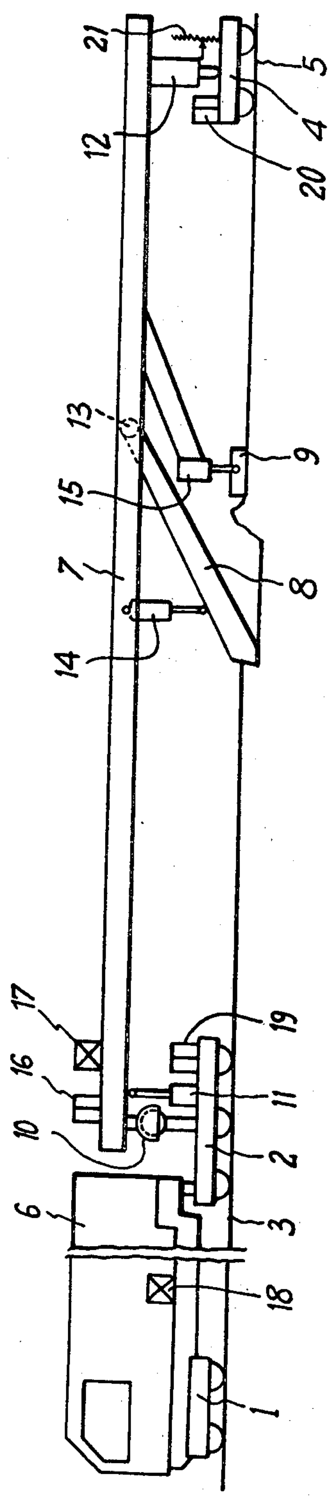
Feb. 10, 1970 JEAN-JACQUES BOYER **3,494,299**

RAILROAD REPAIRING MACHINES

Filed April 15, 1968 5 Sheets-Sheet 1

Fig: 1



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5 Sheets-Sheet 2

Fig. 2

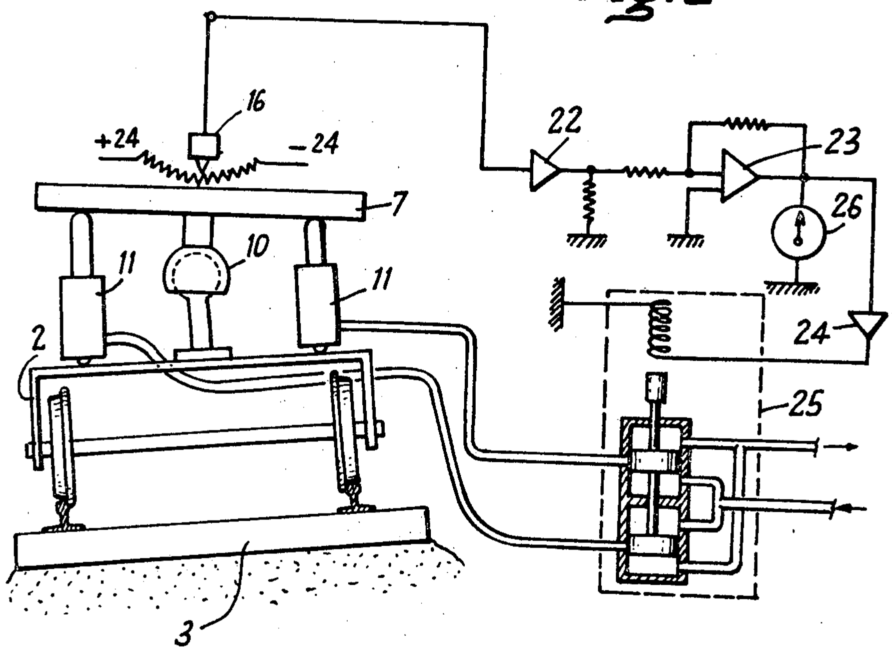
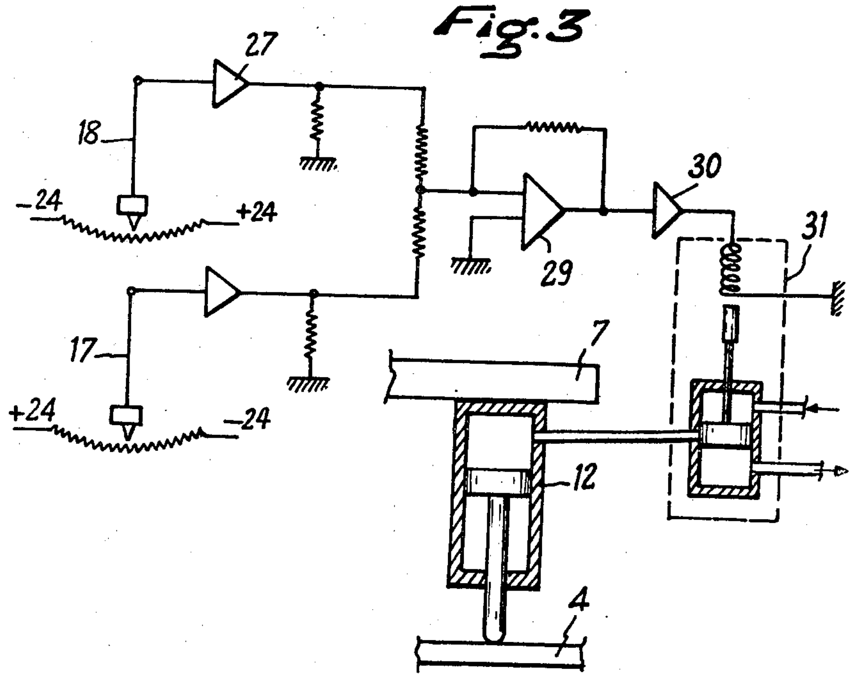


