United States Patent

[11] **3,608,497**

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[33] **Austria**
[31] **A2238/68**

[54] **TAMPING AND LEVELLING MACHINE**
11 Claims, 9 Drawing Figs.

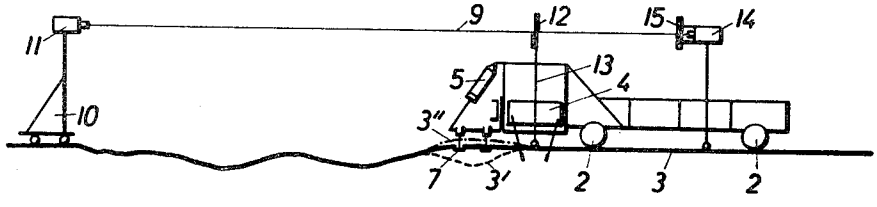
[52] **U.S. Cl.** ..... **104/7 R,** 104/12
[51] **Int. Cl.** **E01b 27/17,** E01b 29/04
[50] **Field of Search** ..... 104/7, 7 A, 7 B, 8, 12

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Assistant Examiner—Richard A. Bertsch
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ABSTRACT: In a mobile track tamping and levelling machine, the reference system includes a beam transmitter and a pair of beam receivers associated with one or both track rails. A pair of masking boards is associated with the receivers for masking a portion of the beam, the respective upper and lower edges of the boards facing towards each other and preferably being aligned. Fluid-operated track-lifting means is controlled by signals from the receivers which depend on the beam portion or intensity received thereby as the boards enter into the beam path during the track-lifting operation.



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SHEET 1 OF 2

Fig. 1

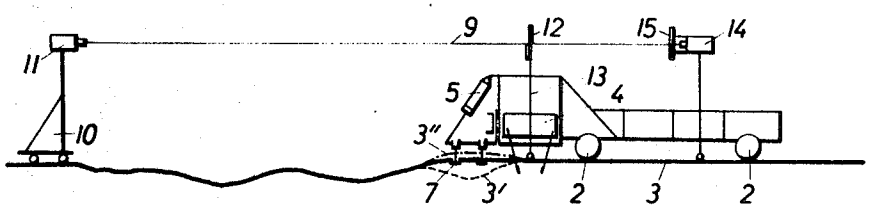


Fig. 2a

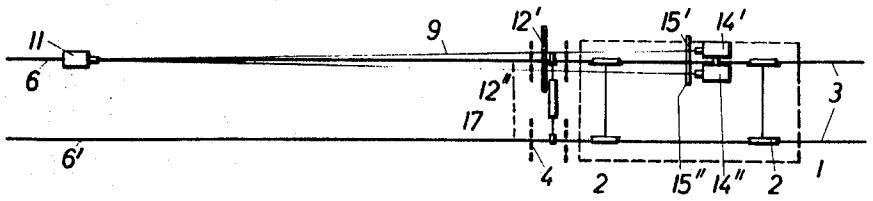


Fig. 2b

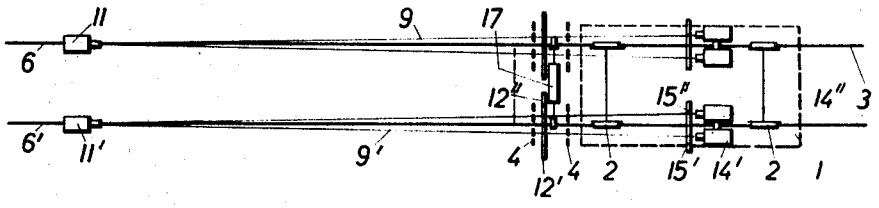
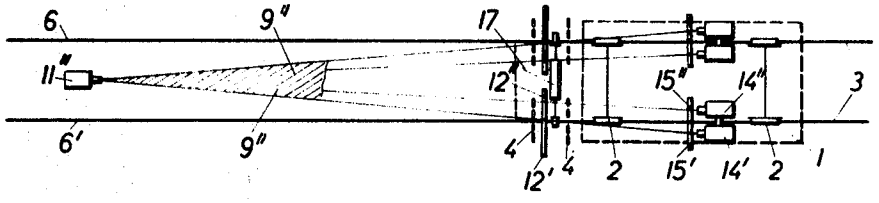


