A system and method for controlling railroad surfacing is provided. A computerized controller compares desired railroad rail position values with actual railroad rail position values such that a tamper machine raises, lowers, and horizontally moves the rails to correct the alignment of the rails and ties. The system may be used in conjunction with existing shadowboard tamper systems, with the computerized controller receiving precision reference signals corresponding to desired rail position values, and moving projectors according to the difference of the railroad rail position value and desired railroad position value.
METHOD AND SYSTEM FOR CONTROLLING RAILROAD SURFACING

RELATED APPLICATION

[0001] This application claims priority to U.S. Provisional Application Ser. No. 60/602,978, filed on Aug. 16, 2004.

BACKGROUND OF THE INVENTION

[0002] The present invention generally relates to railroad placement and surfacing. More particularly, the present invention relates to a method and system for controlling such railroad surfacing. The control system of the present invention can be used in conjunction with existing surfacing systems.

[0003] When constructing a railroad, after properly grading the underlying land, a bed of gravel or ballast is formed from anywhere between one and three feet thick. The railroad ties are embedded in the ballast and the rails attached thereto. In the case of wooden railroad ties, the rails are nailed to the ties with spikes. In the case of concrete ties, clips connect the rails and the ties.

[0004] The rails and ties must then be set at a predetermined height and alignment. The rails must be a certain height above the ballast and stay within pre-set tolerances with respect to alignment.

[0005] A machine, often called a ballast tamper, is used to lift the rails and ties and vibrate the gravel ballast such that the ties can be set at the proper depth and the rails aligned. Survey points or stations established during the design of the rail track are used to determine what the position and depth of the rail and railroad ties should be.

[0006] Over time, the railroad must be maintained as the gravel and ballast sink into the ground. Such sinking is not constant through the length of the railroad. Accordingly, the tamper machine must be utilized to periodically lift and realign the rail and railroad ties and either vibrate the existing gravel into place, or vibrate new gravel into place to properly set the ties and rails.

[0007] In the past, a buggy having infrared projectors was moved to no more than 100 feet away from the tamper machine on what was considered “good track” and projected infrared beams to sensors positioned on the machine. A shadowboard on the machine cooperatively worked with the infrared projector and sensor to determine proper alignment between the projector and sensor, and thus proper alignment and position of the rails and tracks. This is commonly referred to as a shadowboard system.

[0008] However, the current method of “tamper” or surfacing the rails and railroad ties using the existing shadowboard system leaves much to be desired. First, the buggy must be placed no more than 100 feet in front of the machine. Thus, every 100 feet the buggy must be repositioned. According to the survey station reference point or marker data, at least one individual moves a surface or vertical projector, as well as a horizontal or line projector, to the proper position. This may require manually moving the projectors to the desired point. In some cases, the projectors are positioned at the end of a tube or rod which can be moved horizontally or vertically using hydraulics or motors or the like. An operator at the tamper machine must move the shadowboards and/or sensors until the proper alignment is achieved, wherein the shadowboards block the infrared beam from the projectors. At least two or three individuals are required to operate the existing shadowboard system. The existing shadowboard system is also very difficult to use when the rail has vertical or horizontal curves or dips. In fact, it can take an average of three passes of the tamper machine to set the rails within the required tolerances. This is particularly the case when there are dips in the rail as the infrared projectors shoot their signals over the sensors. As the buggies with the projectors are typically between 50 and 100 feet in front of the tamper machine, there is a built-in error in the correction to the rails. For example, in the case when the buggy and projectors are positioned approximately 100 feet from the tamper machine, and assuming there is approximately a 15 feet spacing between the shadowboards and the sensors, there is an approximately 7:1 error correction ratio. Thus, if the projector is within a seven inch depth of track of the tamper machine, the tamper machine will create a one-inch depth from the desired height. Thus, the tamper machine must pass and lift the rails at least two or three times before the rails are of the sufficient height that the projectors can communicate with the infrared receivers on the tamper machine before the shadowboards come into alignment and indicate that the rail is set at the proper tolerance level. Once the tamper machine has lifted and aligned the rails to the desired position, typically after multiple passes, the buggy must be positioned uptrack of the tamper machine and the projectors manually positioned, as described above.

