Aug. 11, 1964 E. OVILLE 3,143,974

DEVICE FOR LIFTING RAILWAY TRACKS

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Fig. 1.

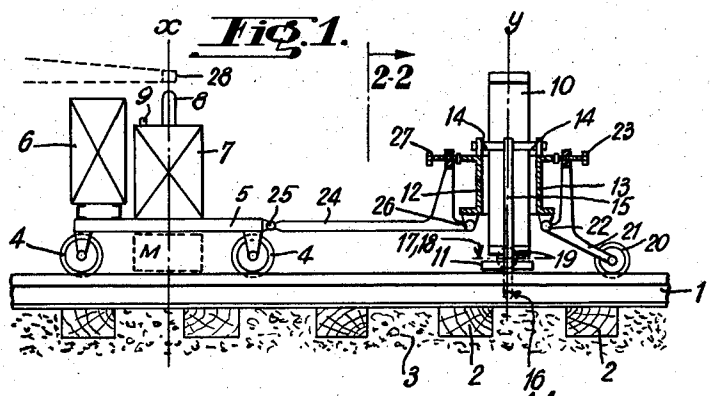


Fig. 2.

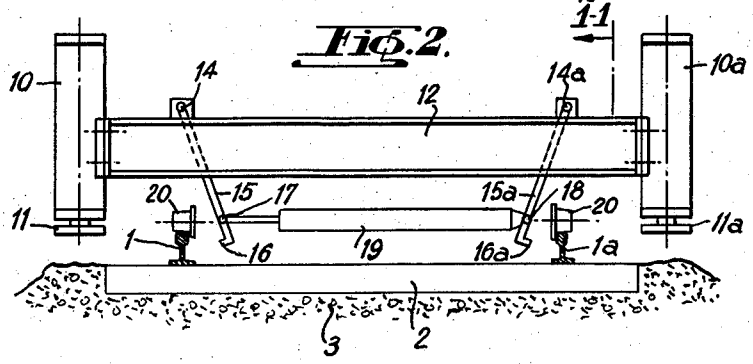


Fig. 4.

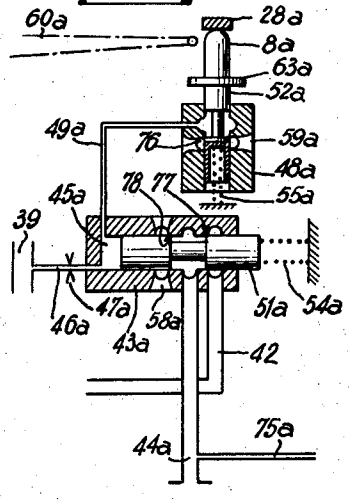
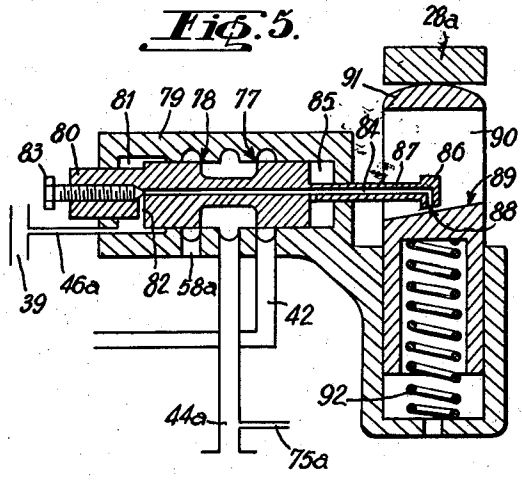


Fig. 5.