Fig. 3



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RAILROAD REPAIRING MACHINES

Filed April 15, 1968 5 Sheets-Sheet 3

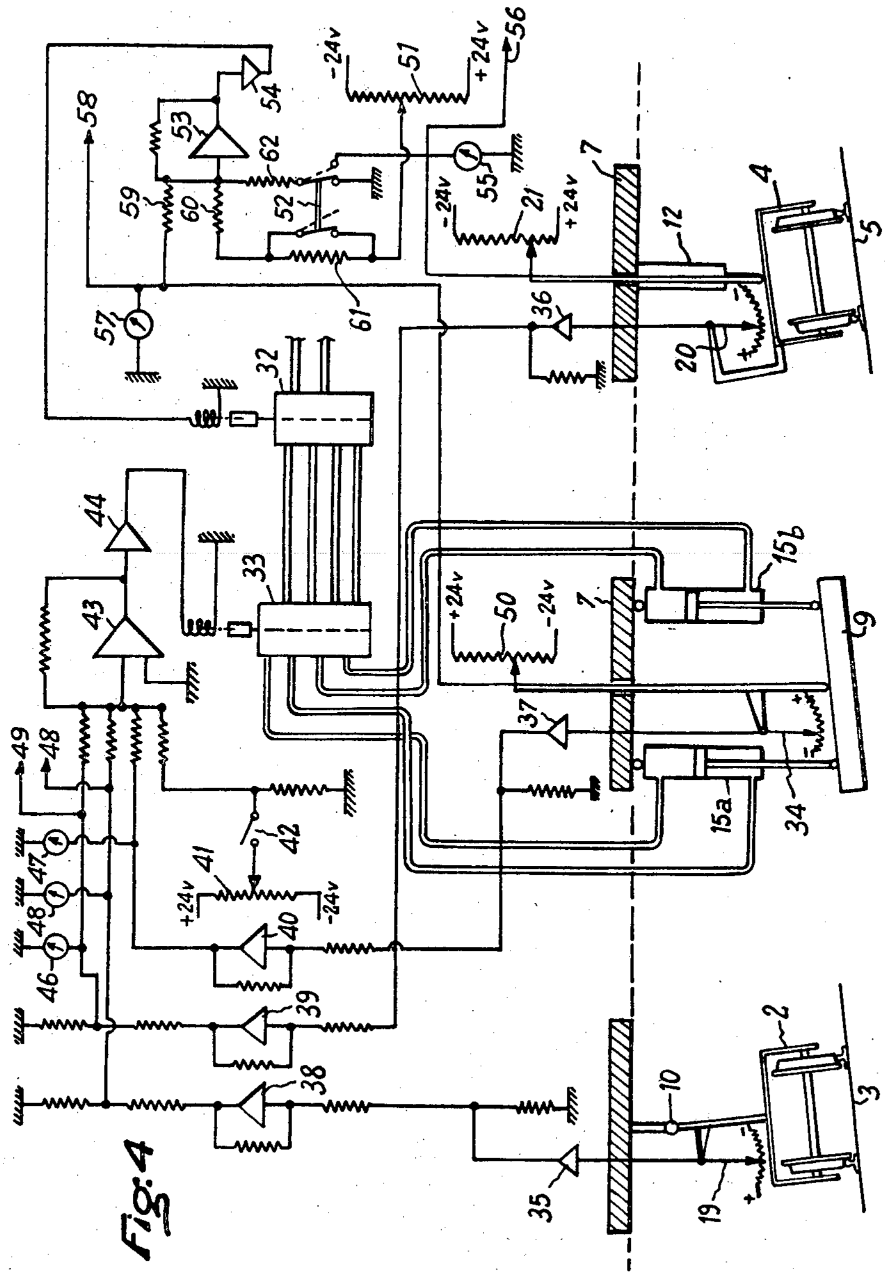

Fig. 4

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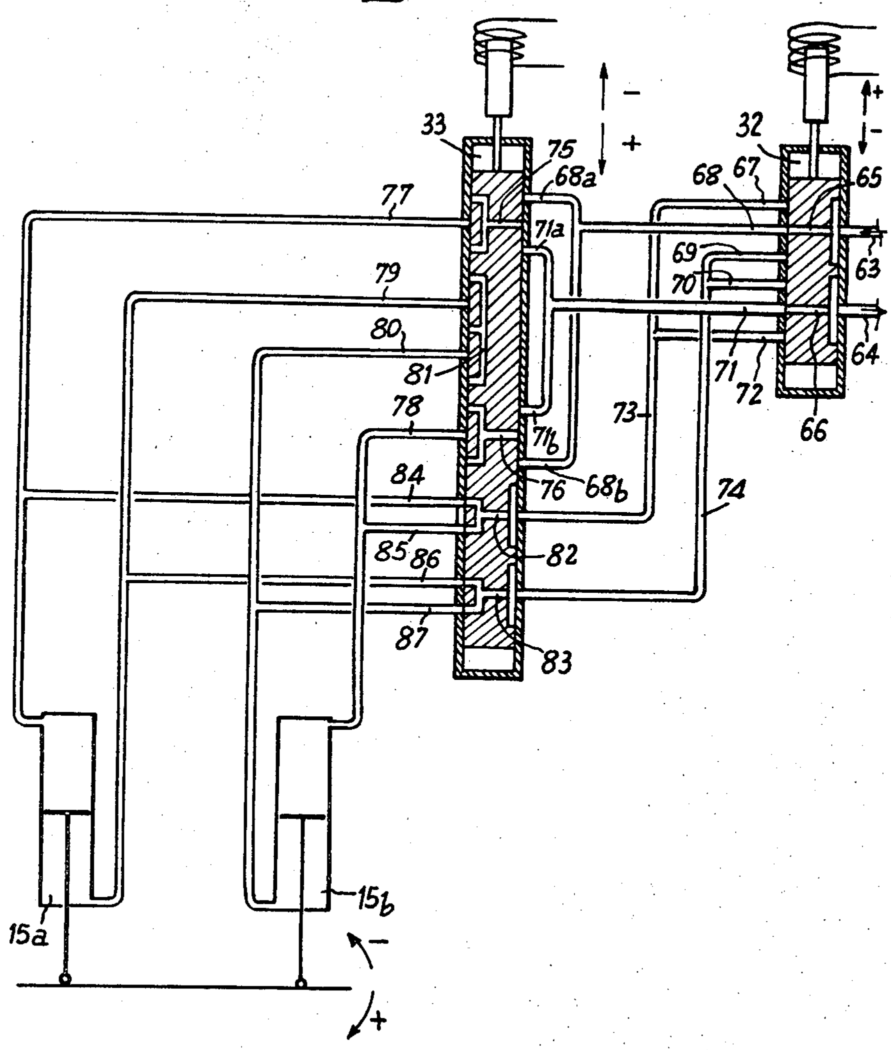
Fig. 5



