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Carlson

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(54) **SYSTEM AND METHOD FOR MONITORING A CONDITION OF A PAVING MACHINE**

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G07C 5/08 (2006.01)
E01C 19/22 (2006.01)

(52) **U.S. Cl.**

CPC ***G07C 5/0808*** (2013.01); ***E01C 19/22*** (2013.01); ***G07C 5/0816*** (2013.01); ***G07C 5/0841*** (2013.01); *E01C 2301/10* (2013.01)

(58) **Field of Classification Search**

CPC ... E01C 19/22; E01C 2301/10; G07C 5/0808; G07C 5/0816; G07C 5/0841

USPC 404/84.05, 77, 79, 95, 118

See application file for complete search history.

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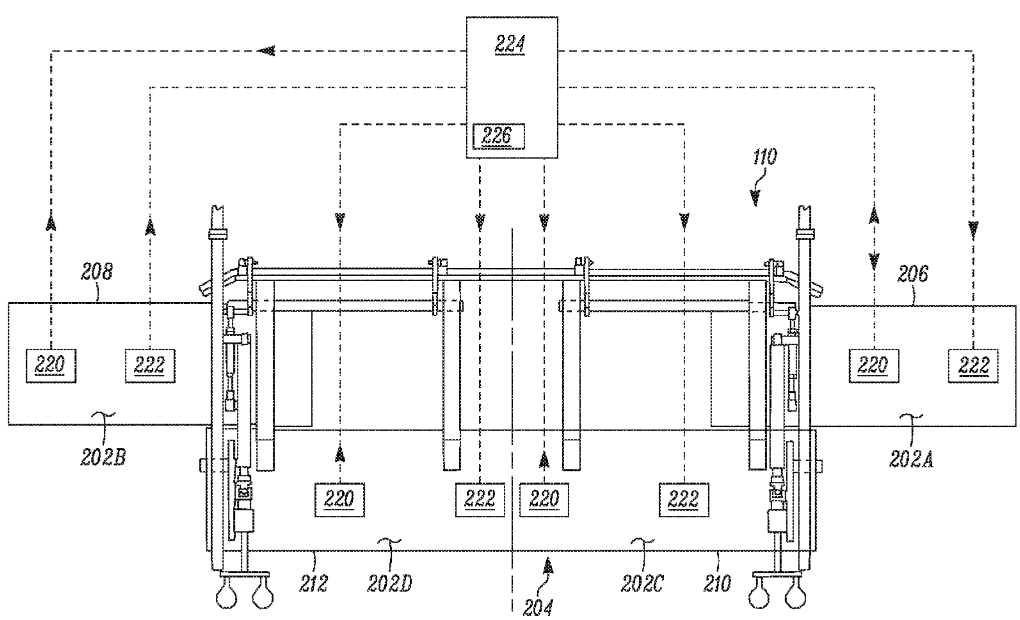
Primary Examiner — Raymond W Addie

(57) **ABSTRACT**

A system and a method for monitoring a condition of a paving machine. The system includes a screed plate and a heating element for heating the screed plate. The system also includes a controller configured to determine a heat-up time for the screed plate and compare the heat-up time to a predetermined time. The controller is further configured to provide a signal indicating that the screed plate needs to be replaced if the heat-up time is less than or equal to the predetermined time.