Fig. 2c



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Fig. 3

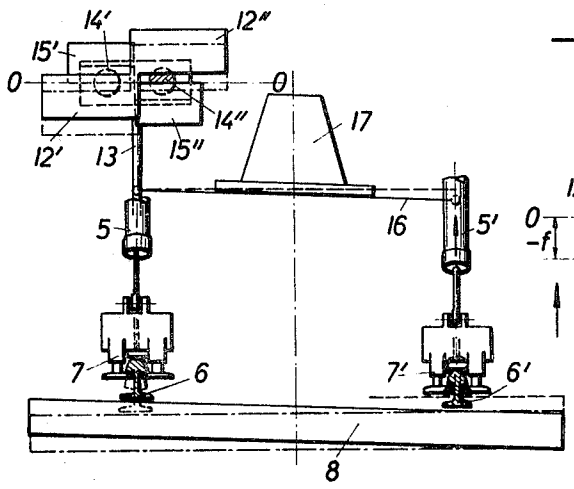


Fig. 4

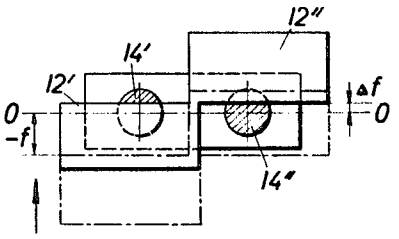


Fig. 5

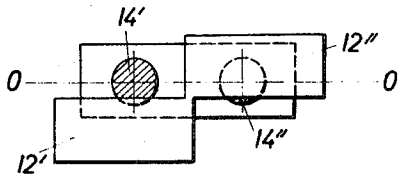


Fig. 6

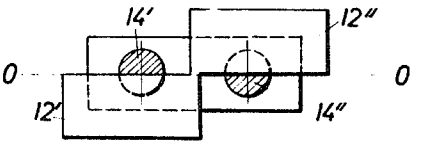
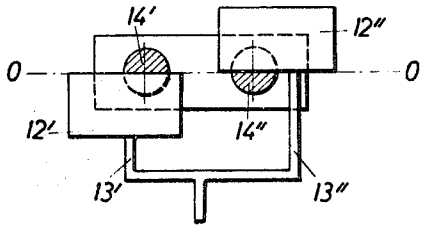


Fig. 6a



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TAMPING AND LEVELLING MACHINE

BACKGROUND AND SUMMARY OF THE INVENTION

The present invention relates to a mobile track tamping and levelling machine mounted on the track rails for movement in a working direction during a track-grading operation.

Conventional machines of this general type may comprise a reference system for detecting and controlling the level of the track, which system includes a beam transmitter means and a beam receiver means spaced apart in the direction of track elongation. A beam transmitted by the transmitter means is received by the receiver means, and the axis of the beam constitutes a reference line in respect of which the track is lifted. Such reference systems further include a masking board means supported on a track section to be levelled and vertically moving therewith during levelling for entering into the path of, and interfering with, the beam so as to mask the same. A fluid pressure, preferably hydraulically, operated track-lifting means is mounted in the range of the masking board means in such machines.

It is the primary object of this invention to increase the accuracy of the lifting control obtained by such reference systems without appreciably to reducing the speed of the lifting operation which must be considerable to meet modern track maintenance requirements.

Particularly in modern, high-efficiency machines wherein track lifting is effected rapidly and forcefully, it frequently happens that lifting is continued beyond the desired level, i.e. after the masking board has reached the reference beam, because of inertia in the controls. This reduces the accuracy of the levelling operation.

With the arrangement of the invention, such excess lifting is either completely avoided or, if it happens occasionally, the excess lift is automatically erased by a downward movement to the desired level. Such an automatic control may be readily incorporated into the otherwise conventional control system of machines of the indicated type.

This is accomplished by providing a pair of horizontally adjacent receivers for each transmitter, the pair of receivers being associated with one of the track rails. A pair of masking boards is associated with the pair of receivers for masking a portion of the beam, one of the masking boards having a horizontally extending upper edge and the other masking board having a horizontally extending lower edge, the edges facing towards each other and preferably being in alignment. Upward movement of the masking boards during track levelling will cause one masking board gradually to mask the portion of the beam associated with one of the receivers while the other masking board will gradually move out of the path of the portion of the beam associated with the other receiver.