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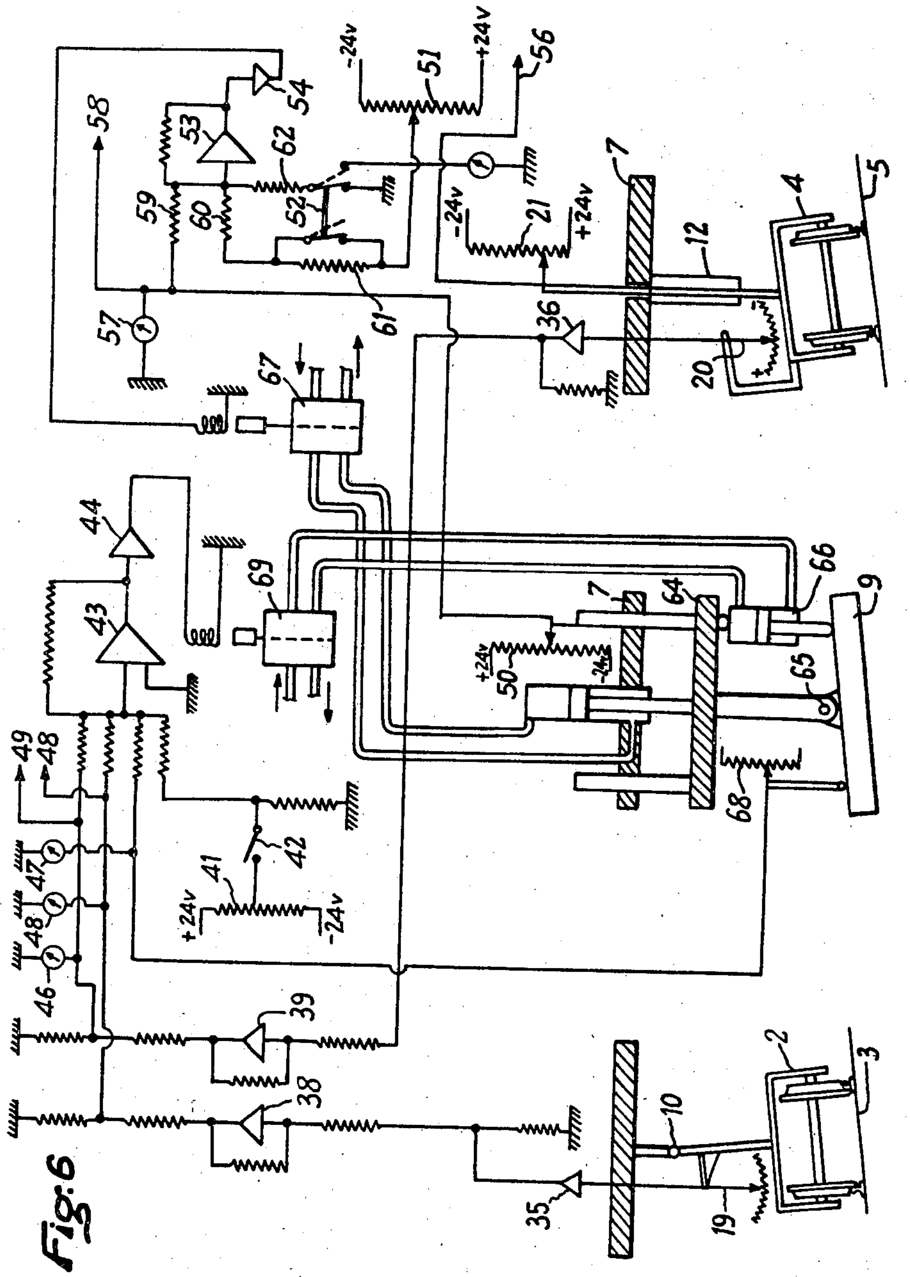

Fig. 6

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3,494,299 RAILROAD REPAIRING MACHINES

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Int. Cl. E01b *29/04, 33/18*
U.S. Cl. 104—8 22 Claims

ABSTRACT OF THE DISCLOSURE

A machine for repairing a railroad track and including a beam the front of which rests on a bogie running over the rear end of the portion of the track which is to be renewed while the rear end of the beam rests on another bogie running over the front end of the portion of the track which is being actually renewed. The beam, the shovel, the levelling and ramming means provided for the repair and renewal of the track and jacks are provided for controlling the longitudinal and transverse slopes of the beam and also those of the implements carried thereby and their operative level. This is obtained by indicators controlling the jacks through the agency of auxiliary valves.

Numerous machines for repairing railroad tracks and chiefly for clearing away the ballast provide simultaneously said clearing and the renewal of the railroad and it is consequently essential to set the various implements, chiefly the levelling blade and the ramming means which ensure the levelling of the new railroad bed, at a location which is perfectly defined in relationship with a reference surface, which is generally constituted by the prior bed, before its clearing and over which the front axle or the front section of the machine is caused to progress.

It is furthermore necessary to record, as the machine progresses, various parameters such as the front cant and, after the track has been actually repaired, further parameters such as the slope of said track, the height of the new track with reference to the prior track and the depth and cant of the cleared ballast, so as to allow a comparison with the required data.

Lastly, it is desired to automatically compare said parameters with the required parameters in a manner such as to ensure a manual or automatic control of the different parts, with a view to correcting the operative position of the different implements, which is possible only if an accurate reference surface is available.

My invention has for its object to satisfy the above reqirements by fitting the implements on an independent beam through the agency of members adjusting their position with reference to said beam, which latter is carried at both ends by a bogie with the interposition of means adapted to modify the longitudinal and/or transverse slope of the beam.

Preferably, the beam is carried by the rear bogie, through the agency of a jack the body or cylinder of which is rigid with the beam, while the piston rod of the jack engages said bogie, through a ball and socket joint associated with two lateral jacks which are controlled in a manner such as to maintain the desired transverse slope required for the beam.

According to a preferred embodiment, said lateral jacks are controlled so as to keep the beam in a transversely horizontal position. An arrangement for checking this transverse horizontality of the beam is carried by the latter in the vicinity of the front ball and socket joint and ensures an automatic control of the front lateral jacks. An arrangement for checking the longitudinal slope of the beam is also fitted on the beam, in the vicinity of the front ball and socket joint and controls, in conformity with the comparison made between the measured value and the required value of the slope, an auxiliary valve feeding the rear jack.