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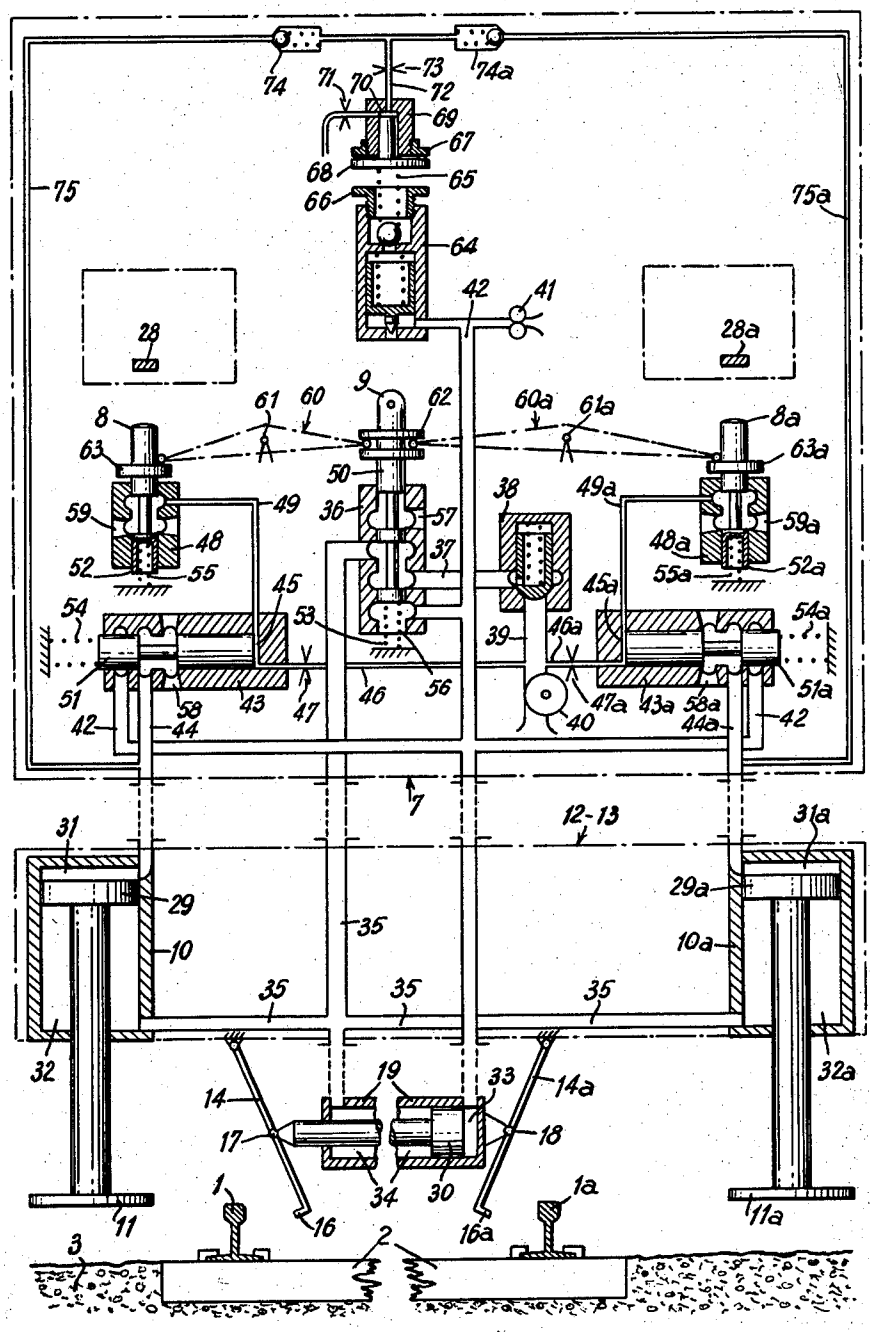


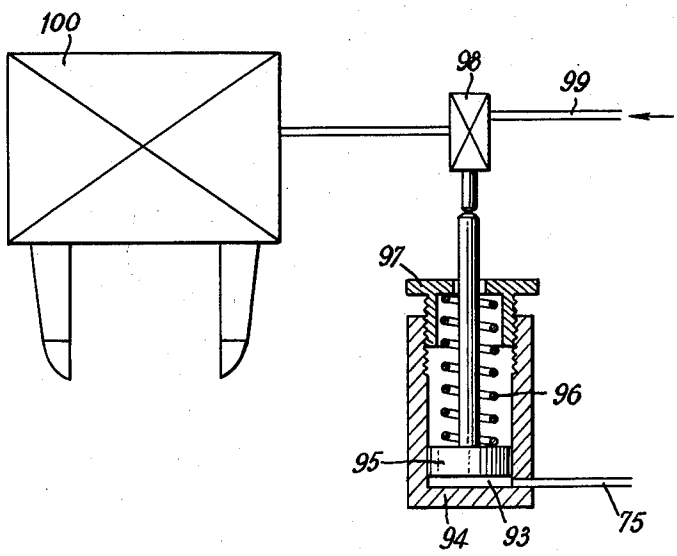
Fig. 3.

