non-stop) measurement over relatively long sections of track. The satellite buggy and the parking space in the machine for the entry and exit of the satellite buggy into and from the machine provide overall for even better performance of the machine per kilometer because the intervals between trains may be even better utilized, above all by particularly rapid deployment of the satellite buggy and by equally rapid withdrawal from operation for relatively long in-transit
runs of the machine. The use of a laser transmitter and the positioning of the satellite buggy far ahead of the machine which this makes possible enables the machine to travel continuously and hence with great efficiency over relatively long sections of track. Another advantage is that the satellite buggy with its highly sensitive measuring instruments is automatically protected against weather and damage in its loaded state in the machine without any need for further time-consuming manoeuvring work, the laser transmitter advantageously being permanently ready for operation to enable work to be commenced even more quickly. In addition, the machine together with the satellite buggy may be incorporated in a train formation for relatively long in-transit runs without any need for further manipulation. In overall terms, therefore, the machine according to the invention is easier and more practical to handle both for measuring and correcting work and also for entry and exit manoeuvres into and from the parking space.

In another advantageous embodiment of the invention, the machine comprises at its front end — for receiving the buggy on its way to the parking space — a preferably closeable opening at least corresponding to the transverse peripheral profile of the satellite buggy and is designed as a track measuring or geometer car with vertically and laterally adjustable sensors for determining the lateral and vertical position and, preferably, also the twist of the track, its gauge and other track parameters and is equipped with a comparator for comparing the actual values determined via the satellite buggy with the specified values and also with a storage unit for these measured data. By virtue of its ability to advance continuously over long sections of track, this track measuring or geometer car provides for the first time for efficient, exact measurement of the track position in relation to its specified position.
as shown on the track plan. At the same time, unimpeded measurement of other track parameters, such as joint level, twist, etc., is also possible, enabling the entire geometry of the track to be determined. The comparator and storage unit enables the exact different between the specified values stored for example on a magnetic tape and the actual values determined to be rapidly determined and immediately stored. These track correction data stored on a magnetic tape may then be fed, for example, into the control unit of a track tamping, levelling and lining machine by which the track can be brought into its exact specified position with a high level of efficiency. The closeable opening also enables an operator's seat to be arranged in this region.

Another particularly preferred embodiment of the invention is characterized in that the satellite buggy, which is connected to a drive and which is controllable, preferably by a radio telecontrol set, for fully automatic entry and exit into and from the machine is equipped with a distance-measuring unit which, as known per se, comprises a laser transmitter and receiver with the same optical axis extending in a plane perpendicular to the track axis for contactless determination of the distance of the lateral position or the vertical deviation of the track from fixed points or from the adjacent track. A combination such as this of a remote-controllable satellite buggy equipped with a laser transmitter with a distance-measuring unit provides for particularly high accuracy of measurement and for particularly high performance because the laser transmitter, which forms a straight reference line for the machine, may be brought rapidly and without contact into an absolute specified position according to the track plan. In addition, the direction of the laser onto the fixed point or onto the adjacent track is not affected by extraneous light and is even possible in darkness.

Another particularly practical embodiment of the
Invention is characterized in that, at its end facing the machine, the satellite buggy is additionally connected to a vertically displaceable wheel axle which acts as a sensor and on which are arranged the laser transmitter and the distance-measuring unit, the laser transmitter and the distance-measuring unit being connected to one another for common vertical and lateral displacement. The connection of the laser transmitter and the distance-measuring unit in conjunction with the vertical and lateral alignment of the distance-measuring unit with the fixed point or with the adjacent track guarantees exact displacement of the laser transmitter into its position indicating the specified position of the track. By vertical displacement of the wheel axle, the sensitive laser transmitter can be lifted off the track together with the distance-measuring unit for the entry and exit of the buggy into and from the machine.

According to another practical aspect of the invention, the self-propelled satellite buggy is designed for drive-powered or automatic raising and lowering via a sloping track which consists of ramp-like rails designed to be placed onto the laid track at their lower ends and connected for extension to guide rails arranged in the parking space of the machine. With a sloping track such as this which can be set up rapidly between the laid track and the parking space of the machine, the satellite buggy may be brought very quickly and safely into its working position or parked position - with utilization of even relatively short-intervals between trains for the measuring and correcting work on busy sections of track.

In another advantageous embodiment of the invention, the self-propelled satellite buggy has its own cabin and is equipped with units designed for radio telecontrol from the machine for measuring and storing the distance from the specified position or from fixed points or from the adjacent track and with the similarly remote-controlled laser trans-
mitter. Utilizing its simple entry manoeuvre into the roomy interior of the machine, the satellite buggy may be designed as a small-scale vehicle with high performance through the abundant provision of various precision measuring instruments. The fact that the measuring instruments on board the satellite buggy can be remote-controlled by the person operating the machine provides for even better cooperation by eliminating misunderstandings.