20 Claims, 3 Drawing Sheets



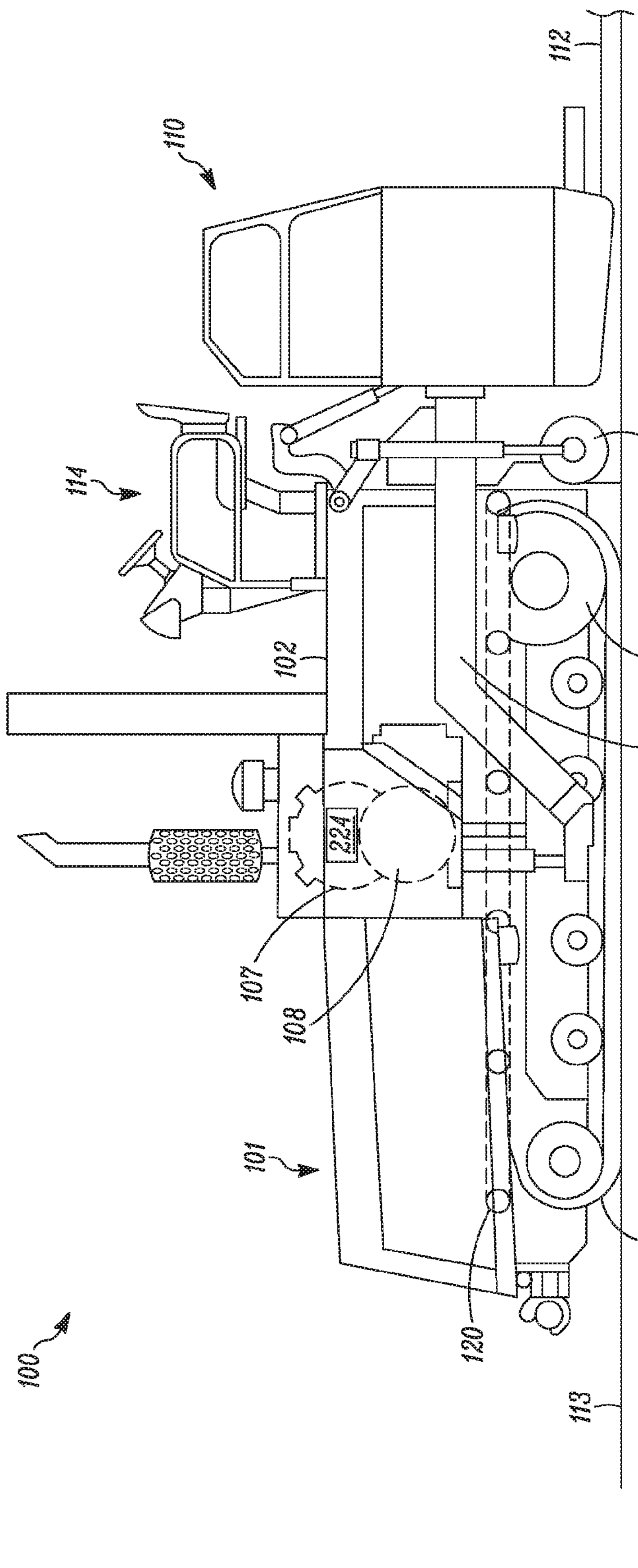


FIG. 1

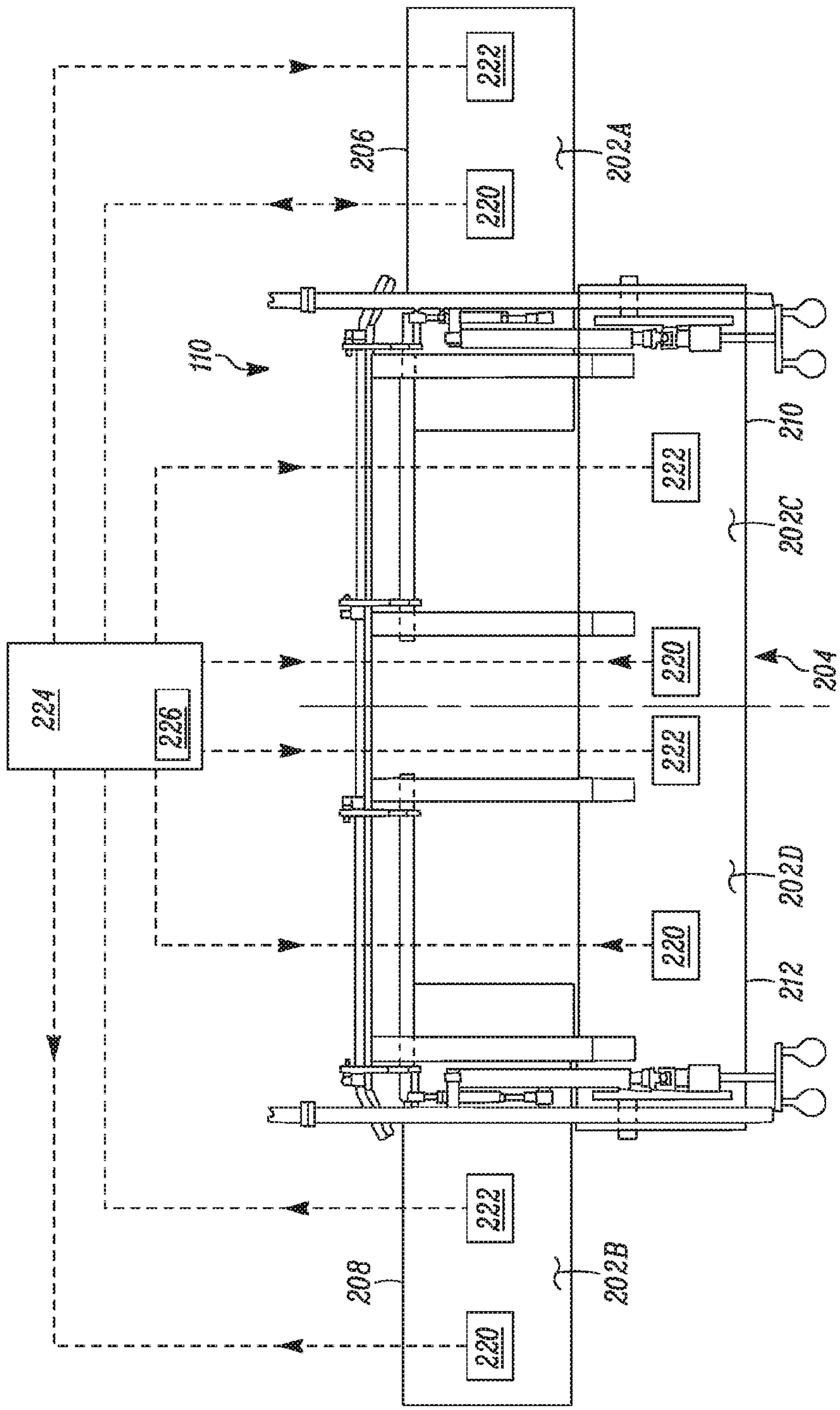

222
220
206
202A
110
222
210
202C
224
226
220
204
222
202D
220
212
222
208
202B
220

FIG. 2

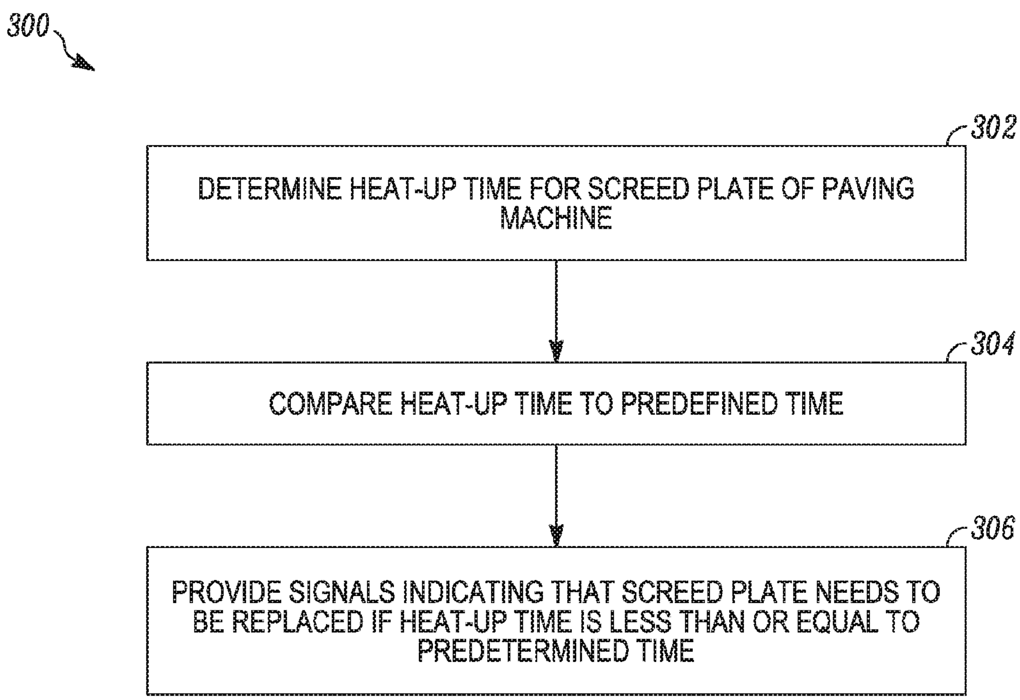

300
302
DETERMINE HEAT-UP TIME FOR SCREED PLATE OF PAVING MACHINE
304
COMPARE HEAT-UP TIME TO PREDEFINED TIME
306
PROVIDE SIGNALS INDICATING THAT SCREED PLATE NEEDS TO BE REPLACED IF HEAT-UP TIME IS LESS THAN OR EQUAL TO PREDETERMINED TIME

FIG. 3

SYSTEM AND METHOD FOR MONITORING A CONDITION OF A PAVING MACHINE

TECHNICAL FIELD

The present disclosure generally relates to a paving machine. More particularly, the present disclosure relates to a system and a method for monitoring condition of the paving machine.