[0009] As such, only approximately 800 feet per day can be surfaced using the existing shadowboard system and tamper machines. Moreover, the existing shadowboard systems are not extremely accurate and thus make the surfacing or tampering of commuter rail lines, which have much tighter tolerances, very time consuming and costly.

[0010] Accordingly, there is a need for enhancing the existing railroad surfacing systems such that greater accuracy is achieved, the number of passes by the ballast tamper machine is reduced, and the feet per day of surfacing is greatly improved. What is also required is a system which is capable of guiding the ballast tampering machine to create vertical and horizontal curves. The present invention fulfills these needs and provides other related advantages.

SUMMARY OF THE INVENTION

[0011] The present invention resides in a railroad rail surfacing control system, which can be used in combination with existing shadowboard systems. The system and method of the present invention improves surfacing accuracy and efficiency such that the rails can be set within the necessary tolerances in automatic fashion in as few as a single pass. Thus, many more feet per day can be surfaced than using existing technology. Moreover, the method and system of the present invention allows vertical and horizontal curves to be automatically resurfaced.

[0012] Generally, the method for controlling the railroad surfacing in accordance with the present invention includes imputing desired railroad rail position values into a controller. Railroad rail position correction values are determined by comparing the desired railroad rail position values with actual railroad rail position values. The railroad rail is
moved to the determined correction value position using a railroad tamper machine, which is operably associated with the controller.

[0013] In one embodiment, the inputting step includes the step of inputting a table of desired railroad rail position values for a predetermined length of railroad track into the controller. The position of the tamper machine with respect to the length of the railroad track is determined. A reference signal may be obtained from a transmitting device associated with a known marker in relation to the position of the tamper machine on the railroad track, which corresponds to a desired railroad position value. The tamper machine then automatically corrects the rail position using the table of desired railroad rail position values and reference signal.

[0014] In another embodiment, the reference signal from a transmitting device is used. A reference signal receiver is in communication with the controller, and the controller moves a shadowboard system projector a distance corresponding to the railroad rail correction value. The shadowboard system projector is disposed uptrack of the shadowboard and sensor of the tamper machine. In a particularly preferred embodiment, the reference signal receiver and shadowboard system projector are mounted on a buggy coupled to a front of the tamper machine.

[0015] In one embodiment, the reference signal is transmitted by at least one laser device positioned uptrack of the tamper machine. The laser device is disposed relative to a known survey marker. The laser device transmits a surface laser reference signal and a line reference signal to provide desired vertical and horizontal railroad rail position values. Typically, a first laser transmits a surface laser reference signal, while another laser transmits a line laser reference signal. Laser receivers associated with line and surface projectors receive the respective laser signals. The controller interprets the signal and moves the line or surface projectors a correction distance.

[0016] In another embodiment, the reference signal is transmitted by a GPS transreceiver positioned relative to a known survey marker. The GPS transreceiver is adapted to receive GPS signals from satellites, and transmits a reference signal to a reference signal receiver associated with the line or surface projector. The reference signal receiver comprises a GPS antenna receiver in communication with the controller for moving the projector, as needed.

[0017] An interface unit is preferably disposed within the tamper machine cab. The interface unit includes a display for displaying values corresponding to a desired railroad rail position and actual railroad rail position. The interface unit is adapted to permit the tamper machine operator to manually make railroad rail position corrections and deviate from the desired railroad rail position as necessary.

[0018] Other features and advantages of the present invention will become apparent from the following more detailed description, taken in connection with the accompanying drawing which illustrate, by way of example, the principals of the present invention.