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DEVICE FOR LIFTING RAILWAY TRACKS

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Fig. 6.



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DEVICE FOR LIFTING RAILWAY TRACKS

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5 Claims. (Cl. 104—12)

In the course of installation or maintenance work on railway lines, it is often required to place and to maintain temporarily in an exact position in a plane which is transversal to the line, one or the other, or both the heads of the rails, and this at one or at several points of the line according to requirements.

In particular, a precise positioning in height is required for the levelling operations and transversally to the line for the aligning operations. It is clear that the problem is similar for any direction in the transversal plane and the case of the levelling of the line will be examined more particularly.

The correct positioning in height here offers particular difficulties owing to the precision required either in respect of the transversal inclination of the rolling plane (or warp), or in respect of the longitudinal profile of the line of rails.

Often, however, one has had to be satisfied with simple lifting and wedging devices, such as wedges, extensible wedges, mechanical, hydraulic or electric jacks, often combined with rail clamps, which in turn were sometimes suspended from frames, portals, etc.—movable along the line or not—or again from maintenance machines such as tamping machines, wedging machines, etc.

In order to obtain greater precision, improved systems have also been proposed which comprise at least one jack operating as a servo-motor constantly tending to increase in length and consequently to lift the track, until a contact comes to rest against a fixed stop, thus stopping the lifting motion. If for instance the point supporting the servo-motor subsides, the latter automatically increases its length, until compensation is achieved.

All these known systems, the operation of which is in effect the same as that of an extensible wedge, either automatic or otherwise, have a common defect which resides in the fact that the thickness of the wedge can only be reduced by manual adjustment, which is left to the operator's judgment. The result is that the prescribed level for the rolling plane also depends, on the one hand on the fixity of the supporting point, and on the other on the rigidity of the wedge itself, and eventually, on that of the support or supports between the rail and the point of support.

Multiple disadvantages, which are very troublesome in practice, result from this, owing to the numerous causes which can modify, either in one sense or the other, in a permanent or transient but always uncertain manner, either the level of the point of support or the height between the rail and the point of support.

It will be sufficient to mention the placing of a second jack (owing to the rigidity of the rail, for instance), the vibration tamping which is usually effected under the sleeper to increase the firmness of the wedged point (and which generally tends to lift the track), the application of a variable load over the point of support (for instance the passage of a loaded axle), the irregular and

uncertain elasticity and plasticity of the bed of ballast and of the subgrade, the accidental displacement of a rail clamp in relation to the rail, the spring suspension of the vehicle supporting the clamps, the momentary defective adjustment of the reference stop of a servo-motor (for instance lifting and lowering following vibrations), etc.

It is thus necessary to touch up the initial bedding, and the touching up operations must in addition be preceded and followed by relatively protracted and delicate measuring and checking operations, which are all the more numerous as one is never sure at any given moment of the exact level of each of the adjusted points. These disadvantages are the cause of others, the most serious of which are the necessity of employing supplementary labor, a lengthier period during which the line is out of service, higher costs, etc.

It may be mentioned here that similar difficulties and disadvantages are encountered when the line is being aligned.

The present invention aims at eliminating these disadvantages by means of a device operating as a servo-motor (reversible) which is automatically controlled in both directions in function of the prescribed position in the transversal plane, for one at least of the heads of the rails.

The object of the present invention is a device for lifting railway tracks, characterized in that it comprises at least one servo-motor which can be controlled in both directions, to place and maintain at least one line of rails in a predetermined position in a plane which is transversal to the track and in relation to a fixed point, and means controlling this servo-motor, in the abovementioned two directions, in function of the position of the rail in relation to the said fixed point, so as to ensure that this position this maintained.

The accompanying drawings illustrate in a schematic manner and by way of a non-limiting example, an embodiment of the device according to the invention, in the case of the levelling of the track.

FIGURE 1 is a schematic side view of this embodiment, showing a partial cross-section along **1**—**1** in FIGURE 2.

FIGURE 2 is a simplified frontal view of the servo-motor itself, along **2**—**2** in FIGURE 1.

FIGURE 3 is a hydraulic scheme showing the essential elements of the control.

FIGURE 4 refers to one of the elements of the scheme shown in FIGURE 3.