An arrangement for checking the actual length of the rear jack as compared with its theoretical length measures the difference in level between the prior track and the restored track and corrects possibly in an automatic manner and in accordance with the difference between the measured value and the required value the height of the levelling blade.

In a preferred embodiment, the means for measuring and controlling the slopes with reference to horizontality are constituted by highly accurate clinometers or gradient indicators producing a voltage the value of which depends on the slope of the axes of said instruments with reference to a vertical line, in a plane defined hereinafter as their vertical operative plane.

The arrangements checking the slopes of two or more parts with reference to one another are constituted by either a clinometer fitted on a part assuming a variable slope when a cooperating part has an unvarying slope or else by clinometers carried by the cooperating parts, together with the means comparing the values of the parameters supplied by said clinometers, or again by one or more potentiometers spaced with reference to one another or with reference to the point where the cooperating parts are pivotally interconnected, the resistance of said potentiometer being carried by one of said parts, while the slider is carried by the other part.

The means checking the transverse horizontally of the beam is perferably constituted by a clinometer carried by the beam with its vertical operative plane extending perpendicularly to the beam axis, the voltage produced by the clinometer controlling, after amplification, the auxiliary valve controlling the feed of the lateral jacks.

According to a preferred embodiment, the longitudinal slope of the beam is adjusted in accordance with the slope of the actual track, through the agency of means checking the slope and including a pilot clinometer carried by a part resting on the extant track and a further clinometer carried by the beam, the vertical operative planes of both clinometers being parallel with the track axis, said clinometers being associated with a computer comparing the voltages supplied by said clinometers and controlling, in conformity with the results produced by said comparison, the auxiliary valve feeding the rear jack. When the spacing between the pilot measuring clinometer carried by the bogie for instance or by the beam section engaging the prior extant track and the point at which the controlled implement or implements carried by the beam engage the track is important, the control is preferably ensured through the agency of memorizing means.

The longitudinal slope of the beam may also be adjusted by a programming system or else, although such an embodiment is difficult to execute, the beam may be held horizontally and the height of the implements with reference to such a horizontal beam is adjusted by means controlled by one of the piloting means referred to hereinabove and acting as slope-correcting means.

The transverse cant or slope of the levelling and ramming implements for the new track is preferably controlled by the arithmetical means of the cant values of the old or prior track and of the new track measured in registry with the corresponding bogies carrying the beam. According to one embodiment, a first clinometer having its operative plane perpendicular to the track axis is fitted on the front bogie running over the old track and a second clinometer, the operative plane of which is also perpendicular to the track axis is fitted on the rear bogie unning over the new track, while a slope-detecting instrument produces a voltage corresponding to the trans-'erse slope of the levelling implements; the half sum of the voltages produced by the two clinometers is compared in a computer with the voltage of the slope-detecting instrument, said computer controlling the auxiliary valve feeding the jacks defining the transverse slope of the levelling implements. A potentiometer provided for adjusting the cant produces an auxiliary voltage which is fed in parallel with the voltage of the slope-detecting instrument, so as to correct the cant in accordance with its measured value. Said cant-adjusting potentiometer may be cut out by a switch.

The vertical location or depth of the levelling implement with reference to the beam defines the level of the new track with reference to the old track and is adjusted by means of a jack. Preferably, said position is checked by a potentiometer controlled by the modifications in length of the jack adjusting the level of said levelling implement. Said jack may be automatically controlled in a manner such that the depth of the levelling implement with reference to the beam may be constant or else in a manner such that the difference in level between the old and the new track may retain a predetermined value.

In the first case, the voltage supplied by the potentiometer checking the depth of the levelling implement with reference to the beam is compared by a computer with the voltage fed by a manually adjustable potentiometer indicating the desired depth of said levelling implement and the computer controls the auxiliary valve feeding the jack defining the depth of the levelling implement.

In the second case, the voltage of a manually adjustable potentiometer indicating the modifications in the level of the track is compared in a computer with the voltage of a potentiometer measuring the level of the new track with reference to the beam and said computer controls again the auxiliary valve feeding the jack defining the depth of the levelling implement, so as to maintain equality between the two voltages. According to a preferred embodiment, the voltage of the potentiometer measuring the level of the track is added to a voltage which is a function of the voltage of the potentiometer indicating the modification in level of the track and their sum, possibly with a multiplying coefficient, is compared in the computer with the voltage produced by the potentiometer indicating the modification in the level of the track. The ratio between the sum of the voltages of the measuring and indicating potentiometers is equal to the ratio between the distance separating the levelling implement from the front bogie and that separating the front and rear bogies.

The depth and cant of the shovel are checked by potentiometers and/or clinometers and the voltages supplied are compared with the voltages supplied by adjusting potentiometers in computers controlling the auxiliary valves associated with the jacks defining the depth and cant of the levelling implements.

Further features of my invention will appear in the reading of the following description of various embodiments thereof, reference being made to the accompanying drawings, wherein:

FIG. 1 is a diagrammatic lateral elevational view of a ballast-clearing and levelling machine, executed in accordance with my invention.

FIG. 2 is an electromechanical diagram showing the means checking and controlling the horizontal transverse horizontality of the beam.

FIG. 3 is an electromechanical diagram showing the means checking and controlling the longitudinal slope of the beam.

FIG. 4 illustrates diagrammatically a first embodiment of the arrangement checking the value of the cant and level of the new track and adjusting same.

FIG. 5 is a detail diagram of the electrically controlled valves and of the hydraulic circuits appearing in FIG. 4.

FIG. 6 is a diagrammatic view of a second embodiment of the arrangement controlling the cant and level of the new track.

FIG. 1 illustrates thus a ballast-clearing and track-levelling machine including a front bogie 1 and a central bogie 2 running over the prior old track 3 and furthermore a rear bogie 4 running over the new track 5. Between the bogies 1 and 2 there is a motor carriage 6 and between the bogies 2 and 4, there extends a beam 7 carrying the shovel 8 and the diagrammatically illustrated levelling and ramming implements 9. The beam 7 carries also the means for sifting the old ballast and conveyors for the removal of the waste material, while the feed and distribution of said new and recovered ballast have not been illustrated, since they do not form part of the present invention.