BRIEF DESCRIPTION OF THE DRAWINGS

[0019] The accompanying drawings illustrate the invention. In such drawings:

[0020] FIG. 1 is diagrammatic view of a laser-based control system for railroad surfacing embodying the present invention;

[0021] FIG. 2 is a perspective view of a line laser push cart, used in accordance with the present invention;

[0022] FIG. 3 is a perspective view of a shadowboard projector buggy, used in accordance with the present invention;

[0023] FIG. 4 is an enlarged and partially fragmented perspective view of area "A" of FIG. 3, illustrating a line laser signal receiver and a line projector, used in accordance with the present invention;

[0024] FIG. 5 is a partially fragmented elevational view of a scale associated with the line signal reference receiver;

[0025] FIG. 6 is a diagrammatic view illustrating the inter-connection of various components of the system of the present invention;

[0026] FIG. 7 is a diagrammatic view of a tamper machine operator interface unit, used in accordance with the present invention; and

[0027] FIG. 8 is a diagrammatic view of a GPS-based railroad surfacing control system, embodying the present invention.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0028] As shown in the accompanying drawings, for purpose of illustration, the present invention resides in a system and method for controlling railroad surfacing. As will be more fully discussed herein, the system and methodology of the present invention enable the automatic adjustment of the rails of the railroad track with little or no operator intervention. Proper railroad surfacing can be achieved in as little as one pass by a tamper machine by as few as a single worker. Moreover, as will be more fully discussed herein, the length of railroad track which can be adjusted and resurfaced per day is greatly increased in comparison to existing methods.

[0029] With reference now to FIG. 1, as discussed above, existing railroad surfacing systems include a tamper machine 10 which is capable of lifting and moving the rails 12 of a railroad track vertically and horizontally, and vibrating existing gravel or adding new gravel to properly raise and align the rails 12 to within accepted tolerances. A projector buggy 14 having multiple infrared projectors 16 is positioned up to 100 feet uptrack from the tamper machine 10 and emits an infrared signal 18 towards the tamper machine 10. The tamper machine 10 includes sensors in the form of infrared photocells 20 and movable shadowboards 22. When calibrated, the shadowboard 22 is moved until it occludes or blocks the infrared signal 18 from the projector 16 such that it is not received by the sensor 20. When the railroad track 12 deviates right, left or vertically, the sensor 20 is able to detect the infrared signal 18, and the tamper machine 10 moves the rails 12 to the desired position. However, as discussed above, this methodology presents several drawbacks.
In various embodiments of the present invention, the existing “shadowboard” is implemented. However, as illustrated in FIG. 1, the projector buggy 14, instead of being positioned up to 100 feet uptack of the tamper machine 10, is coupled to the front of the tamper machine 10. This creates a nearly one-to-one (1:1) error correction ratio. It will be appreciated by those skilled in the art that the various components carried by the projector buggy 14, as will be more fully discussed herein, could be attached directly to the tamper machine 10. However, as existing railroad surfacing systems already include a separate buggy 14, the present invention utilizes the buggy 14 by coupling it to the front of the tamper machine 10.

With continuing reference to FIG. 1, the present invention also implements a reference signal from a transmitting device associated with a known marker in relation to the position of the tamper machine 10. It is well-known in the art that survey markers are positioned along the railroad track 12. This is done when the railroad track is designed and built. Each survey marker provides references for desired rail position values at that point of the railroad track 12. Thus, whereas the prior art systems would place the projector buggy 14 at a position on the track deemed “good” or approximately within the tolerance of the railroad track design, the present invention utilizes transmitting devices 24 or 38, calibrated to the known surveyor marker which transmit precision reference signal 26 to a receiver 28 or 44 associated with the projector 16 or 46. A computerized controller 30 in electronic communication with the receiver 28 or 44 selectively moves the projector 16 or 46 in response to deviation from the reference signal 26. Preferably, an interface display unit 32 is provided in the tamper machine cab so that the operator of the tamper machine 10 can monitor the progress of the railroad surfacing, and make adjustments as deemed necessary.