In another preferred embodiment of the invention, the self-propelled satellite buggy has an L-shaped cross-section, the side extending vertically upwards forming the cabin and the side extending substantially perpendicularly thereto forming a platform and an operator's seat provided in the vicinity of the opening of the machine is raised so that the platform of the satellite buggy may pass beneath. This advantageous construction enables a separate operator's seat to be arranged in the vicinity of the opening in the front end of the machine despite the size of the satellite buggy made relatively large by the cabin, so that the machine can be driven in both directions. By virtue of the fact that the operator's seat is arranged at a distance from the floor, the correspondingly low platform of the buggy is able to pass beneath it without any need to change the seat position and without any need for time-consuming manipulations.

According to another advantageous aspect of the invention, the front part of the machine provided with a window and control console is in the form of a front flap which is designed to be lifted open about a hinge, extending transversely of the longitudinal axis of the machine in the vicinity of the roof which closes off the opening for receiving the satellite buggy. A front flap such as this can be rapidly lifted open, eliminating any interference with the entry and exit of the satellite buggy and at the same time releasing a roomy opening. After the
satellite has passed through, the cabin of the machine may quickly be restored to the orderly state to which the operator is accustomed for performing his various tasks.

The present invention also relates to an advantageous process for the automatic and - at least in sections - continuous comparison of actual and specified versines, particularly along curved sections of track, and for determining the vertical position of a track using a machine of the type described above, characterized in that, in the section of track to be measured, the satellite buggy is moved from the machine onto the laid track and, with development of a relatively long distance therefrom, the distance-measuring unit of the satellite buggy together with the laser transmitter is aligned, preferably by remote control, with a fixed point of the track, after which - with alignment of the laser receiver arranged on the machine with the laser beam directed by the laser transmitter onto the machine - the actual versines and the actual vertical position of the laid track are determined by the machine advancing continuously in relation to the stationary satellite buggy and - with storage of the measured data - are compared with the specified position, the satellite buggy being sent forward again after the approach of the machine and the laser transmitter being aligned with a new fixed point, and in that, on completion of the measuring process, the satellite buggy is returned under remote control to the parking space by way of the sloping rails and in that the stored measured data are then optionally fed into the control unit of a correcting machine, for example a track tamping, levelling and lining machine, for correcting the position of the track. This process, which utilizes even brief intervals between trains on particularly busy tracks, provides for particularly rapid deployment and withdrawal of the satellite buggy for exact measuring of the actual position of the track in relation to its specified
position as shown on the track plan. By using laser beams, even relatively long sections of track may be exactly measured in a rational manner. In cases where the distance from the station to the measuring site is relatively long, it is a particular advantage that the satellite may be parked in the machine capable of travelling at relatively high speeds, enabling the interval between trains to be even better utilized.
One example of embodiment of the invention is described in detail in the following with reference to the accompanying drawings, wherein:

Figure 1 is a side elevation of a machine constructed in accordance with the invention in the form of a track measuring or geometer car with the front flap raised and with a satellite buggy accommodated inside.

Figure 2 is a highly diagrammatic plan view of the machine shown in Figure 1 with the satellite buggy situated far in front of the machine and aligned with a fixed point of the track.

Figure 3 is a front elevation of the machine on a larger scale with the satellite buggy accommodated therein in the direction of arrow III in Figure 1.

Figure 4 is a front elevation of the satellite buggy accommodated therein with the laser transmitter and distance-measuring unit.

The machine 1 shown in Fig. 1 is designed to travel on bogie-type undercarriages 2 along a track 5 formed by rails 3 and sleepers 4 and is constructed as a track measuring or geometer car 6 with sensors 7 for measuring the vertical and lateral position of the track and other track parameters, such as twist, gauge, division into kilometers, joint level of both rails and superelevation. The track measuring car 6 consists essentially of a frame 8 with a box-like superstructure 9 and comprises a central drive and power supply system 10, a propulsion drive 11, a switching and electronic cabinet 12 and a recorder or computer 13. Measured data recorded mechanically by the sensors 7 and converted by linear transducers into electrical voltages are fed into the computer 13, compared in a comparator 14 with the stored specified data of the track plan and the differences stored in a storage unit 15. The sensors 7 are in the form of telescopic measuring axles and are connected to compressed-air cylinders 17 for permanent
application of the flanges of their measuring wheels to
the edges of the rails. Odometers 18 and 19
are provided at both ends of the machine 1. Provided
between the two outer sensors 7 are two measuring chords 20
each guided in the vicinity of a rail 3 for the vertical
position of the track and a centrally extending lining
measuring chord 21. At their rear ends - in the working
direction indicated by an arrow 22 - these chords 20,21 of
wire are directly attached to the axle of the sensor 7
and, at their front ends, to a laser receiver 23, 24.