The position of the receivers and of the transmitter may be reversed without changing the functioning of the system. Thus, while it is preferred to mount the beam receivers rearwardly of the transmitter in the working direction, this is not essential for the invention as long as two receivers responsive to a beam or like radiated energy produce a control signal or pulse and two beam-masking boards associated with the two receivers and vertically moving with the track during a levelling operation interfere with the beam. The control signals or pulses are functions of the radiated energy measured at these receivers and control the operation of the track-lifting means, one of the receivers emitting a control signal designed to lift the track and the other receiver emitting a control signal designed to brake, stop or reverse the track lifting.

Since the two masking boards of this invention to together indicate the desired track level and control the lifting stroke to attain this level, it is preferred for the upper edge of one board and the lower edge of the other board to be in horizontal alignment.

Each of the beam receivers emits a control signal controlling the fluid pressure operating the track-lifting means, according to one feature of the invention. Preferrably, the control signal of the beam receiver whose upper edge moves into the beam path operates the lifting means to lift the track,

while the control signal of the beam receiver whose lower edge moves into the beam path during the levelling operation operates the lifting means to slow, stop or reverse the track lift.

In accordance with another preferred feature of this invention, the beam receivers are constituted by beam intensity meters or are connected to such meters so that a common control pulse dependent on the difference between the received beam intensities may be used as control signal for the lifting operation. Preferably, this control signal will control the pressure in the two hydraulic cylinder chambers of the motor used to effectuate the lifting in direct proportion to the two beam intensities at the receivers.

BRIEF DESCRIPTION OF DRAWING

Other objects, advantages and features of the present invention will become more apparent in the following detailed description of certain now-preferred embodiments, taken in conjunction with the accompanying drawing wherein

FIG. **1** is a schematic side elevational view of a mobile track tamping and levelling machine incorporating a reference system for detecting and controlling the track-lifting operation;

FIG. **2***a*, **2***b* and **2***c* are top views of such a machine showing three embodiments of a reference system arrangement according to this invention;

FIG. **3** is an enlarged front view of the machine of FIG. **2***a*, showing only the track-lifting means and the associated reference system;

FIGS. **4** to **6** are enlarged front views of the masking boards and associated receivers of a modified embodiment, showing three different positions during the levelling operation; and

FIG. **6***a* is similar to FIG. **6** but shows a different embodiment of a pair of masking boards.

DETAILED DESCRIPTION

Referring first to FIG. **1**, there is seen a generally conventional mobile track tamping and levelling machine mounted on the track rails **6**, **6'** for movement in a working direction i.e. towards the left. As is well known, such a machine includes a frame **1** running with its front and rear running gears **2**, **2** on a previously graded track section **3**. The frame includes a portion extending forwardly of the front running gear and overhanging a track section **3'** to be levelled, this frame portion holding the vertically movable ballast-tamping means **4** and mounting in front the track-lifting means **5**.

As best seen in FIG. **3**, the track-lifting means includes a pair of hydraulic motors **5**, **5'** each including a cylinder and a piston glidably mounted therein, the piston dividing the cylinder interior into two chambers, at least one of which receives hydraulic fluid. The piston rods of the motors are attached to frames for the twin double-roller sets **7**, **7'** which, when closed, grip the rails **6**, **6'** under the railhead. During the lifting operation, this known lifting unit pulls up the rails gripped from underneath at two points by the roller clamps. After completion of the lifting operation, the machine can be moved on while the roller clamps remain continuously pressed under low pressure to the lower edge of the railhead.

As is shown in FIG. **1** in exaggerated form to illustrate the point more clearly, the ungraded track section **3'** is to be levelled in relation to track section **3** but, due to inertia of the valves in the hydraulic circuit of the lifting unit and/or other reasons, it frequently occurs that the track is lifted too high, as indicated by the chain-dotted line **3''**.

All the above structures are known, as is the reference system for controlling the levelling operation and which includes a beam transmitter member **11** and a beam receiver member **14**, these members being spaced in the direction of track elongation. A beam **9** is transmitted from beam transmitter **11** to beam receiver **14** and the axis of the beam constitutes a reference line or may define a reference plane in respect of which the track is levelled. The beam transmitter is

mounted on front buggy **10** and the beam receiver is mounted rearwardly of the receiver in the working direction of the machine, the beam receiver being supported on the track rail with which it is associated in the graded section of the track. A masking board means **12** is supported by carrier rod **13** on the track section to be levelled and vertically moves with this track section during levelling for entering into the path of beam **9** and masking the same. When the masking board interferes with the beam, the receiver produces a corresponding control signal, i.e. a pulse which controls the hydraulic fluid flow into the hydraulic motors of the lifting unit. Desirably, the control signal may depend on the intensity of the beam received.