The beam 7 rests on the bogie 2 through a central ball and socket joint 10 and two lateral jacks 11; the latter are illustrated as transversely shifted with reference to each other for sake of clarity, although they lie in practice in the same transverse diametrical plane as the joint 10. Said jacks 11 allow adjusting the relative transverse slope of the beam 7 with reference to the bogie 2. The rear end of the beam 7 rests on the bogie 4 with the interposition of a jack 12 the body or cylinder of which is rigid with the beam, while the end of its piston rod is secured to the bogie 4 through a ball and socket joint. Said jack 12 allows adjusting the height of the rear end of the beam 7 with reference to the bogie 4.

The shovel system 8 is carried by the beam 7 with the interposition of a ball and socket joint 13 and of two lateral jacks 14 which allow adjusting the depth and transverse slope of the shovel system. The levelling and ramming means are also carried by the beam 7 with the interposition of jacks 15 which allow modifying their height and transverse slope with reference to the beam.

In the embodiment described by way of example, the beam 7 is held horizontally in a transverse direction and extends in parallelism with the prior old track. The transverse horizontality of the track is checked by a clinometer 16 carried by the beam 7 and having its vertical operative plane perpendicular to the longitudinal axis of the beam. The longitudinal slope of the beam is checked by a clinometer 17 of which the vertical operative plane is parallel with the longitudinal direction of the beam. In order to allow a checking of said slope as compared with the slope of the prior old track, a clinometer 18 carried by the motor carriage 6 has its vertical operative plane parallel with the longitudinal direction of said motor carriage. Said clinometer may in fact be carried as well by the bogie 2.

In order to ensure a comparison between the cants of the old and new tracks, a clinometer 19 is carried by the bogie 2 and its vertical operative plane is perpendicular to the longitudinal axis of said bogie, while a clinometer 20 is carried with the same angular setting by the bogie 4.

The detecting means include furthermore an arrangement for collecting the value of the height of the rear end of the beam 7 with reference to the track 5, said means including with a variable potentiometer 21, means collecting the values of the depth and cant of the levelling and ramming means to be described hereinafter.

FIG. 2 illustrates diagrammatically an example of the means provided for checking and maintaining the transverse horizontality of the beam 7, said figure being a cross-section passing across the joint 10 through which the beam 7 is pivotally carried by the bogie 2 running over the old track 3, said joint 10 being associated with two lateral jacks 11 defining the transverse seating of the beam 7.

The beam 7 carries, as already mentioned, the clinometer 16, of which the vertical operative plane extends transversely of the beam.

In the accompanying drawings, the clinometers have been illustrated as including a pendulum cooperating with an arcuate resistance, but it is preferable to resort to a highly accurate clinometer provided with a return to zero. The voltage fed by the clinometer **16** is amplified in a stage **22** compared in an analogical computing stage **23** with a zero voltage and the positive, zero or negative result is caused, in a stage **24**, to control an electrically controlled slide valve **25** which cuts off the feed of the jacks **11** in the case of a zero result, while it sends pressure into either of the jacks **11** according to the sign of the result obtained, while the other jack is connected with the exhaust. A voltmeter provided with a zero indication **26** allows checking the proper operation of the arrangement.

FIG. 3 illustrates diagrammatically the electromechanical means checking and controlling the slope of the beam, so as to make it conform with the slope of the old track. The clinometer **18** supplies a voltage which depends on the slope of the motor carriage **6** and consequently on the slope of the old track, while the clinometer **17** supplies a voltage which is a function of the opposite sign of the slope of the beam. When using a highly accurate clinometer provided with a return to zero, said voltage is a sinusoidal function of the slope angle. After amplification in the amplifying stages **27** and **28**, said two voltages are compared in an analogical computing amplifier **29** and their amplified difference is sent through a matching stage **30** to an electrically controlled valve **31** which, according to the sign of the result obtained in the computer **29**, sets the chamber of the jack **12** in connection either with the supply of pressure or with the exhaust.

The electromechanical means adjusting the cant and depth of the levelling means **9** with reference to the beam **7** include two separate electric circuits (FIG. 4) controlled by two electrically controlled valves inserted in series and illustrated at **32** and **33** and described hereinafter with further detail, said valves controlling in their turn the double acting jacks **15***a* and **15***b* defining the location of the levelling and ramming means.

The cant of the levelling means, is, in the embodiment illustrated in FIG. 4, controlled so that it may remain equal, with a possible correction, to an average between the cant of the old track **3** and the cant of the new track **5**, these two cants being measured by the clinometers **15** and **20** respectively, which are carried by the bogies **2** and **4**. The cant of the levelling means **9** is measured by the clinometer **34** of which the vertical operative plane is perpendicular to the track axis.

The voltages at the output of each of the three clinometers **19, 20** and **34**, amplified in the amplifiers **35, 36** and **37**, are sent into analogical computers **38, 39** and **40**. The half voltages fed by the computers **38** and **39** are added with the voltage fed by the computer **40** and with a correcting voltage produced by an adjustable potentiometer **41** which may be switched off by a switch **42** and the sum obtained enters then an analogical computing amplifier **43** of which the output signal is power-amplified by an amplifier and matching stage **44** controlling the electrically controlled valve **33**. Said valve may assume three positions corresponding to neutrality increase of the cant in a positive direction and decrease of the cant in a negative direction, the modification in the cant being executed by a modification in length of the same amplitude, but in opposite directions of the jacks **15***a* and **15***b*.

The cants of the old track, of the new one and of the levelling means may be read on the voltmeters **45, 46** and **47** the values of the cants of the old and new tracks being furthermore sent through the outputs **48** and **49** to recording means.

The means controlling the depth of the levelling means may be operated either by hand or automatically. The circuit includes a variable potentiometer **50** of which the voltage is a function of the depth of said levelling means, a potentiometer **21** the voltage of which is controlled by the modification in length of the jacks and is a function of the difference in voltage between the new track and the

old one and a manually adjustable potentiometer **51** adapted to indicate the depth of adjustment of said levelling means.

In the case of a manual operation, the double switch **52** is set in the position illustrated so that the potentiometer **21** is cut out of the circuit. The voltages of the two potentiometers **50** and **51** are compared in an analogical computer **53** of which the output is sent after amplification into an amplifying matching stage **54**, so as to feed the electrically controlled valve **32**. The latter may assume three positions corresponding to neutrality, increase of the cant and reducing of same; the level of the new track may be read on a voltmeter **55** and said value is sent through an output **56** to recording means. The depth of the levelling means is similarly read on a voltmeter **57** and sent by the output **58** to recording means.