All three sensors 7 are provided in the immediate vicinity
of the bogie-type undercarriages 2 for performing the
measurements under load. They are pivotally connected to
the bogie-type undercarriages 2 by a linkage 25 and can be
lifted off the track for in-transit runs of the machine 1 by
actuation of the compressed air cylinders 17. The central
sensor 7 is connected to a pickup 26 in the region of the
central lining measuring chord 21 and to further pickups 27
in the region of the vertical measuring chord 20. These
pickups surround the associated chord with a bifurcated
feeler which converts any change in the position of the
chord into corresponding electrical measured quantities
via a rotary potentiometer and relays them to the computer 13.

At its centre, the box-like superstructure 9 on the
frame 9 comprises a partition 28 which extends perpendicularly
of the longitudinal axis of the machine and which closes
off the rear space for the measuring instruments, the
central power supply system 10 and a driver's cabin 29.
The front space remaining is intended to accommodate an
entire buggy in the form of a satellite buggy 30 with a
parking space 31. A recess or opening 33 shown in Fig. 3
is provided in the superstructure 9 at its front end 32
for raising and lowering the satellite buggy 30 from the
parking space 31 onto the track 5, this recess or opening 33
being closeable by a hinged front flap 35 comprising a
window and a control console 34 with a radio set. The front flap 35 is designed to be raised and lowered by a cylinder 39 about a hinge 36 extending transversely of the longitudinal axis of the machine in the vicinity of the roof of the superstructure 9 formed by two sidewalls 37 and a roof 38. The satellite buggy 30 propelled by its own drive 40 is designed to travel into and out of the opening 33 of the machine 1 via a sloping track 41 comprising retractable and extendable, ramp-like rails 42 adjoining the machine 1. The ramp-like rails 42 are designed to be connected to guide rails 43 arranged in the parking space 31 for the satellite buggy 30 by quick-release fastenings. As can be seen from Fig. 3 in particular, a cable winch 45 provided with a drive 44 is provided in the rear part of the parking space 31, its cable 46 being releasably connectible to the satellite buggy 30. A guide roller 47 is provided at the front end of the machine for low-friction guiding of the cable 46 fastened to the satellite buggy 30.

As can be seen in particular from Figs. 3 and 4, the satellite buggy 30 designed to travel on its own undercarriages 48 has an L-shaped cross-section, the side extending vertically upwards forming a cabin 49 and the side extending substantially perpendicularly thereto forming a platform 50. To allow the platform 50 of the satellite through, an operator's stand 51 provided on the track measuring car 6 in the region of the opening 33 is arranged raised on a supporting plate 52 which is only connected to one side wall 37 of the track measuring car 6. The front sensor 7 which is situated beneath the operator's stand 51 is connected to a supporting plate 53 on which one horizontal and two vertical spindle drives 54 and 55 are arranged. These drives are designed for transverse and vertical displacement of the laser receivers 23, 24 arranged thereon and connected to the end points of the measuring chords 20,21 in the direction indicated by double arrows.
at its rear end (in the working direction), a distance-measuring unit 56 and a laser transmitter 57 connected thereto. The laser transmitter 57 is connected to a drive 59 for horizontal displacement on a horizontal spindle drive 58. This horizontal spindle drive 58 is designed for vertical displacement together with the distance-measuring unit 56 and the laser transmitter 57 by vertical spindle drives 60 arranged at its ends with drives 61, the vertical spindle drives 60 being fixed to a support plate 62. The support plate 62 rests on a wheel axle 63 which is designed to act as a sensor and which, for vertical displacement from the working position illustrated into the in-transit position shown in Fig. 1, is connected to a hydraulic cylinder 64 pivotally connected to the satellite buggy 30. A pressing post 65 (Figs. 1,2) hydraulically operable at both ends and connected to the satellite buggy 30 is provided for pressing a flanged wheel of the axle 63 and of the undercarriages 48 against the left-hand rail, in the example illustrated. The post 65 is pressed against the rail 3 opposite the reference rail. Between the pressing post 65 and the rear undercarriage 48 there is another wheel axle 66 in the form of a sensor with a cross-level gauge. For contactless determination of the distance of the lateral position or vertical deviation of the track 5 from fixed points 68 arranged, for example, on overhead-line poles 67, the distance measuring unit 56 comprises a laser transmitter and receiver 69 with the same optical axis 70 extending in a plane perpendicular to the axis of the track, as described in detail in Applicants' GB-PS 2093 308 B. The laser transmitter 57 is equipped with a special lens by which the laser beam is fanned out into a horizontal plane and a vertical plane. The horizontal light plane influences the levelling and the vertical light plane the lining of the track. The two laser beam light planes are shown diagrammatically in
It is known to

transmitter which, in fact, is best removed from the buggy
before it is suspended from the machine.