FIGURE 5 shows a variant of the same element.

FIGURE 6 concerns a variant.

On the left may be seen a first vehicle, or measuring vehicle, the four flanged wheels **4** of which carry a chassis **5** on which are fixed the general supply motor-pump **6** and an oil tank in which the control members are lodged. Two fingers, only one **8** of which is shown, emerge from this tank plumb over each line of rails and in a plane *x* situated at equal distances from the front and rear wheels **4** of the car, whilst a single "start-stop" push-button **9** is provided.

The lifting device itself is harnessed to this measuring vehicle and is arranged symmetrically in relation to the central plane of the track, so that only a part of this device may be seen in FIGURE 1. Two hydraulic jacks **10** and **10***a* having bases **11** and **11***a* are fixed—plane *y*

in FIGURE 1— to the extremities of a transversal beam—seen in cross-section—made up of two profiles of U-shaped cross-section **12** and **13**, between which are articulated in **14** and **14***a*, two levers **15** and **15***a* provided with hooks **16** and **16***a* and connected to the articulations **17** and **18** of a hydraulic jack **19** called the clamping jack. The two wheels **20** of this lifting vehicle are mounted on two levers **21** pivoted in **22** to the base of the abovementioned profile **13** and against the upper part of which they abut by means of their respective adjusting screws **23**. In a similar manner, the central drawbar **24**, which is articulated at both extremities **25** and **26**, abuts against the other profile **12** mentioned above, by means of its adjusting screw **27**.

In order that the drawing may be clearer, the ducts and auxiliary members have not been shown.

Two adjusting stops, one of which only **28** is visible in the drawing, are arranged in the measuring plane *x* above each of the fingers **8** mentioned above and are secured to an auxiliary device of any suitable kind—partially shown by dotted lines—which rests on the ground, the ballast or the rails at a sufficiently great distance from the described device to remain uninfluenced by it.

FIGURE 2 illustrates with the same references, a part of the components of the lifting apparatus.

The operation is then as follows:

In the position shown, the lifting apparatus is suspended from three points, i.e., **25** and the two wheels **20**, by the action of the drawbar and of the two levers **21** abutting against the profiles. In reality the bases **11** and the hooks **16** have sufficient clearance in height to avoid any obstacle on the track and to allow the free motion of the device.

When the later has been immobilized at the desired point, the push-button **9** is actuated thus starting off the operation of the lifting control. Owing to the action of the clamping jack, the hooks **16** engage the underside of the heads of the rails, whilst the vertical jacks cause the bases **11** to be pushed down against the ballast. As the pressure in these jacks increases, the transversal beam **12–13** is lifted and draws up the clamping levers **15** with it, and thus lifts the two rails and their sleepers.

This lifting motion of the track continues until each of the rails having reached its prescribed level, the corresponding finger **8** comes lightly in contact with its stop **28** which is adjusted in consequence.

If for any reason, for instance if the points of support **11**, **11***a* are lowered because the ballast subsides, or if the clamp slips slightly on the rails, or the level of one of the rails subsides, the corresponding finger **8** is released and causes the lifting motion to be renewed. If, on the contrary, the point of support **11** or **11***a* is raised, or if the level of the rail exceeds the required height, or again if the stop **28** is lowered, etc., the finger **8** is pushed in and causes the required lowering of the rail, as will be seen further on. It is easy to see that the level of each of the rails can thus be maintained exactly at the prescribed value.

When the "stop" push-button is released, the three jacks bring the components back to their initial positions.

The screws **23** and **27** allow the adjustment, according to the wear of the rail, for instance of the height between the hooks and the heads of the rails, so as to limit at will the lost lifting motion of the transversal beam.

It may be noted that when the latter is lifted, the screws **23** and **27** leave their rests against the U-shaped profile irons so that the beam has a certain angular freedom which avoids the loading of the measuring car at **25**. On the other hand, the flanged wheels **20** continue to guide this beam transversally to the track.

Finally, it may be remarked that a certain difference in the level of the rail may occur between the measuring plane *x* and the lifting plane *y*, a difference which depends on the undulation which is thus created along the line of rails owing to the effect of the lifting motion.

It is clear that the distance between *x* and *y* can be adapted according to the requirements. In particular, it is possible to annul it without any difficulty, by combining in a single four-wheeled truck the two parts, measuring and lifting, of the described device.