BACKGROUND

Paving machines are used to apply, spread, and compact a mat paving material over a paving surface. A paving machine generally includes a tractor and a screed assembly having a number of screed plates. The tractor has a hopper for receiving paving material such as, asphalt, from a truck and a conveyor system for transferring the paving material rearwardly from the hopper for discharge onto the paving surface. The paving machine includes augers to spread the paving material across the paving surface in front of the screed assembly.

The screed assembly smoothens and compacts the paving material on the paving surface. To facilitate a proper deposition of the paving material, the screed plates are typically heated. Heating the screed plates assists the paving material in flowing under the screed plates and reduces adhesion of the paving material to the screed plates. If the screed plates are not adequately heated, the bituminous mixture of the paving material contacts the bottom of the screed plate and begins to harden, resulting in build-up of paving material and excessive drag. Generally, screed plates are heated to a temperature close to the temperature of the heated asphalt material.

U.S. Pat. No. 6,334,735 is related to a controller for a heating system of a paving screed including a screed plate. The heating system is connected with the screed and configured to transfer thermal energy to the screed plate and includes an actuator configured to adjust thermal energy output of the heating system. The controller includes a temperature sensor connectable with the screed and configured to sense temperature of the screed plate. The sensor is also configured to generate electrical signals proportional to sensed temperature. An electrical logic circuit is electrically connected with the sensor and is electrically connectable with the actuator. The logic circuit is configured to compare a temperature signal from the sensor with a desired temperature value and to automatically operate the actuator such that the actuator adjusts thermal energy output of the heating system so as to maintain screed temperature about the desired temperature value.

The screed plates may undergo wear and tear over a period of time due to friction with the paving material, temperature etc. The screed plates may not wear evenly and the misshaped plates affect the mat and a performance of the machine. As such, the screed plates may need to be replaced as and when required for smooth operation of the paving machine. Conventionally, the screed plates are checked and replaced based on the service life or every season.

However, in some cases, the screed plates may be non-operational and may need to be replaced sooner even before their service life due to various other reasons such as, harsh and dynamically changing operating conditions, amount of material laid, operator error etc. Offline checking of the screed plates for damage may decrease the operational time of the paving machine and may affect the productivity. As such, there exists a need for efficiently monitoring a condition of the paving machine.

SUMMARY OF THE DISCLOSURE

In an aspect of the present disclosure, a system for monitoring a condition of a paving machine is provided. The system includes a screed plate and a heating element for heating the screed plate. The system further includes a controller configured to determine a heat-up time for the screed plate and compare the heat-up time to a predetermined time. The controller is further configured to provide a signal indicating that the screed plate needs to be replaced if the heat-up time is less than or equal to the predetermined time.

In another aspect of the present disclosure, a method of monitoring a condition of a paving machine is provided. The method includes determining a heat-up time for the screed plate and comparing the heat-up time to a predetermined time. The method further includes providing a signal indicating that the screed plate needs to be replaced if the heat-up time is less than or equal to the predetermined time.

In yet another aspect of the present disclosure, a system for monitoring a condition of a screed plate is provided. The system includes a heating element for heating the screed plate. The system also includes a controller configured to determine a heat-up time for the screed plate and compare the heat up time to a predetermined time. The controller is further configured to provide a signal indicating that the screed plate needs to be replaced if the heat-up time is less than or equal to a predetermined time.

Other features and aspects of this disclosure will be apparent from the following description and the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

The features and advantages of the present disclosure will become more apparent from the detailed description set forth below when taken in conjunction with the drawings.