Figure 1 in the form of dash-dot lines I1, I2.

The sequence of operations involved in track measurement by means of the track measuring car according to the invention is described in detail in the following.

The track measuring car 6 together with the satellite buggy 30 in its parking place 31 is driven along the section of track to be measured, the operator sitting in the operator's seat 51 and operating the drive and control instruments arranged on the control console 34. On arrival at the measuring site, the machine 1 is stopped and the front flap 35 is raised by actuation of the cylinder 39. The ramp-like rails 42 are withdrawn from the parking place 31 and, with their lower shoe-like ends resting on the rails 3 of the laid track 5, are connected to the guide rails 43 arranged in the parking place by means of quick-release fastenings. The satellite buggy 30 is then automatically sent out to a fixed point 68 far ahead of the machine 1 by the machine operator in the track measuring car 6 using a mobile radio telecontrol set 73 removable from the control console 34 (Fig. 2). The distance-measuring unit 56 is also directed with its optical axis 70 onto the fixed point 68 shown on the track plan under remote control for the purpose of determining the lateral and vertical distance of the track position. If a deviation is detected from the specified value fed into the control unit 74 according to the track plan, the laser transmitter 57 is immediately displaced laterally and/or vertically into its specified position by actuation of the corresponding spindle drives 59, 61. In that position, the horizontal laser beam plane 71 is exactly parallel to the specified position of the track so that the associated laser receiver 23 together with the measuring chords connected thereto are likewise moved automatically into the specified vertical position. Accordingly, the exact deviation of the actual position of the track from the specified values may thus be determined by the pickups.
27 arranged on the sensor 7.

The vertical laser beam plane 72 corresponds in its position relative to the track to the chord of an arc marked on the track plan and controls the laser receiver 34 connected to the lining measuring chord 21. The exact versine values of the actual track position 75 (Fig. 2) in relation to the chord of an arc on which the specified track position 76 is based can be transcribed by the pickup 26 situated on the central sensor 7. For determining the exact distance of the satellite buggy 30 from the machine 1 or more precisely from the foremost sensor 7, the under-carriage 48 of the satellite buggy 30 is connected to an odometer 77. The actual values determined are compared in the comparator 14 with the specified values stored on magnetic tape and made available by the local railway authority, the difference being stored in the storage unit 15 with corresponding kilometer marking. The stored data are the basis for evaluation of the condition of the track by the railway authority in question and may be fed into the control unit of a track tamping, levelling and lining machine for efficiently restoring the track to its exact specified position. The described measuring process takes place with continuous advance of the track measuring car 6 with the operator sitting in the operator's seat 51 and the front flap 35 in the lowered position in the working direction indicated by the arrow 22 until the stationary satellite buggy 30 is reached. The satellite buggy 30 is then sent forward under remote control to the next fixed point (shown in chain lines in Fig. 2) by actuation of its drive 40. On arrival at the next fixed point, the distance measuring unit 56 together with the laser transmitter 57 is moved into the specified position. The continuous measuring process then begins again through the advance of the track measuring car 6.

On completion of the work involved in the measuring
process, the front flap 35 is raised again and the ramp-like rails 42 are placed on the laid track 5 and on the guide rails 43. Shortly before reaching the ramp-like rails 42, the satellite buggy 30 (of which the wheel axle 63 acting as a sensor was raised together with the laser transmitter 57 and the distance measuring unit 56) may be connected to the end of the cable 46 and raised into the parking place 31 by actuation of the drive 44 of the cable winch 45. After removal of the ramp-like rails 42 and lowering of the front flap 35, the track measuring car 6 may be driven into a station or into a siding. The satellite buggy 30 may of course also be automatically raised onto the ramp-like rails 42 through its drive and driven into the parking place 31.