With reference now to FIGS. 1-3, in one preferred embodiment, the precision reference signal transmitting device 24 comprises a laser. The laser device 24 transmits a surface or vertical signal to provide vertical desired rail position values or data. Typically, as illustrated in FIG. 1, the surface or vertical signal 26 is transmitted by a laser device 24 positioned over the known survey marker, such as on a tripod. The surface laser signal receiver 28 is disposed on the buggy cart 14 in association with at least one vertical or surface projector 16. As discussed above, the surface receiver 28 is in electronic communication with a controller 30, which includes the necessary electronic circuitry to receive the signal data and determine whether the vertical projector should be repositioned. The controller 30 is adapted to selectively power on electric motors or hydraulic drive devices 34 so as to selectively move the projectors 16 up or down, as necessary. This can be easily done using electric motors wherein the controller 30 selectively powers the motors 34 on and off and directs the vertical movement. The surface laser signal receiver 28 is adapted to determine when the precision laser signal 26 is received at a zero reference point, or above or below the reference point in the receiver 28. For example, if the buggy cart 14 enters into a dip, the laser reference signal 26 will be received on an upper portion of the sensors of the receiver 28. This information would be relayed to controller 30, which would determine that the projector 16, as well as the receiver 28, must be moved upwardly until the laser signal 26 is received at the zero reference point or center sensor of the receiver 28. The movement of the vertical projector 16 causes the infrared signal 18 to be detected by the photocell sensor 20 on the tamper machine 10. Thus, the tamper machine 10 raises the rails 12 until the shadowboard occludes the infrared signal 18, indicating that the rails 12 are properly set.

As mentioned above, in the laser control system of the present invention, a line or horizontal reference signal can be generated and received as well. With reference to FIG. 2, this is typically accomplished by using a laser transmitting device 36 mounted on a hand trolley 38 which is calibrated to a known survey marker. Preferably, the trolley 38 includes a battery 40 or other power source for the laser 36.

A scope 42 or other alignment device is used to align the laser signal with a line laser signal receiver 44 positioned on the trolley 14 and associated with a line projector 46, as illustrated in FIGS. 3. A light bar 48 disposed on the buggy 14 can also be used to assist the operator in determining when the laser signal is in alignment with the receiver 44. That is, a plurality of lights 50, typically three, can be operably positioned on the bar 48. When the laser signal is centered on the receiver 44, the central light 50 is illuminated. However, if the laser signal is off-center, such as left or right, one of the side lamps 50 is illuminated. In this manner, when initially calibrating the system, the tamper machine operator or worker can properly align the laser signal.

With reference now to FIGS. 3-5, the line laser receiver 44 operates in a similar manner to the surface laser signal receiver 28, in that it is electronically connected to the controller 30 and conveys information as to the position of the line laser signal received (whether the signal is centered or drifts left or right). The controller 30 then makes adjustments to the horizontal position of the line projector 46 by selectively powering a motor or the like to move the projector 46. It will be seen that the projector 46 is typically connected to the end of a sliding bar or rod 52. This rod or bar 52 is selectively moved left or right by an electric motor or the like 54. Of course, moving the projector 46 left or right affects the shadowboard and sensor alignment position on the side of the tamper machine 10, causing the tamper machine to move the rails 12 a corresponding distance to the left or right.

Preferably, as illustrated in FIGS. 4 and 5, a scale or ruler 56 is disposed relative to the sliding bar 52 so that the operator can visually determine the offset from the reference point or the amount that the projector 46 has been moved. Typically, although not shown, at least one similar ruler 56 is associated with the vertical or surface projector 16 so that the operator can make a visual determination of the displacement of the surface projector 16 as well.