FIG. **1** is a side view of an exemplary paving machine having a screed assembly, according to an embodiment of the present disclosure;

FIG. **2** is a plan view of the screed assembly of FIG. **1**, and an associated system for monitoring a condition of the paving machine, according to an embodiment of the present disclosure; and

FIG. **3** is a flowchart for a method of monitoring a condition of the paving machine, according to an embodiment of the present disclosure.

DETAILED DESCRIPTION

Wherever possible, the same reference numbers will be used throughout the drawings to refer to the same or the like parts. Referring to FIG. **1**, an exemplary paving machine **100** (hereinafter referred to as "the machine **100**") is illustrated. Although, the paving machine **100** is depicted in the FIG. **1** as an asphalt paver, the presently disclosed concepts may be used on any kind of a paving machine and for any kind of material engaging operation performed by the work surface machine, that may form a layer of material on a paving surface.

As shown in FIG. **1**, the machine **100** may include a tractor **101** having a frame **102**. The machine **100** may also include one or more traction devices **104** coupled with the frame **102** that has a front end **105** and a rear end **106**. In the illustrated embodiment, the traction devices **104** includes wheels. However, in various alternative embodiments, the traction devices **104** may include other types of ground engaging members such as bogies, tracks and the like. Further, the traction devices **104** could also include different combinations of the ground engaging members. For example, the paving machine **100** may include a combination of wheels and tracks.

The traction device **104** may be driven by a power source, e.g., an engine **107** via a transmission (not shown). The transmission may be a hydrostatic transmission or a mechanical transmission. The engine **107** may further drive an associated generator **108** that is used to power various system on the machine **100**.

Referring to FIGS. **1** and **2**, the paving machine **100** also includes a screed assembly **110** that is coupled to the tractor **101** and attached at the rear end **106** of the frame **102**. The screed assembly **110** is configured to spread and compact a material into a layer or mat **112** of desired thickness, size and uniformity on a ground surface **113**.

The screed assembly **110** may be connected behind the machine **100** by a pair of tow arms **111** (only one of which is visible in FIG. **1**) that may extend between the frame **102** of the machine **100** and the screed assembly **110**. The tow arms **111** are pivotally connected to the frame **102** such that the relative position and orientation of the screed assembly **110** relative to the frame **102**, and the ground surface **113**, may be adjusted by pivoting the tow arms **111** in order, for example, to control a thickness of the paving material deposited on the ground surface **113**. The screed assembly **110** includes multiple screed plates **202** (shown in FIG. **2**). The screed plates **202** and a system for monitoring a condition of the screed plates **202**, will be explained in detail in conjunction with FIG. **2**.

Referring to FIG. **1**, the machine **100** may also include an operator station **114**, and may also include a user interface (not shown) for accepting user input and displaying information to the operator.

The machine **100** may also include an auger **122** coupled to the tractor **101** and located between the tractor **101** and the screed assembly **110**. The auger **122** may be placed at the rear end **106** of the frame **102** and adjacent to the screed assembly **110**. The auger **122** is configured to receive the paving material supplied by the conveyors **120** and spread the material evenly ahead of the screed assembly **110**. In an example, the auger **122** may be a screw auger. The machine **100** may have a single auger **122** or any number of augers **122**.

Referring to FIGS. **1** and **2**, the screed assembly **110** may be any of a number of configurations such as, but not limited to, a fixed width screed, a rear mount extendible screed, a front mount extendible screed, or a multiple section screed that includes extensions.

In the illustrated embodiment of FIG. **2**, the screed assembly **100** includes a main screed section **204** and screed extensions **206**, **208**. It should be understood that the screed extensions **206**, **208** are shown as being front mounted but can be either front or rear mounted extensions. In an extended mode, the screed extensions **206**, **208** may extend outwardly from either side of the main screed **204**. The screed extensions **206**, **208** may include separate screed plates **202**A, **202**B.

The main screed **204** may include first and second sections **210**, **212** one on each side of a longitudinal central axis. The screed extensions **206**, **208** may be slidably mounted to the first and second sections **210**, **212** of the main screed **204** respectively. The main screed **204** and first and second sections **210**, **212** may include screed plates **202**C, **202**D or alternatively only a single screed plate. Thus, the main screed **204** may include multiple screed plates **202**A, **202**B, **202**C, **202**D (also collectively referred to as the screed plates **202**).

In an embodiment, the screed assembly **110** may include a vibratory mechanism (not shown) positioned above the first and second screed sections **210**, **212** and the screed extensions **206**, **208** to aid in the initial compaction of the paving material being laid down.