According to the present invention and as more fully shown in FIGS. **3** to **6**, the masking board means comprises a pair of masking boards **12'**, **12''** and a pair of horizontally adjacent beam receivers **14'**, **14''** is provided for the beam transmitter **11**. Each of the masking boards is associated with one of the receivers for masking a portion of the beam received from the transmitter. In the embodiments of FIGS. **1–3**, complementary masking boards **15'**, **15''** are mounted fixedly in front of the beam receivers **14' 14''** and arranged to mask that portion of the receivers which is not masked by the moving masking boards **12' 12''** when they are in the position indicating the desired track level, as will be explained more fully hereinafter, i.e. the receiver portions which do not receive any beam portion exciting a control signal.

In the illustrated embodiments, the moving masking boards **12' 12''** are mounted on a common carrier **13** and form a unit. Each masking board is rectangular and the rectangular masking boards are diametrically opposite each other, with one corner of one board being connected to one corner of the other board, the upper edge of board **12'** and the lower edge of board **12''** extending in a straight line passing through the connected corners.

However, as shown in FIG. **6***a*, the two boards need not form a unit but may be mounted side by side on carriers **13'**, **13''**, the horizontally extending upper edge of one board in all embodiments facing towards the horizontally extending lower edge of the other board. In this manner, upward movement of the masking boards during track levelling will cause the one masking board gradually to mask the portion of the beam associated with the one receiver while the other masking board will gradually move out of the path of the portion of the beam associated with the other receiver.

In the embodiment of the reference system illustrated in FIG. **3**, the cross level of the track may be controlled by mounting crossbeam **16** on the carrier **13**, for instance, a pendulum or level **17** on the crossbeam indicating the superelevation of the track.

The double receivers and double-masking boards arrangement of this invention may be used advantageously in connection with a variety of reference systems, some examples being illustrated in FIGS. **2***a–c* and described hereinbelow.

FIGS. **2***a–c* are top views of a machine as shown in side view in FIG. **1**. In the embodiment of FIG. **2***a*, a single beam **9** is used vertically above track rail **6**, which is the grade rail. After the grade rail has been levelled with the aid of the reference beam **9**, the other rail **6'** is adjusted by means of the cross level or pendulum **17**, as also shown in FIG. **3**, the original track position being shown in FIG. **3** by the chain-dotted lines indicating the level of tie **8** and rails **6**, **6'**, the track position after lifting of grade rail **6** being shown in full lines, and the final position of the track being shown in broken lines, this final position being reached after rail **6'** has been lifted under the control of the superelevation control device **17**.

FIG. **2***b* shows the use of two reference beams **9** and **9'** respectively with rails **6** and **6'**. In this case, an additional transmitter **11'** is mounted vertically above rail **6'** and a pair of receivers are associated with the additional transmitter, additional masking board means of the same type as used, in connection with beam **9** provided for beam **9'**. In this embodiment, the superelevation control device **17** may be eliminated or used only as as an extra control.

In the embodiment of FIG. **2***c*, a single transmitter **11''** is mounted on front buggy **10** but emits a broad beam constituting a reference plane **9''** which extends across the width of the track and thus is received by both pairs of receivers mounted above each rail. In this illustrated embodiment, this single transmitter is mounted centrally between the rails but, if desired, it could be mounted above either rail, with its wide beam focused so that it is received by the pairs of receivers above both rails.

Whatever the reference system, the operation of the double-masking board arrangement remains unchanged and will be explained more fully hereinbelow, the photocells of the receivers **14'**, **14''** being shown circular to receive the beam **9** and/or **9'** of circular cross section, the axis of each beam and the center of each pair of receivers associated with the beam being coaxial.

Fig. **3** shows the original position of the masking boards **12'**, **12''** before levelling in chain-dotted lines. In this lowermost position, the masking boards, which are supported on the rail **6** by the carrier rod **13** running on the rail by means of a roller, indicate the need for lifting the rail **6** to level the track, the desired level being reached when the upper edge of board **12'** and the lower edge of board **12''**, which are in alignment, lie in horizontal plane **0—0**, which passes through the axes of the receivers **14'**, **14''**.