In the case of an automatic operation, the switch **52** is set in the position illustrated in interrupted lines and the voltage of the potentiometer **21** is sent into the analogical computer **53**. However, it is necessary for such an automatic operation to reduce the efficiency of the potentiometer **50**, that is the influence of the levelling means. In fact, the slope of the beam is defined by that of the old track and the levelling means **9** are controlled depthwise in a manner such that their depth may assume a value with reference to the beam **7** which is obtained when the beam **7** assumes the same slope as the old track. If there is any difference between said slope of the beam and that of the old track, that is in the case of the beginning of a slope or a crushing of the new ballast, the length of the jack **20** varies and said variations correspond to a variation in the voltage V21 of the potentiometer **21**. Since the levelling means **9** lie approximately at equal distances from both bogies **2** and **4**, their modifications in depth should be equal to half the modifications in length of the jack **12**. To obtain such a result, the resistances **29** and **30** having the same value r and a resistance **61** of a value r are introduced for automatic operation in series with the resistance **60**, while the resistance **60** is given a value $2r$. The arrangement operates henceforward, so as to retain the relationship $0.5V21+0.5V51-V50=0$, wherein V21, V51 and V50 designate the voltages of the potentiometers **21, 51** and **50** respectively.

Consequently, the electrically controlled valve **32** will be retained in a neutral position or shifted into one of the two positions corresponding to an increase or reduction in depth, while the elastically controlled valve **33** is held in its neutral position, or else is shifted into one of its two positions corresponding to a modification of the cant in a positive or negative direction. The modifications in depth should be obtained by a simultaneous extension or shortening of the two jacks, while the modifications in cant should be obtained by an elongation of one jack accompanied by a simultaneous shortening of the other jack. It is however possible to act only on a single jack in the case of a simultaneous modification of cant and depth.

Said modus operandi may be obtained with electrically controlled valves and distributing circuits illustrated in FIG. 5. The electrically controlled valve **32** is provided with an input **63** for a compressed fluid and an output towards the exhaust at **64**. This input and output are permanently connected through corresponding grooves with two channels **65** and **66** adapted to selectively register with three output channels **67** to **69** and **70** to **72** respectively corresponding to the positions of the slide valve providing an increase in depth, neutrality and reduction in depth. The outputs **67** and **72** on the one hand and **69** and **74** on the other hand are interconnected through channels **73–74**. Pressure being desigated by + and connection with the exhaust by —, the electrically controlled valve **32** provides selectively the following connections: for neutrality 68+, 71—, 72 and 74=0 while the increase in depth is given by the following connection 73+, 74—, 68 and 71=0 and the reduction in depth by the connecion 73—, 74+, 68 and 71=0, the zero value corresponding merely to a cutting off of the channel concerned.

The electrically controlled slide valve 33 is similarly provided on the one hand with two inputs 68*a* and 68*b* fed by the channel 68 and two inputs 71*a* and 71*b* fed by the channel 71, while two further inputs 73 and 74 open into distributing grooves. The sliding section of the valve is provided with two Y-shaped channels 75 and 76, the common input of which normally lies between the inputs 67*a*, 71*a* and 67*b*, 71*b* respectively, when the valve is in its neutral position. The outputs of these Y-shaped channels 75 and 76 are adapted to cooperate with two further channels 77 and 78 leading respectively to the upper operative chambers of the jacks 15*a* and 15*b*. Two further channels 79 and 80 lead out of the lower operative chambers of the jacks 15*a* and 15*b*, towards further inputs of the valve 33 and cooperate with an M-shaped groove 81 in the sliding section of the latter, so that they may be cut off for the neutral position of the electrically controlled valve 33, while they are interconnected for t he two positions corresponding to a modification in the cant. The sliding section of the valve 33 is furthermore provided with two Y-shaped channels 82 and 83, the common input of which is permanently connected with the channels 73 and 74, while the two outputs of each of said channels 82 and 83 communicate with corresponding channels 84, 85–86, 87 respectively for the neutral position of the slide valve, or with only one of each pair of channels for the positions corresponding to a modification in the cant. The channel 84 is connected with the channel 77 and the channel 85 is connected with the channel 78, said channels 77 and 78 opening into the upper cylinders of the jackets 15*a* and 15*b*, while the channels 86 and 87 are connected with the channels 79 and 80 opening into the lower chambers or cylinders of the same jacks.

I will now disclose the successive stages of operation in the case of FIG. 5.

(1) Electrically controlled valve 32 in a neutral position.

(a) The electrically controlled valve 33 being in its neutral position, the inputs 68*a* and 68*b* are subjected to pressure, while the inputs 71*a* and 71*b* are connected with the exhaust. The inputs 73 and 74 are cut off, so that the jacks 15*a* and 15*b* remain in the position they occupy.

(b) If the valve entering its position corresponding to an increase in the cant, the channel 78 is subjected to the pressure of 68*b*, while 77 is connected with the exhaust through 71*a*. The jack 15*b* expands and the volume driven out of its lower cylinder passes through 80, 81 and 79 into the lower chamber of the jack 15*a* which becomes shorter by a corresponding length.

(c) If the valve 33 enters its position corresponding to a reduction in the cant, the connections are obtained between 68*a* and 77 and between 71*b* and 78, while 79 and 80 are interconnected by the M-shaped groove 81, which ensures a reversed operation of the jacks which have in this case again no action on the average depth of operation of the implements.

(2) The electrically controlled valve 33 being in its neutral position.

(a) If the electrically controlled valve 32 enters its position corresponding to an increase in depth, the pressure of 73 is sent into the channels 84 and 85, so as to produce a simultaneous expansion of both jacks, of which the lower cylinders are connected with the exhaust through 79–86 and 80–87 respectively and thence in common through 83, 74 and 66.

If the valve 32 were in a position corresponding to a reduction in depth, the operation is reversed.

In the case of a cant becoming incorrect for any reason whatever, during a modification in depth, the electrically controlled valve 33 would become operative.

(3) Simultaneous operation of the two electrically controlled valves 32 and 33.