The screed assembly **110** may function to spread the paving material distributed by the paving machine **100** onto the ground surface. In order to achieve an optimum workability of the paving material, a temperature of the screed plates **202** may need be maintained at a desired temperature or within a predetermined temperature range. This desired temperature or the temperature range may depend upon the paving material, paving surface, ambient conditions etc.

As shown in the FIG. **2**, the screed plates **202** is provided with one or more heating elements **220**. The screed plates **202** may be heated by the heating elements **220**, such that a thermal energy may be transferred from the screed plates **202** to the material.

The screed assembly **110** may also be powered by the generator **108** or the engine **107**. The generator **108** may be used to power multiple components associated with the screed assembly **110**, for example, crown actuators (not shown), the heating elements **220** etc.

It should be noted that the configuration of the screed assembly **110** and the screed plates **202** described herein is merely exemplary in nature, and the concepts of the present disclosure may be suitably implemented for any configuration of the screed assembly **110** that has a screed plate **202**.

In an embodiment, the heating elements **220** may be disposed on each screed plates **202**A, **202**B, **202**C, **202**D. Further, the heating elements **220** may also be disposed on forward portions and/or rearward portions of the screed plates **202**. However, this disclosure is not limited to this construction and other numbers of heating elements **220** may be provided for each screed plate. The heating elements may also be associated with one or more controls such as, an on/off switch, a warm-up switch and the like.

In one embodiment, the heating element **220** may include an electrical heater (not shown). In an example, the electric heater may be a sheet formed from a resistive conductive wire. The heating element **220** may be fixed or bonded to the screed plate **202** by suitable bonding materials. The electric heater may be powered by a power source such as the generator **108**. In another embodiment, the heating element **220** may include gas burners (not shown) e.g., propane heaters, diesel heaters and the like. In yet another embodiment, the heating element **220** may include an electrically controlled heating pad.

The heating element **220** may switch into an energized state to start heating the screed plate **202**. Further, the heating element **220** may change into a de-energized state after heating the screed plate **202**. In an embodiment, the heating element **220** may switch to the de-energized state upon determining that the screed plate **202** has reached a desired temperature.

In an embodiment, the heating element **220** may be controlled by an electric logic circuit. For example, the heating element **220** may be configured to heat the screed plate **202** to the desired temperature. The heating element **220** may receive a feedback of the temperature of the screed plate **202**, and regulate accordingly to maintain the screed plate **202** at the desired temperature. In another embodiment, the heating element **220** may change into the de-energized state based on its own temperature.

As shown in FIG. **2**, the screed plate **202** is provided with one or more temperature sensors **222** configured to provide a temperature of the screed plate **202**. In one embodiment, the temperature sensors **222** may be disposed on each of the screed plates **202** of the screed assembly **110**. Additionally or optionally, the temperature sensors **222** may be disposed at multiple locations on each of the screed plates **202**.

In another embodiment, the temperature sensor **222** may be provided on one of the screed plate **202** that is more prone to wear based on the application of the machine **100**. It may be contemplated to provide the temperature sensor **222** at any suitable location on the screed plate **202** to enable measuring of the temperature of the screed plate **202**. Alternatively, the temperature sensor **222** may be suitably disposed on the heating element **220**. In another embodiment, the temperature sensor **222** may form part of the heating element **220** or integrated therein.

In one embodiment, the temperature sensor **222** is a thermocouple. Alternatively, the temperature sensor **222** may be any other appropriate device that is capable of measuring the temperature of the screed plate **202**. In one embodiment, the heating element **220** may be in communication with the temperature sensor **222**. The heating element **220** may utilize a feedback provided by the temperature sensor **222** to regulate the temperature of the screed plate **202**. Further, the temperature sensor **222** may be encased inside a housing (not shown) to protect internal components from the foreign particles.

As shown in FIG. **1** and FIG. **2**, the machine also includes a controller **224**. The controller is configured to monitor a condition of the paving machine **100**. In an embodiment, the controller **224** is an electronic control module of the machine **100**. The controller **224** may include a microprocessor, an application specific integrated circuit ("ASIC"), or other appropriate circuitry and may have a memory or other data storage capabilities. The controller **224** may include functions, steps, routines, data tables, data maps, charts and the like saved in and executable from read only memory to monitor the productivity of the paving machine **100**.