If the rail is accidentally lifted higher than desired, due, for instance, to inertia of the control, of the hydraulic circuit valves, or for other reasons, and the masking boards are thus lifted with the rail to the position shown in full lines in FIG. **3**, the moving masking board **12'** and the fixed masking board **15'** completely mask the photocell of receiver **14'**. On the other hand, the photocell of receiver **14''** is laid free by the upward move of board **12''** and receives the beam below the lower edge of board **12''** and above the upper edge of fixed board **15''**. This causes a pulse to be produced by receiver **14''** to constitute a control signal for operation of the lifting motor **5**. Since the photocell of the receiver indicates the intensity of the received beam, the amount of the excess lift or the desired return stroke of the lifting motor are a direct function of the metered intensity and may be used to brake or stop the operation of the motor during the upward lift.

Excess lifting is encountered particularly if pressure and hydraulic fluid flow in motor **5** are high, i.e. if the rail is rapidly lifted since the valve means in the hydraulic circuit will shut off the hydraulic fluid flow only after the track rail has reached the desired level. The control signal emitted from receiver **14''** when its photocell receives the beam, may be a pulse which controls the pressure in the cylinder chambers of motor **5**, thus braking, stopping or reversing the lifting stroke.

Since this control is automatic, it does not substantially slow the lifting operation. As soon as both receivers are fully masked by cooperating boards **12'**, **15'** and **12''**, **15''** i.e. when their respective upper and lower edges are in plane **0—0**, no further signal is emitted, the lifting operation ceases, and the rail is in the desired position.

As soon as the grade rail **6** has been levelled, the superelevation control device **17** may be used to level rail **6'**, it being within the scope of the present invention to use as device **17** to emit a control signal similar to the control signals emitted by receivers **14'**, **14''** to operate hydraulic motor **5'** in a manner similar to the controlled operation of motor **5**.

It will be appreciated that, if the control signal depends on the beam intensity received by the receivers, the fixed masking boards **15'**, **15''** may be omitted since the intensity will change as a consequence of the relative vertical position of the masking board edges in respect of the photocells of the receivers.

FIGS. **4** to **6** show the latter arrangement without fixed masking boards. In FIG. **4**, the chain-dotted lines indicate The position of the double-masking boards **12'**, **12''** when the rail is spaced a vertical distance $-f$ from the reference plane **0—0**. In this position, the photocell of receiver **14''** is fully masked by board **12''** while the photocell of receiver **14'** receives the full intensity of the beam since the upper edge of board **12'** is

below the cell. The difference between the beam intensities received by the two receivers is at a maximum, the highest intensity being received by receiver **14'** and no beam intensity at all being measured at receiver **14''**. The ratio of the two intensities, i.e. the difference between the intensities, is used to produce a potential which operates the hydraulic fluid flow to the hydraulic motor so that the motor lifts the rail clamps and, with it, the rail, the rapidity of the lifting stroke, i.e. the hydraulic pressure in the motor, varying in direct proportion to the difference of the measured intensities at the receivers. In other words, as the rail is lifted and the one receiver begins to become masked, while the other receiver gradually becomes unmasked, the difference of the beam intensities is gradually reduced and the lifting correspondingly slows down.

As the lifting operation proceeds in this controlled manner, the double-masking board first assumes the position shown in FIG. **5**, wherein receiver **14'** receives only about 80 percent of the entire beam energy while receiver **14''** already receives 20 percent of this energy, i.e. the difference of the received beam intensities has been reduced, the potential produced by this measured difference has been correspondingly reduced and the lifting is slowed down. This slowdown is produced simply by controlling the hydraulic fluid flow by this control potential so that the pressure difference in the two cylinder chambers of the motor rises and falls in the same proportion as the intensity difference at the beam receivers.

FIGS. **6** and **6***a* show the position reached when the desired rail level has been attained. In this position, both photocells receive the same beam intensity i.e. each 50 percent the difference between the intensities is 0, the pressure difference in the motor cylinder chambers is correspondingly 0, and lifting ceases. Of course, the pressure measurement in the motor cylinder chambers must take into consideration that the fluid in one chamber exerts its pressure upon the entire face of the piston while the pressure face on the lower side of the piston, which faces into the other chamber, is reduced by the attachment of the piston rod to this lower side.