An electronic and operational diagram of the system is shown in FIG. 6. As discussed above, surface and laser receivers 28 and 44 are in electronic communication with the controller 30, and send signals as to the position of the laser reference signal received thereby. The controller 30 may also be fed information as to the location of the tampers machine 10 on the railroad track, such as by a distance wheel 58 operably connected to the tamper machine 10 or the buggy 14. The position of the surface and line actuators is also monitored. Based on the comparison of the current rail
position, as determined by the current position of the projectors 16 and 46, and the deviation of the laser signals from the receivers 28 and 46, the projectors 16 and 46 are moved a corresponding distance to the desired rail position. This information is relayed to an operator interface unit 32, which is typically positioned within the cab of the tamper machine 10 so as to be readily accessible by the operator of the tamper machine 10.

[0038] With reference now to FIG. 7, an exemplary operator interface unit 32 is shown. In a particularly preferred embodiment, the operator interface unit 32 comprises a touch-screen interface with a display 60 having touch-screen icons. This operator interface 32 can take other forms as well, although a display is preferably incorporated into the unit 32. This unit 32 enables the operator to initially calibrate the system and set reference points. Moreover, the operator of the tamper machine 10 can use the unit 32 to select between the various modes of operation of the system, as will be more fully described herein.

[0039] As illustrated in FIG. 7, the laser control system is shown. Corrections to the surface (vertical) and line (horizontal) positions of the rails is given in tenths of a foot, and can be selected as millimeters as well. In the fully automatic mode, the operator of the tamper machine can merely monitor the progress of the rail resurfacing and re-calibrate the system in the event that either the surface or line laser reference signals are lost, such as if the tamper machine 10 enters into a significant dip and the laser reference signals are lost by the receivers 28 or 44. Alternatively, the operator is permitted to manually adjust and correct the rail positioning. This is done by entering into a manual mode and adjusting up or down the surface vertical position of the rail, or left and right the line or horizontal position of the rail. For example, the operator may wish to raise the rails 12 only 5/10 of a foot rather than the desired 6/10 of a foot corresponding the exact desired rail placement. The operator of the tamper machine 10 may also determine that a certain section of rail 12 may require two passes due to the sizable correction error. In this case, the operator could manually take over the resurfacing operation and raise the rails a predetermined amount the first pass, and then finish the raising of the rails on a second pass to the desired position, as indicated by the reference signals.

[0040] With reference now to FIGS. 7 and 8, the present invention is operable in a variety of modes. In addition to the laser reference signal mode, the present invention also supports a Global Positioning Satellite (GPS) control system. The operator interface unit 32 allows the operator to switch between these various modes.

[0041] With particular reference to FIG. 8, the GPS mode a GPS transceiver 62 is positioned directly over a known survey marker. This survey marker may be uptrack of the tamper machine 10, as with the case of the laser transmitters 24 and 36. Alternatively, GPS transceiver may be placed over a known survey marker off the track as well. This is due to the fact that the GPS signals emitted by the transceiver 62 need not be in a “line of sight” as with the laser signals. In fact, a limitation of the previously described laser control system is that the laser transmitters 24 and 36 had to be positioned on a section of rail in front of the tamper machine 10 with a direct line of sight to the receivers 28 and 44. Laser signal reception, given current technology, enables the laser transmitters 24 and 36 to be placed approximately 500 feet uptrack of the tamper machine. However, using the GPS system, the GPS transceiver 62 can be placed a much greater distance, such as 5,000 feet, from the tamper machine 10. The GPS transceiver 62 receives GPS signals from the plurality of satellites 64, as is known the art, that give the transceiver 62 data as to its position. It is known that while GPS position data is fairly accurate, it can be off by a small percentage due to interference with the atmosphere and the like. Thus, with the GPS transceiver 62 positioned over the known survey marker, its exact location is known, for example 4.0 feet above the surveyed marker. The received GPS data from the satellite 64 then provides a correction value. Fore example, the GPS data from the satellites may provide a 0.1 foot difference such that it indicates that the GPS transceiver 26 is 4.1 feet above the known survey marker.