In the hydraulic scheme of FIGURE 3, part of the components which have already been described have been shown again—with the same references—in particular the transversal beam **12–13** with its two servo-motors **10** and **10***a* and the clamping jack **19** on the one hand, and on the other—mounted on the tank **7**—the "start-stop" push-button **9**, and the two fingers **8** and **8***a* surmounted by the corresponding exterior stops **28** and **28***a*.

Pistons **29**, respectively **29***a* and **30** can slide in the jacks **10**, **10***a* and **19** forming the chambers **31** and **32** for the first, **31***a* and **32***a* for the second and **33**, **34** for the last. The three chambers **32**, **32***a* and **34** are directly connected together by the conduit **35** which on the other hand leads to the "start-stop" distributor **36**, which in its turn is fed on the one hand—through the conduit **37**, the check valve **38** and the conduit **39**—by a large delivery pump **40**—called the "rapid advance and withdrawal" pump—and on the other hand by a high-pressure pump **41**—the "regulating" pump—through a conduit **41** which opens into the chamber **33** mentioned above. This conduit also leads to two distributing relays **43** and **43***a* to which the chambers **31**, respectively **31***a* of the vertical servo-motors mentioned above are connected by the conduits **44**, respectively **44***a*.

The chambers **45** and **45***a* of these relays **43**, respectively **43***a*, communicate, on the one hand with **39** by means of the two conduits **46**, respectively **46***a*, each of which passes through a diaphragm **47**, respectively **47***a*, and on the other hand with two distributors **48**, respectively **48***a*—called "regulating" distributors—by means of two conduits **49**, respectively **49***a*.

The five distributors **36**, **43**, **43***a*, **48** and **48***a* mentioned above have their slide-valves **50**, respectively **51**, **51***a*, **52** and **52***a*, constantly biased by springs **53**, respectively **54**, **54***a*, **55** and **55***a*, tending to return them in the upward direction or towards the centre of the figure. The bodies of these distributors are fixed inside the tank into which they can thus allow their oil to escape through the respective openings **56** and **57**, **58** and **58***a*, **59** and **59***a*.

Two levers **60** and **60***a*—shown in dots and dashes—are articulated in **61**, respectively **61***a*, on the tank and are engaged by one of their extremities in a groove **62** provided on **9**, and can rest by the other on the collar **63**, respectively **63***a* provided on each finger **8** and **8***a* mentioned above.

The conduit **42** of the regulating pump is connected in addition to a discharge valve **64** the regulating spring **65** of which is actuated—between certain limits determined by the adjustable stops **66** and **67**—by the piston **68** of the cylinder **69** which is provided with a chamber **70** having a calibrated outlet opening **71** (diaphragmed) and is connected by the conduit **72**, diaphragmed in **73**, to two check valves **74** and **74***a* fed through two conduits **75**, respectively **75***a*, which in turn lead to the conduits **44**, respectively **44***a* already mentioned.

The sections—shown by dotted lines—of the conduits **35**, **42**, **44** and **44***a*, are flexible, articulated or sliding tubes to allow relative motion between the components that they connect together.

The operation is then as follows:

In the position shown, the push-button **9** is in its upper position, or "stop" position, so that the slide-valve **50** connects **42** with the discharge through **56**, which releases the pressure in the pump **41** and the chamber **33**. On the other hand, **34**, **32** and **32***a* are subjected to the pressure of the pump **40** through **39**, **37** and **35**, since the check valve **38**, of well-known design, only opposes a negligible resistance in this direction. A certain amount

of fluid flows—at a very low rate because of 47, respectively 47*a*—through 46, respectively 46*a*, to the chamber 45, respectively 45*a*, connected to discharge through 49 and 59, respectively 49*a* and 59*a*, so that the slide-valves 51 and 51*a*, respectively biassed by 54, respectively 54*a*, connect 44, respectively 44*a*, with the discharge 58, respectively 58*a*, and thus annul all pressure in 31 and 31*a*, as well as in 75 and 75*a*. The pressure in 72 and 70 is also zero—because of 71—and 68 compresses 65 to a minimum determined by the adjustment of 67.

The three jacks are thus maintained in the withdrawn position by 40, whilst 41 delivers at no appreciable pressure, and therefore with a greatly reduced power consumption.