According to the invention, the automatic entry and exit manoeuvring of the satellite buggy 30 and optionally - particularly under difficult working conditions - the taking of bearings on one or the other fixed point 68 may be performed by a machine operator seated in the cabin 49.
CLAIMS
The claims defining the invention are as follows:

1. A travelling on-track machine for measuring and recording and/or even for correcting the position of a track comprising a transmitter designed to emit laser beams or planes and arranged on a buggy which travels under its own power along the uncorrected track and further comprising a laser received provided on the machine equipped with track measuring reference systems for determining various track parameters, such as longitudinal level, direction and the like, characterized in that, for continuous determination and/or correction of the actual position of the track over at least relatively long sections in relation to the lateral and/or vertical deviation of the specified position of the track, the buggy connected to the laser transmitter is designed as a self-propelled satellite buggy for drive-powered or automatic raising and lowering from the front end of the machine and in that, at its front end in the working direction, the machine is equipped to accommodate the entire satellite buggy, more especially with a parking space for the entry and exit of the buggy.

2. A machine as claimed in Claim 1, characterized in that, at its front end - for receiving the buggy on its way to the parking space - the machine comprises a preferably closable opening at least corresponding to the transverse peripheral profile of the satellite buggy and in that the machine is designed as a track measuring or geometry car with vertically and laterally adjustable sensors for determining the lateral and vertical position and, preferably, also the twist of the track, the gauge of the track and other track parameters and is equipped with a comparator for comparing the actual values determined via the satellite buggy with the specified values and also with a storage unit for these measured data.

3. A machine as claimed in Claim 1 or 2, characterized in that the satellite buggy which is connected to a drive and which is controllable, preferably by a radio telecontrol set, for fully automatic entry and exit into and from the machine is equipped with a distance measuring unit which, as known per se, comprises a laser transmitter and receiver with
Another particularly practical embodiment of the...

the same optical axis extending in a plane perpendicular to
the track axis for contactless determination of the distance
of the lateral position or the vertical deviation of the track
from fixed points or from the adjacent track.

4. A machine as claimed in Claims 1 or 3, characterized
in that, at its end facing the machine, the satellite buggy
is additionally connected to a vertically displaceable wheel
axle which acts as a sensor and on which are arranged the
laser transmitter and the distance measuring unit, the laser
transmitter and the distance measuring unit being connected to
one another for common vertical and lateral displacement.

5. A machine as claimed in any of Claims 1 to 4, charac-
terized in that the self-propelled satellite buggy is designed
for drive-powered or automatic raising and lowering via a
sloping track which consists of ramp-like rails designed to
be placed onto the laid track at their lower ends and connected
to extension to guide rails arranged in the parking space of
the machine.

6. A machine as claimed in any of Claims 1 to 5,
characterized in that the self-propelled satellite buggy has
its own cabin and is equipped with units designed for radio
telecontrol from the machine for measuring and storing the
distance from the specified position or from fixed points or
from the adjacent track and with the similarly remote-
controlled laser transmitter.

7. A machine as claimed in any of Claims 1 to 6,
characterized in that the self-propelled satellite buggy has
an L-shaped cross-section, the side extending vertically
upwards forming the cabin and the side extending substantially
perpendicularly thereto forming a platform and in that an
operator's seat provided in the vicinity of the opening of the
machine is raised so that the platform of the satellite buggy
may pass beneath.

8. A machine as claimed in any of Claims 1 to 7,
characterized in that the front part of the machine provided
with a window and a control console is in the form of a front
flap which is designed to be lifted open about a hinge
extending transversely of the longitudinal axis of the machine
in the vicinity of the roof and which closes off the opening
9. A process for the automatic and at least in sections continuous comparison of actual and specified versines, particularly along curved sections of track, and for determining the vertical position of a track using a machine of the type claimed in any of Claims 1 to 8, characterized in that, in the section of track to be measured, the satellite buggy is moved from the machine onto the laid track and, with development of a relatively long distance therefrom, the distance measuring unit of the satellite buggy together with the laser transmitter is aligned, preferably by remote control, with a fixed point of the track, after which - with alignment of the laser receiver arranged on the machine with the laser beam directed by the laser transmitter onto the machine - the actual versines and the actual vertical position of the laid track are determined by the machine advancing continuously in relation to the stationary satellite buggy and - with storage of the measured data - are compared with the specified position, the satellite buggy being sent forward again after the approach of the machine and the laser transmitter being aligned with a new fixed point, and in that on completion of the measuring process the satellite buggy is returned under remote control to the parking space by way of the sloping rails and in that the stored measured data are then optionally fed into the control unit of a correcting machine, for example a track tamping, levelling and lining machine, for correcting the position of the track.


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interference with the entry and exit of the satellite buggy
and at the same time releasing a roomy opening. After the
are in the form of telescopic measuring axles and are connected to compressed-air cylinders 17 for permanent