[0042] At the tamper machine 10, GPS signal reference receivers, in the form of GPS antennas 66, are associated with the projectors 16 and 46, similar to the laser reference signal receivers 28 and 44. These receivers 66 also receive positional data from the satellite 64. However, as discussed above, this positional data can be off by a fraction of an inch or even more. Thus, transceiver 62 emits a correction signal 68 to the antenna 66. This signal 68 indicates, for example, that the positional data from the satellite 64 is in error 0.1 feet. This information is provided to the controller 30, which then calculates and determines the desired rail position, and moves the projectors 16 and 46 accordingly. As discussed above, movement of the projector 16 or 46 causes the tamper machine 10 to raise the rail 12, or move them left or right according to the existing shadowboard system methodology.

[0043] Referring again to FIGS. 6 and 7, the operator interface unit 10 can be used to select between the laser or GPS control systems. The controller 30 then receives pertinent data through the relevant port for either the GPS or laser receiver. The controller 30 is electronically connected to the operator interface unit 32 to provide this information visually to the tamper machine operator, as well as to receive commands from the operator to override the automatic functions and adjust the position of the projectors 16 and 46 according to the operator’s manual commands. In the case when the GPS system is used, a three-dimensional illustration may be shown on an operational display 70 to show the operator the three-dimensional desired rail placement versus the actual rail placement, and other information.

[0044] Thus, the operator of the tamper machine 10 is able to select between a variety of modes. First, a standby mode can be selected wherein the conventional projector and shadowbox system is used instead of the precision referenced signals from either the laser or GPS equipment. Alternatively, the automatic laser mode can be selected and the tamper machine 10 controlled by the controller 30. As another alternative, when using GPS equipment, the tamper machine 10 is controlled by the control 30 which responds to the received GPS information. In either of these modes, the operator can select manual mode for either the surface and/or line rail positioning.

[0045] Although the projectors 16 and 46 and receivers 28, 44 and 66 have been described as being placed on a tamper buggy 14 coupled to the front of the tamper machine,
it will be appreciated that these components could be incorporated onto or into the tamper machine 10 itself. Thus, the electronic circuitry of the controller 30 could be incorporated into the tamper machine 10, and the laser signal or GPS signal receivers coupled to the tamper machine 10 and movable with the projectors 16 and 46 on the tamper machine 10 itself. However, as most existing railroad surfacing operations already include a tamper buggy 14 with projectors 16 and 46, the laser signal receivers 28 and 44 or GPS antennas 66, as well as a controller 30, are typically positioned on the buggy 14 for convenience sake.

[0046] It will be appreciated that the aforementioned embodiments of the present invention provide significant advantages over the traditional railroad surfacing systems and methodology. Whereas the projector buggy 14 could be placed no more than 100 feet in front of the tamper machine 10 on “good track”, with the projectors 16 and 46 manually moved into position, the laser-based system of the present invention enables the laser transmitters 24 and 36 to be placed approximately 500 feet from the tamper machine 10. Moreover, these transmitters are referenced to a known survey marker.

[0047] Further, the projectors 16 and 46 are automatically moved as the tamper machine 10 progresses along the rails 12. The coupling of the buggy 14 to the tamper machine 10 also significantly reduces the correction error. Thus, a single operator can use the laser-based system of the present invention to precisely correct approximately 2,000 feet of rail in one day, instead of requiring two or three operators to surface approximately 800 feet per day. Using the GPS-based system of the present invention, a single operator can precisely position approximately 4,000 feet of rail per day. This increase is largely due to the fact that the reference data of the known survey marker need only be established and calibrated once per day using the GPS system. The laser-based system must be recalibrated and new survey markers approximately every 500 feet. The existing shadowboard system must be recalibrated approximately every 50 to 100 feet and multiple passes are often required to fully correct the track.