When the push-button 9 is pressed down to the "start" position, the slide-valve 50 connects 35 to 57 so that the pressure drops in 32, 32*a* and 34, whilst 37 communicates with 42 cut off from 56. The pressure due to 40 and 41 rises progressively in 42, and therefore in 33, so that the clamping jack 19 is immediately actuated.

Simultaneously, 62 causes 60 and 60*a* to swing so that they move away from 63, respectively 63*a*, thus releasing the slide-valves 52 and 52*a*, which rise under the action of their spring 55, respectively 55*a*, and close 49 and 49*a*, which causes the pressure to increase in the chambers 45, respectively 45*a*, which continue to be fed through 46, respectively 46*a*, and 39, 40. The slide-valves 51 and 51*a* compress their respective spring 54 and 54*a*, and connect 42 and 44, respectively 44*a*—which are cut off from 58, respectively 58*a*—so that 31 and 31*a* are subjected to the increasing pressure due to 40 and 41, which causes 29 and 29*a* to move in the downward direction.

Thus the two pumps 40 and 41 simultaneously feed the three jacks 19, 10 and 10*a*, the motion of which is therefore very rapid during this period of approach—owing to the fact that there are only small opposing resistances—which lasts until contact occurs between 16 and 1, respectively 16*a* and 1*a*, 11 and 11*a* and the ballast 3.

At this moment, the pressure still being on the increase, the beam is lifted, pulling the hooks 16 and 16*a* up with it which engage under the heads 1, respectively 1*a*, of the rails. This period, which is very short, can be considered as forming part of the period of approach.

According to the type of tamping machine used, the track may have a tendency to lift by the action of the spades at the end of the tamping operation. It is then advantageous to provide a device which loads the rail, for instance at the point of measurement. A simple solution consists in resting a heavy mass on the rail above the sleeper which has to be tamped, and which will then be lifted by the servo-motor at the same time as the rail. The mass M can be seen in FIG. 1.

At the same time, the pressure being on the increase in 75 and 75*a*, fluid flows at a progressively increasing rate through 74 and 74*a* into 70, from where it escapes through 71, the rate remaining however very small owing to 73 and 71. The pressure drop across 71 induces a certain pressure in 70, which does not however move 68, retained by the spring 65—supposing that the latter is sufficiently compressed in its minimum position of adjustment, imposed by 67—controlling the discharge valve 64, the principle of which is well known and which then prevents any fluid escaping through it from 42.

When the pressure in 42 becomes equal to the maximum pressure which can be furnished by the pump 40—which may be supposed to be, for instance, of the centrifugal type—the check valve 38 closes and the pressure in 42 continues to increase owing to the effect of the high pressure pump 41 and it may be seen that 68 is finally caused to move, thus compressing 65 more and more, which keeps 64 in the closed position.

When there is sufficient pressure in the circuit 42, the rails and tracks are lifted thus causing the measuring truck to move in the upward direction, as previously indicated, and the general movement continues until one of the fingers, for instance 8, comes lightly to rest against the exterior point of reference 28, which, to simplify the explanation, is taken to be fixed. The slide-valve 52 is progressively pushed into the body of its distributor 48, which eventually causes 49 to communicate slightly with the discharge 59 which decreases the pressure in 45. The slide-valve 51 tends to cut off 44 from the feed line 42 to put it practically simultaneously in communication with the discharge 58 according to the well-known double edge control method. The lifting motion of the servo-motor 10 is thus arrested, independently of that of 10*a* which is only arrested at the moment of contact between 8*a* and 28*a*, according to a process similar to the previous one.

It is easy to understand that, as has already been said, the exact level of each rail, measured in the plane *x* of FIGURE 1 by the mean position of the truck on its wheels, can be maintained as long as desired and independently as long as desired and independently of any modification other than the adjustment in height of one or of the other of the reference stops 28 or 28*a*, which operation only requires a very small effort. In short, it may be said that the level of the rails will faithfully follow the level of the fingers 8 and 8*a* in both directions by the action of the servo-motors thus controlled, not in effort, but in position, and in a reversible manner, i.e., in both directions of adjustment of these servo-motors.