Although, the controller **224** is illustrated as a single, discrete unit, in other embodiments the controller **224** and its functions may be distributed among multiple distinct and separate components. The controller **224** may also be operatively associated with various other components of the machine **100**, such as actuators associated with the screed assembly **110**.

Communication between the controller **224** and the other electrical components such as the temperature sensor **222**, heating element **220** may be established by sending and receiving digital or analog signals across electronic communication lines or communication busses, including by wireless communication.

The controller **224** is configured to determine a heat-up time for the screed plate **202**. More specifically, the controller **224** may determine a time required for the screed plate **202** to reach a predetermined temperature. In one example, the predetermined temperature may be the desired temperature for the screed plate **202** at which a required quality of the mat may be obtained as discussed above.

The predetermined temperature may be set for the paving machine **100** based on various parameters related to a type and density of the material used, a geometry of the screed plates **202** and the like. In an embodiment, the controller **224** may be configured to provide an energizing signal for commanding the heating element **220** to heat the screed plate **202** and a de-energizing signal for commanding the heating element **220** to turn off. Accordingly, the heating elements **220** may be configured to heat the screed plates **202** to the predetermined temperature. For example, the heating elements **220** may be energized to start heating of the screed plates **202**. Further, the heating elements **220** may be de-energized to cease heating of the screed plate **202** upon reaching the predetermined temperature.

In one embodiment, the controller **224** may determine the heat-up time based on signals received from the temperature sensor **222**. The controller **224** may utilize temperature signals at each of a starting and ceasing of heating the screed plate **202** to determine the heat-up time. For example, a software logic may be implemented by the controller **224** and/or the temperature sensor **222** to determine when the heating of the screed plate **202** started and when the heating ceased. The time duration between the starting and ceasing of the heating may be determined as the heat-up time. Moreover, the controller **224** may utilize a rate of change of temperature of the screed plate **202** to determine the heat-up time for the screed plate **202**.

In an embodiment, the controller **224** may receive signals from the multiple temperature sensors **222** disposed at various locations on the screed plate **202**. In such a case, the controller **224** may determine a heat-up time for each of the locations of the screed plate **202**. Further, the controller **224** may consider the lowest heat-up time as the heat-up time for the screed plate **202**.

In another embodiment, the controller **224** may determine the heat-up time based on signals communicated to the heating element **220**. The controller **224** may be configured to monitor the energizing and de-energizing sate of the heating element **220**. For example, the controller **224** may monitor an ON signal and an OFF signal of the heating element **220**. Accordingly, the controller **224** may determine the heat-up time based on a time taken to switch from the energized state or the ON-signal to the de-energized state or the OFF signal respectively.

In yet another embodiment, the system may further include a timer **226** communicably coupled with the controller **224**. In an example, the timer **226** may be integrated with the controller **224**. In an embodiment, the controller **224** may start the timer **226** when the heating of the screed plate **202** started. Further, the timer **226** may end the timer **226** when the heating of the screed plate **202** is ceased. Alternatively, the controller **224** may receive readings of the timer **226** when the heating of the screed plate **202** and started and ceased.

In one embodiment, the controller **224** may determine that the heating of the screed plate **202** started and/or that the heating of the screed plate **202** is ceased based on the signals from the temperature sensor **222**. In another embodiment, the controller **224** may determine that the heating of the screed plate **202** started and/or that the heating of the screed plate **202** is ceased based on the signals from the heating element **220**, for example, the ON-signal, the OFF-signal.

In yet another embodiment, the controller **224** may utilize a combination of the signals received each from the heating element **220** and the temperature sensor **222** to determine that starting and ceasing or end of the heating of the screed plate **202**.

Further, the controller **224** may compare the heat-up time to a predetermined time. In an embodiment, the controller **224** may retrieve the predetermined time from a memory. In an example, the predetermined time is a time period required for heating the screed plate **202** to the predetermined temperature, when the screed plate **202** is in a healthy state and have not worn out. The screed plate **202** of a certain thickness or a volume may take the predetermined time to heat-up. However, due to wear or other factors, an effective volume of the screed plate **202** may decrease. As such, as the thickness or the volume of the screed plate **202** decreases, less amount of time may be taken to heat the screed plate **202**.