[0048] The railroad surfacing system of the present invention is also useful in that it provides the ability to pre-program both horizontal and vertical curves, and also to use a slope laser for vertical curves. This enables curve railroad surfacing to be done in one or two passes, instead of the arduous process of repeatedly passing over curves, as is presently done. In this curve surfacing mode, the tamper operator enters a table or list of desired rail position values, including station number or survey marker numbers and values and offset values. This is typically done using a hand-held device 71, which communicates with the controller 30. These values are stored in a PLC of the controller 30. The tamper operator then switches the system to the appropriate auto-curve mode. Functionally, the operator enters a series of “station numbers” for offsets to occur. The station numbers are specific survey points used to initially set the track. Station numbers are typically eight-digit numbers that can be either in feet or centimeters. The user then inputs a starting station number, direction of travel (station numbers going up or down) and “calibrates” the distance wheel 58 to that value. At each “station number” the operator can input offset values for the surface projector, surface laser receiver, or line projector. Between stations, the offset is calculated as an offset value per foot moved. The tamper machine operator can review and/or modify entries from the hand-held data entry terminal on the touch screen panel interfacing 32 in the tamper cab. An additional motorized device 72 is utilized to move laser receiver 25 independent of device 34 so that curve tangency and slope data can be incorporated into the automatic movement of projector 16. The operator does not need to make any adjustments to the projectors while working through the curve. Instead, the laser receivers and tamper projectors are automatically moved to correspond to the values previously entered along the curve as the tamper machine 10 moves. Vertical curve surfacing can also be performed under the laser control. Of course, those skilled in the art will realize that the curve mode could also be performed using the aforementioned GPS system.

[0049] It is also contemplated by the present invention that known survey marker point values, also referred to as stations, can be entered into the hand held device 71, and the GPS or laser precision signals used merely as reference signals, the tamper machine 10 automatically correcting the rail position to the desired rail position based upon the information input in the list or table of survey marker positions and information. Thus, even relatively straight or flat sections of rail 12 could be corrected according to the pre-programmed and input listing of desired values. Instead of entering the survey marker or station values, exact values of the rail positions, at any given point along the railroad track could be entered into the hand held device 71, which could control the tamper machine 10 operation with or without GPS or laser reference signals. Actual rail position values are compared with the input desired rail position values, and a corresponding correction made either vertically and/or horizontally to the rails to move them into the desired position or within acceptable tolerance levels.

[0050] Those skilled in the art will readily appreciate that the present invention provides many advantages over existing railroad surfacing systems. The present invention provides a high degree of precision and speed when laying new track or surfacing existing track. Simultaneously, the time required for surfacing is decreased, as the track can typically be precisely laid or positioned in only one or two passes. Instead of requiring two or three workers, the present invention requires only one or two workers, presenting a significant reduction in labor costs for surfacing operations. Maintenance costs of the surfacing equipment is also decreased. Moreover, curves can be resurfaced and positioned very accurately in as few as a single pass.

[0051] Although several embodiments have been described in detail for purposes of illustration, various modifications may be made to each without departing from the scope and spirit of the invention. Accordingly, the invention is not limited, except as by the appended claims.

What is claimed is:
1. A method for controlling railroad surfacing, comprising the steps of:
   inputting desired railroad rail position values into a controller;
   determining railroad rail position correction values by comparing the desired railroad rail position values with actual railroad rail position values; and
moving the actual railroad rail position to the determined correction value position using a railroad tamper machine operably associated with the controller.

2. The method of claim 1, wherein the inputting step includes the step of inputting a table of desired railroad rail position values for a predetermined length of railroad track into the controller.

3. The method of claim 2, including the step of determining the position of the tamper machine with respect to the length of the railroad track.

4. The method of claim 3, including the step of obtaining a reference signal from a transmitting device associated with a known marker in relation to the position of the tamper machine on the railroad track and corresponding to a desired railroad position value.