It may also be understood that, if the stop 28 or the rail itself, or both, are subjected to vibrations, due for instance to tamping operations, it is still possible to control with precision the level of the track—according to the mean position—extreme or intermediate—of the vibrating elements—by appropriate means, such as means to damp the motion of the slide-valve 51 for instance, which are within the scope of the man of the art.

It can be seen easily that the three jacks are brought back to their initial position by releasing the "stop" push-button 9.

Without entering into further detail concerning the operation, it is deemed sufficient to mention that the two check valves 74 and 74*a* visibly prevent any mutual influence between the two individual controls 10 and 10*a*, and at each instant allow the greater of the two pressures obtaining in 31 and 31*a* to be applied to 75, this pressure then determining in 42—by a judicious choice of the dimensions of the components of the assembly 64/69—a pressure which is constantly slightly higher. The power required to drive the pump 41 is thus reduced to a minimum at any instant.

FIGURE 4 reproduces—with the same references—a part of the hydraulic scheme of FIGURE 3 and shows in addition the distributor—relay 43*a* with its controlling distributor 48*a*, but with their slide-valves 51*a*, respectively 52*a*, in a middle position corresponding to the adjustment for maintaining a static lifting load. It may be seen that the governing edges of the slide-valves and of the bodies are adjacent to one another in 76, 77 and 78 so as to create the desired presure in 45*a* and 44*a* according to a technique well-known to the man of the art.

It is sufficient to underline the fact that in this control system, a difference in height—measured from the mean position—between the side-valve 52*a* and the body 48*a* is transformed into a pressure variation—measured from the mean maintaining pressure—in the pressure chamber 31*a* of the servo-motor 10*a*. It is thus possible to amplify or to demultiply at will—according to the chosen dimension or to the components—the effect of the said differences on the control of the device, which, for instance enables the precision to be increased, the conditions of stability of operation to be improved, etc.

FIGURE 5 shows a variant of the construction of the control group of FIGURE 4 which is based on another

mode of amplification of the variations in height mentioned above.

Here the members 43*a* and 48*a* are united in a single casing 79. The slide-valve 80 of the relay is constantly biassed—towards the right in the figure—by the pressure—which, to simplify things, is supposed constant—obtaining in 39, 46*a*, the chamber 81 and the boring 82 drilled in the slide-valve 80. The screw 83 allows the adjustment of the pressure obtaining in the duct 84—in permanent communication with the chamber 85—which bends inside the rectangular head 86 which terminates the rod 87 prolonging 80, and ending in an opening 88 over an inclined plane 89 formed at the bottom of the opening 90 with parallel faces—to guide 86 and 89—formed in the new finger 91 which slides in 79 and is constantly biassed in the upward direction by the spring 92.

The operation is then as follows:

The slide-valve 80 which for instance has an annular cross-section in 85 which is double the annular cross-section in 81, is balanced when the pressure in 85 is half the constant pressure in 81. If the pressure in 85 is lower the slide-valve moves—towards the right in the figure—until the opening 88 is partially closed by 89. It is obviously to be seen that the slide-valve 80 is compelled to reproduce faithfully—in the horizontal direction and with a certain ratio of amplification, determined by the inclination 89—the vertical movements of the finger 91 in relation to its casing 79. The operation of the distributing relay in the main circuit remains unchanged.

As has been previously indicated, the pressure of the fluid acting in a servo-motor, for instance 31 in FIGURE 3, can actuate the measuring and control member 68, regulating, through 64, the power absorbed by the pump 41. This pressure—or any magnitude related to the motive fluid—can also influence other devices, for instance entering into a more or less automatic system.

It is thus that—as is indicated schematically in FIGURE 6—the conduit 75 (of FIGURE 3) can be permanently connected to the chamber 93 of a relay 94 the piston 95 of which is constantly biased in the downward direction (in the figure) by a spring 96 which can be adjusted by a screw 97. When the pressure reaches the value which has thus been predetermined, 95 is lifted and causes—by the action of a distributor 98—the closing of the conduit 99 feeding the hydraulic member controlling the closing of the spades of the tamping group 100, which may be of any usual type.

One may note here the important practical advantage of a servo-motor the position of which is controlled in both directions and which can then act as a dynamometer indicating the vertical thrust exercized by the ballast on the sleeper which is being tamped, and can thus be used to arrest the closing motion of the spades, etc.—whereas up to now it was deemed sufficient to act in function of the horizontal thrust to which the spades were subjected in the ballast, which obviously occasioned errors in the evaluation of the degree of tamping achieved.