Only one case will now be disclosed since the other cases can be readily understood since they are a consequence of a mere permutation of the connections. The valve 32 being in a position corresponding to an increase in depth (73+, 74—), if the electrically controlled valve 33 is in a position corresponding to an increase in the cant the sliding section of said valve switches off the connections 73, 82, 84 and 74, 83, 86 and only 73, 82, 85 and 87, 83, 74 are maintained. The upper cylinder of the jack 15*b* is subjected to pressure and the lower cylinder is connected with the exhaust. Said jack 15*b* is therefore subjected to an expansion which increases both the average depth and the cant. The lower cylinders of the jacks 15*a* and 15*b* are interconnected through 79, 81 and 80, while the upper cylinder of the jack 15*a* remains isolated, which cuts out any possible modification in the length of said jack.

The arrangement described including two electrically controlled valves shows however the drawback that when both valves are in their neutral positions, the upper cylinders and the lower ones of the two jacks are interconnected respectively through 84, 82, 85 and through 86, 83, 87. To remove said drawback, it is possible, when the valve 32 is in its neutral position, to cut off such connections, as illustrated in dotted lines in FIG. 5 for one of said connections. The valve 32′ ensuring the connections between 86′ and 86″ and 87′ and 87″ only for the operative positions of the valve 32. It is also possible, if it is desired to cut off the connection 79, 80 referred to in the preceding paragraph, to cut off similarly the channels 79 and 80 when the valve 32 is not inoperative.

In the embodiment illustrated in FIG. 6, the same parts have received the same reference numbers as in the case of FIG. 4. In contradistinction with FIG. 4, the adjustment of the depth and the adjustment of the cant of the levelling implement 9 with reference to the beam 7 are controlled by two independent arrangements. The depth of the levelling implement is adjusted through the agency of a jack 63 adapted to vertically shift with reference to the beam 7, a member 64 constituted for instance by a carrier arm pivotally secured to said beam. The levelling implement 9 is secured at a predetermined height with reference to the carrier member 64 and is for instance rockably secured through its center to a longitudinal pivot 65 rigid with said member 64. The transverse slope or cant of the levelling implement 9 is adjusted by a double acting jack 66 or else by two jacks arranged symmetrically with reference to the pivot 65.

The wiring diagram controlling the depth of the levelling implement is altogether similar to that illustrated in FIG. 4, but it controls merely through an electrically controlled valve 67 the feeding of the cylinders of the jack 63.

The wiring diagram controlling the cant of the levelling implement is also the same as that illustarted in FIG. 4 except for the fact that the clinometer 34 is replaced by a simple potentiometer 68, the voltage of which is sent directly into an analogical amplifying computer 43.

The electrically controlled two-way valve 69 controls the feeding of the jack 66 in conformity with the result of a comparison between the voltages of the potentiometers 21 to 50 and possibly 51.

The control of the modifications in the depth and cant of the levelling implement is ensured also by two jacks adapted to adjust said depth and cant or else by one or two cant-adjusting jacks in the manner disclosed hereinabove for the levelling implement, or again by similar depth-adjusting jacks.

What I claim is:

1. A machine running on railroad track to renew the ballast of the track, said machine comprising a front bogie, a rear bogie, a rigid beam extending between the bogies, means for securing the front end of the beam to

the front bogie, means for securing the rear end of the beam to the rear bogie, both said means comprising means to adjust the horizontal and transverse slope of the beam relative to the bogies, a shovel carried by the beam between the bogies, levelling means carried by the beam between the bogies, and means for adjusting the position of the shovel and the levelling means relative to the beam.

2. A machine as claimed in claim 1, wherein the means securing the rear end of the beam to the rear bogie include a rear jack, each of the two parts of which, the cylinder and piston rod, engages one of the cooperating parts of the machine the beam and rear bogie, a ball and socket joint between the rear bogie and the cooperating part of said jack and the means securing the front end of the beam to the front bogie include a ball and socket joint carried by one of the cooperating parts of the machine, the beam and the front bogie, and two lateral jacks arranged symmetrically of the longitudinal axis of the machine and connecting the beam with the front bogie of the machine.

3. A machine as claimed in claim 1, wherein the means securing the rear end of the beam to the rear bogie include a rear jack, each of the two parts of which, the cylinder and piston rod, engages one of the cooperating parts of the machine, the beam and rear bogie, a ball and socket joint between the rear bogie and the cooperating part of said jack and the means securing the front end of the beam to the front bogie include a ball and socket joint carried by one of the cooperating parts of the machine, the beam and the front bogie, and two lateral jacks arranged symmetrically of the longitudinal axis of the machine and connecting the beam with the front bogie of the machine and means controlling the operation of last-mentioned lateral jacks to define the transverse angular slope of the beam.

4. A machine as claimed in claim 1, wherein the means securing the rear end of the beam to the rear bogie include a rear jack, each of the two parts of which, the cylinder and the piston rod, engages one of the cooperating parts of the machine, the beam and the rear bogie, a ball and socket joint betweeen the rear bogie and the cooperating part of said jack and the means securing the front end of the beam to the front bogie include a ball and socket joint carried by one of the cooperating parts of the machine, the beam and the front bogie, two lateral jacks arranged symmetrically of the longitudinal axis of the machine and connecting the beam with the front bogie of the machine, and means carried by the beam near its front end and adapted to control said lateral jacks to ensure transverse horizontality of the beam.

5. A machine as claimed in claim 1, wherein the means securing the rear end of the beam to the rear bogie include a rear jack, each of the two parts of which, the cylinder and the piston rod, engages one of the cooperating parts of the machine, the beam and the rear bogie, a ball and socket joint between the rear bogie and the cooperating part of said jack and the means securing the front end of the beam to the front bogie include a ball and socket joint carried by one of the cooperating parts of the machine, the beam and the front bogie, two lateral jacks arranged symmetrically of the longitudinal axis of the machine and connecting the beam with the front bogie of the machine, means comparing the measured and the desired slope of the beam carried by the latter near its front end and an auxiliary valve feeding the rear jack and controlled by last-mentioned means to make the beam assume the desired slope.

6. A machine as claimed in claim 1, wherein the means securing the rear end of the beam to the rear bogie include a rear jack, each of the two parts of which, the cylinder and the piston rod, engages one of the cooperating parts of the machine, the beam and the rear bogie, a ball and socket joint between the rear bogie and the cooperating part of said jack and the means securing the front end of the beam to the front bogie include a ball and socket joint carried by one of the cooperating parts of the machine, the beam and the front bogie, two lateral jacks arranged symmetrically of the longitudinal axis of the machine and connecting the beam with the front bogie of the machine, means comparing the actual length of the rear pack with its theoretical length to thereby define the difference in level beween the track to be renewed and the renewed rack and means controlled by last-mentioned means and adjusting the height of the levelling means with reference to the beam through their securing means.