If the receivers **14'**, **14''** are provided with beam intensity meters, excess lifting will hardly ever occur since the gradually reduced beam intensity difference measured at the two receivers will automatically and correspondingly reduce the upward movement of the rail clamps operated by the hydraulic motor which is controlled by a control signal proportional to this beam intensity difference. However, if such excess lifting should occur, for instance by a vertical distance Δf, as shown in FIG. **4**. The receiver **14'** will receive less than 50 percent i.e. 30 percent of the beam intensity while receiver **14''** receives 70 percent thereof. This reversal will cause a corresponding reversal in the fluid pressures in the two hydraulic cylinder chambers, the upper chamber receiving a higher pressure than the lower chamber, which will cause the motor to press the rail-engaging roller clamps down so as to depress the rail again until the desired level has been reached, which is indicated by a zero differential between the received beam intensities at the two receivers.

It is a considerable advantage of all embodiments of the invention that the control of the lifting stroke in its final phase, which determines the accuracy of the levelling operation, is particularly sensitive without being unduly slowed.

It will be obvious that the improvements herein disclosed are not limited to any particular masking board structure, type of beam and/or type of beam transmitters and receivers but that may modifications and variations may occur to those skilled in the art without departing from the spirit and scope of this invention.

What we claim is:

1. In a mobile track tamping and levelling machine mounted on the track rails for movement in a working direction, comprising a reference system for detecting and controlling the level of the track, said system including beam transmitting and receiving means, said means being spaced in the direction of track elongation, and a beam transmitted by the transmitting means and received by the receiving means, the axis of said beam constituting a reference line, and further including a masking board means supported on a track section to be levelled and vertically moving therewith during levelling into the path of the beam and masking the same; and a fluid pressure operated track-lifting means mounted in the range of the masking board means, the improvement of the pair of horizontally adjacent beam receivers being provided for each beam transmitter, said pair of receivers being associated with one of the track rails; and said masking boards means including a pair of masking boards, each of said masking boards being associated with one receiver for masking a portion of the beam, one of said masking boards having a horizontally extending upper edge and the other masking board having a horizontally extending lower edge, said edges facing towards each other, whereby upward movement of the masking boards during track leveling will cause the one masking board gradually to mask the portion of the beam associated with one of the receivers to reduce the received beam portion while the other masking board will gradually move out of the path of the portion of the beam associated with the other receiver to increase the received beam portion, the intensity of the beam received by the beam receivers varying gradually with the respective beam portion received thereby, each of said beam receivers including means for emitting a control signal proportional to the received beam portion, the control signals controllably operating the track-lifting means in direct proportion to the gradually varying intensity of the beam received by the beam receivers.

2. In the mobile track tamping and levelling machine of claim **1**, said beam receivers being mounted rearwardly of the beam transmitter in the working direction of the machine.

3. In the mobile track tamping and levelling machine of claim **2**, said masking board means being arranged considerably closer to the beam receivers than the beam transmitter.

4. In the mobile track tamping and levelling machine of claim **1**, the masking board edges being in alignment.

5. In the mobile track tamping and levelling machine of claim **2**, said control signal controlling the fluid pressure operating the track-lifting means.

6. In the mobile track tamping and levelling machine of claim **5**, wherein the control signal of the beam receiver associated with the one masking board operates the lifting means to lift the track, and the control signal of the beam receiver associated with the other masking board operates the lifting means to slow, stop or reverse the track lift.

7. In the mobile track tamping and levelling machine of claim **5**, wherein the control signals produce a common control pulse which depends on the ratio of intensities of the beam portions received by the receivers.

8. In the mobile track tamping and levelling machine of claim **5**, wherein a hydraulic motor operates the track-lifting means, the motor including a cylinder and a piston glidably mounted therein, the piston dividing the cylinder interior into two chambers, at least one of which receives hydraulic fluid, and the control signals being arranged to control the flow of the hydraulic fluid into the cylinder chamber.

9. In the mobile track tamping and levelling machine of claim **1**, a common carrier for said pair of masking boards whereby they form a masking board unit, and means for supporting the common carrier on the track rail with which the unit is associated.

10. In the mobile track tamping and levelling machine of claim **9**, each masking board being rectangular, and the rectangular masking boards being diametrically opposite each other, with one corner of one board being connected to one corner of the other board, the upper edge of one of the boards and the lower edge of the other board extending in a straight line passing through the connected corners.

11. In the mobile track tamping and levelling machine of claim **1**, a pair of fixed masking boards complementary to the moving masking boards and arranged to mask that portion of the receivers which is not masked by the moving masking boards when they are in the position indicating the desired level.