According to the type of tamping machine used, the track may have a tendency to lift by the action of the spades at the end of the tamping operation, for instance. It is then advantageous to provide a device which loads the rail, for instance at the point of measurement. It is easy to imagine the simple solution consisting of a heavy mass resting on the rail above the sleeper which has to be tamped, and which will then be lifted by the servo-motor at the same time as the rail.

As there are two regulating elements available, position and pressure, it is in addition possible to provide such stabilizing loads, which may be constant or variable, permanent or temporary, and influenced by one at least of these elements.

Many constructional variants can be imagined within the scope of the invention. It may be sufficient to mention the application of the new system to any given direction of the transversal plane of the track, in particular in the case of the aligning operations already mentioned, the use of a single servo-motor or on the contrary of more than one twin servo-motor, the combination for the simultaneous levelling and aligning operations, the systems controlled by periodic impulses, the devices actuated or controlled mechanically, by a pressure fluid (oil, air, etc.), electrically or by magnetic means, etc., etc. The examples given are therefore in no sense limitative.

It may be seen that the described device is distinguished in that it comprises at least one servo-motor automatically controlled in function of the position prescribed for at least one of the rail heads and in a plane transversal to the track (servo-motor influenced by the position of the rail). It may be:

Adapted for levelling operations;
Adapted for aligning operations;
Combined for levelling and aligning operations;
Controlled by periodic impulses;
Controlled in a continuous fashion;
Operated at more than one speed, operated at variable speeds (rapid approach and withdrawal, slow adjustment);
Actuated or controlled: mechanically, by pressure fluid, electrically, by mixed means;
With the position of the measuring point distinct from that of the lifting point (along the track);
With a difference in position which is amplified or demultiplied (at will, automatically);
With a difference in position transformed into another physical magnitude (for instance pressure, stress, flow).

According to a further embodiment of the invention, the device for lifting can be secured to the support chassis of a tamping machine instead of having the ballast as a fulcrum.

What I claim is:

1. A device for the automatic shifting of a railway track to a predetermined position and for maintaining the track in said position, said device comprising: hydraulically actuated shifting means for shifting the track, means supporting said shifting means and in turn supported on said track and movable with said track as the latter is shifted, means for establishing the position to which said track is to be shifted, control means for said shifting means, said control means comprising a casing supported in fixed relation on said means supported on said track, sensing finger means supported on the latter means for sensing the position of the means which establishes the position to which the track is to be shifted, and pressure fluid distribution means within said casing and controlled by said sensing finger means for in turn controlling fluid distribution to said shifting means to stop the flow of pressure fluid to and from said shifting means to cause shifting of the track in opposite directions in response to the respective direction of actual deviation of the track with respect to said predetermined position.

2. A device for the automatic lifting of a railway track to a predetermined level and for maintaining the track at said level, said device comprising: hydraulically actuated jacks adapted for a raising and lowering function, means operatively associated with the jacks for engaging the track to raise and lower the same in accordance with raising and lowering of the jacks, means supported on said track for being moved therewith as the track is raised and lowered, stops for establishing the level to which said track is to be lifted, control means for said jacks, said control means comprising a member in fixed relation with said means supported on said track, sensing finger means for sensing the position of said stops, pressure fluid distribution means within said member and actuated by said sensing finger means for controlling the fluid distribution to said jacks, said fluid distribution means stopping the flow of pressure fluid to and from

said jacks with the track at the predetermined level and permitting pressure fluid to pass to and from said jacks for selectively raising and lowering the track in response to the direction of the actual deviation of the track with respect to said predetermined level.

3. A device as claimed in claim 2, comprising a vehicle, a tamping device mounted on said vehicle, said tamping device comprising tamping tools and control means for said tools, the latter control means being operatively connected to said jacks, the pressure prevailing in said jacks acting on said control means for said tools.

4. A device according to claim 2 comprising further track loading means positioned approximately in line with the finger sensing means.

5. A device according to claim 4, comprising pumps

for feeding pressure fluid to said shifting means, one of which pumps is adapted for supplying large volumes at low pressure and another of which pumps is adapted for supplying small volumes at high pressure, and means for preventing the escape of fluid under high pressure through the pump which feeds at low pressure.

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