7. A machine as claimed in claim 1, comprising highly accurate clinometers sensitive to the relative transverse and longitudinal slopes of the beam and adapted to produce corresponding voltages.

8. A machine as claimed in claim 7, and means comparing the voltages supplied by the different clinometers.

9. A machine as claimed in claim 1, comprising potentiometers including an arcuate resistance and a slider carried respectively by one of two cooperating parts, the beam and another part of the machine, and means comparing the voltages supplied by said potentiometers.

10. A machine as claimed in claim 1, comprising a clinometer carried by the beam and the operative vertical plane of which coincides with the vertical plane perpendicular to the longitudinal axis of the beam, said clinometer being adapted to supply a voltage depending on the transverse slope of the beam, and an auxiliary valve system feeding the transverse jacks to control said transverse slope and controlled by said voltage.

11. A machine as claimed in claim 1, comprising two clinometers having their vertical operative planes parallel with the longitudinal axis of the beam carried by the rear and the front bogie respectively and adapted to supply voltages depending on the slope measured by them, a comparator comparing the voltages supplied by the two clinometers and an auxiliary valve controlling the rear jack and controlled by the different currents produced by the comparator.

12. A machine as claimed in claim 1, comprising two clinometers having their vertical operative planes parallel with the longitudinal axis of the beam carried by the rear and the front bogie respectively and adapted to supply a voltage depending on the slope measured by them, a comparator comparing the voltages supplied by the two clinometers and an auxiliary valve controlling the rear jack and controlled by the different currents produced by the comparator and memorizing means inserted between the comparator and said valve.

13. A machine as claimed in claim 1, comprising two clinometers having their vertical operative planes parallel with the longitudinal axis of the beam carried by the rear and the front bogie respectively and adapted to supply a voltage depending on the slope measured by them, a comparator comparing the voltages supplied by the two clinometers and an auxiliary valve controlling the rear jack and controlled by the different currents produced by the comparator and programming means controlling the comparator to define the longitudinal slope to be given to the beam.

14. A machine as claimed in claim 1, wherein the means securing the rear end of the beam to the rear bogie include a rear jack, each of the two parts of which, the cylinder and the piston rod, engages one of the cooperating parts of the machine, the beam and the rear bogie, a ball and socket joint between the rear bogie and the cooperating part of said jack and the means securing the front end of the beam to the front bogie include a ball and socket joint carried by one of the cooperating parts of the machine, the beam and the front bogie, two lateral jacks arranged symmetrically of the longitudinal axis of the machine and connecting the beam with the front bogie of the machine, means for maintaining horizontality of the beam, means controlling the height of the shovel and levelling means with reference to the beam,

nd slope-correcting means controlled by the difference 1 level between the two bogies and controlling last-ıentioned means.

15. A machine as claimed in claim **1**, comprising means djusting the cant of the shovel and levelling means in onformity with the arithmetical mean value of the ant of the track to be renewed and the renewed tracks at oints in registry with the two bogies.

16. A machine as claimed in claim **1**, comprising jacks ontrolling the transverse slope of the shovel and levelng means, a first clinometer having its operative vertical lope perpendicular to the beam axis and carried by the ront bogie, a second clinometer having its operative ertical plane perpendicular to the axis of the beam and arried by the rear bogie, said clinometers producing oltages depending on the slopes assumed by them, a lope detector producing a voltage depending on the ransverse slope assumed by the shovel and the levelling ıeans, a computer comparing the half sum of the voltges fed by the clinometers and an auxiliary valve conrolled by the computer and controlling said jacks.

17. A machine as claimed in claim **1**, comprising jacks ontrolling the transverse slope of the shovel and levelling neans, a first clinometer having its operative vertical lope perpendicular to the beam axis and carried by the ront bogie, a second clinometer having its operative ertical plane perpendicular to the beam axis and carried by the rear bogie, said clinometers producing voltges depending on the slope assumed by them, a slope letector producing a voltage depending on the transverse lope assumed by the shovel and the levelling means, a omputer comparing the half sum of the voltages fed by he clinometers and an auxiliary valve controlled by the omputer and controlling said jacks, and a potentiometer dapted to adjust the cant of the levelling and ramming neans and producing an auxiliary voltage corresponding o the desired cant inserted in parallel with the voltage ed by the slope detector to return said cant to the lesired value.

18. A machine as claimed in claim **1**, comprising neans holding the beam in a horizontal position, jacks lefining the level of the levelling means with reference o the beam and potentiometers controlling the operation of the jacks and controlled by the difference in level between the track to be renewed and the renewed track.

19. A machine as claimed in claim **1**, comprising neans holding the beam in a horizontal position, jacks lefining the level of the levelling means with reference o the beam, potentiometers controlled by the difference in level between the track to be renewed and the renewed track, a manually adjustable potentiometer indicating the desired level of the levelling means, a computer comparing the voltages fed by the two potentiometers, an auxiliary valve feeding said jack and controlled by the current passing out of the computer.

20. A machine as claimed in claim **1**, comprising a manually adjustable potentiometer indicating the desired difference in level between the track to be renewed and the renewed track, a second potentiometer measuring the level of the beam with reference to the renewed track, a computer comparing the outputs of the two potentiometers, a jack controlling the level of the leveling means and a valve controlled by said computer and controlling said jack.

21. A machine as claimed in claim **1**, comprising a manually adjustable potentiometer indicating the desired difference in level between the track to be renewed and the renewed track, a second potentiometer measuring the level of the beam with reference to the renewed track, a computer comparing the outputs of the two potentiometers, a jack controlling the level of the levelling means, a valve controlled by said computer and controlling said jack, means adding to the output of the second amplifier a voltage which is a function of the voltage of the first potentiometer.

22. A machine as claimed in claim **1**, comprising means measuring the level and cant of the shovel and producing corresponding voltages, potentiometers supplying voltages corresponding to the desired level and cant, computers associating the voltages of said potentiometers, jacks controlling the level and cant of the shovel and auxiliary valves controlled by the computers and controlling said jacks.

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