5. The method of claim 1, including the step of obtaining a reference signal from a transmitting device associated with a known marker in relation to the position of the tamper machine on the railroad track and corresponding to a desired railroad position value.

6. The method of claim 5, including the step of providing a reference signal receiver in communication with the controller.

7. The method of claim 6, including the step of using the controller to move a shadowboard system projector a distance corresponding to the railroad rail correction value.

8. The method of claim 7, wherein the shadowboard system projector is disposed uptrack of a shadowboard and sensor of the tamper machine.

9. The method of claim 8, wherein the reference signal receiver and shadowboard system projector are mounted on a buggy coupled to a front of the tamper machine.

10. The method of claim 6, including the step of providing a tamper machine operator interface unit, including a display for displaying values corresponding to the desired railroad rail position and actual railroad rail position.

11. The method of claim 10, including the step of permitting the tamper machine operator to manually make railroad rail position corrections using the interface unit.

12. The method of claim 5, wherein the reference signal is transmitted by at least one laser device positioned uptrack of the tamper machine and disposed relative to a known survey marker, the at least one laser device transmitting a surface laser reference signal and a line reference signal to provide desired vertical and horizontal railroad rail position values.

13. The method of claim 5, wherein the reference signal is transmitted by a GPS transmitter positioned relative to a known survey marker relative to the railroad rail and tamper machine.

14. A railroad surfacing system, comprising:

a railroad tamper machine adapted to move railroad rails, the tamper machine including at least one shadowboard and sensor;
a movable infrared signal projector disposed uptrack of the shadowboard and sensor;
a reference signal receiver associated with the projector;
a reference signal transmitter disposed a distance from the tamper machine and associated with a marker corresponding to desired railroad rail position values, the transmitter adapted to transmit a reference signal to the reference signal receiver; and
an electronic controller in electronic communication with the reference signal receiver and adapted to selectively move the projector;

wherein the controller moves the projector a correction distance corresponding to compared desired railroad rail position values determined by the reference signal and actual railroad rail position values; and

wherein the tamper machine moves the railroad rail to the desired railroad rail position value.

15. The system of claim 14, wherein the reference signal transmitter is disposed over a known survey marker.

16. The system of claim 14, wherein the projector and reference signal receiver are coupled to a front of the tamper machine.

17. The system of claim 14, wherein the movable projector comprises a horizontally movable line projector and a vertically movable surface projector.

18. The system of claim 14, wherein the reference signal transmitter comprises a laser transmitter device positioned uptrack of the tamper machine.

19. The system of claim 18, wherein the laser transmitter device transmits a surface laser reference signal and a line laser reference signal to provide desired vertical and horizontal railroad rail position values.

20. The system of claim 19, wherein the laser transmitter device comprises a surface laser reference signal transmitting device and a line laser reference signal transmitting device.

21. The system of claim 20, wherein the reference signal receiver comprises a laser receiver generally aligned with the line laser reference signal transmitting device and associated with a line projector, and a laser receiver generally aligned with the surface laser reference signal transmitting device and associated with a surface projector.

22. The system of claim 14, wherein the reference signal transmitter comprises a GPS transceiver.

23. The system of claim 22, wherein the GPS transceiver is disposed over a known survey marker, and adapted to receive GPS signals from satellites and transmit a reference signal to the reference signal receiver.

24. The system of claim 23, wherein the reference signal receiver comprises a GPS antenna receiver associated with a line projector, and a GPS antenna receiver associated with a surface projector.

25. The system of claim 14, including a tamper machine operator interface unit disposed within a tamper machine cab.

26. The system of claim 25, wherein the interface unit includes a display for displaying values corresponding to the desired railroad rail position and actual railroad rail position.

27. The system of claim 26, wherein the interface unit is adapted to permit the tamper machine operator to manually make railroad rail position corrections.

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