In an embodiment, the controller **224** may calculate the predetermined time corresponding to that particular machine **100**, based on a historic data. For example, the controller **224** may monitor the time taken for the screed plate **202** to heat for a number of times, along with other parameters such as, ambient temperature etc. Accordingly, based on these historic heat-up times, the controller **224** may calculate the predetermined time. In a further embodiment, the controller **224** may continuously monitor a heat-up time of the screed plate **202** and compare the new heat-up time value with the old ones. The controller **224** may accordingly, determine if there is a significant change in the new heat-up time compared to the old ones.

As such, the controller **224** may compare the heat-up time to the predetermined time. Further, the controller **224** may provide a signal indicating that the screed plate **202** needs to be replaced if the heat-up time is less than or equal to the predetermined time. The decrease in heat-up time may be due to decrease in thickness of the screed plate **202** due to wear, tear or damage during an operation of the machine **100**.

In yet another embodiment, the controller **224** may determine the heat-up time as a rate of change of temperature of the screed plate **202**. For example, the controller **224** may determine the heat-up time as a slope of a time Vs temperature plot, wherein the temperature values of the screed plate **202** are received at different time intervals. In such a case, the predetermined time may also correspond to a rate of change of temperature of the screed plate **202**. In an example, as discussed above, the predetermined time may be determined based on the historic data of the screed plate **202**.

In an embodiment, the controller **224** may monitor the rate of change of the temperature of the screed plate **202**. Further, the controller **224** may determine if the screed plate **202** is worn based on the rate of change of the temperature of the screed plate **202**. For example, the controller **224** may determine that the screed plate **202** needs to be replaced, if there is a significant increase in the rate of change of temperature of the screed plate **202** over time.

It should be noted that, although the concepts herein are described for one screed plate **202**, it may be envisioned that the controller **224** may implement the similar concepts and methodologies to one or more of the screed plates **202** of the screed assembly **110** as needed. For example, the controller **224** may determine the heat-up time for each of the screed plates **202**. Further, the controller may compare the heat-up times with the respective predetermined times to determine if the corresponding screed plate **202** needs to be replaced.

In one embodiment, the controller **224** may provide an alert on a display device in the operator station **114**. In another embodiment, the controller **224** may communicate the signal regarding the condition of the paving machine **100** to an operator, or some remote personnel equipped with a computer or a mobile device. These personnel can include job-site foreman, paver operators, paver owners, inspectors etc.

In an embodiment, the controller **224** may implement the algorithm described above continuously and determine the heat-up time whenever, the screed plate **202** is being heated. Alternatively, the controller **224** may implement the algorithm periodically.

INDUSTRIAL APPLICABILITY

With use and implementation of the controller **224** of the present disclosure, the condition of the paving machine **100** may be determined. Specifically, the controller **224** is configured to determine when the screed plates **202** of the machine **100** needs to be replaced. Moreover, the controller **224** analyses the usual process of heating the screed plate **202** to determine if the screed plate **202** needs to be replaced. Further, by disposing the temperature sensors **222** on the screed plates **202**, a temperature of the screed plates **202** is determined, and based on which the life of the screed plate **202** is determined.

Referring to FIG. **3**, the present disclosure is also related to a method **300** of monitoring a condition of a paving machine **100**. In an embodiment, one or more steps of the method may be performed by the controller **224** and other associated components of the machine **100**. The method **300** will be explained hereinafter in conjunction with the paving machine **100**, however, it may be contemplated to implement the concepts of the method **300** to any other paving machine **100** without deviating from the scope of the present disclosure.

At step **302**, the method **300** includes, determining the heat-up time of the screed plate **202**. In one embodiment, the heat-up time may be determined based on the signals receiving through the temperature sensor **222**. The starting time and ending time of heating the screed plate **202** may be determined by a suitable software logic implemented by the controller **224** and/or the temperature sensor **222**. Accordingly, based on the temperature signals received at the starting time and the ending time, the heat-up time may be determined.

In another embodiment, the heat-up time may be determined based on the signals from the heating element **220**. For example, the heat-up time may be determined based on how long the heating element **220** is energized. Accordingly, the ON-signal or the energizing signal and the OFF signal or the de-energizing signal may be monitored and time duration between them may be determined as the heat-up time. In some cases, an offset may be added to the time duration between the energizing signal and the de-energizing signal to account for any lag in transfer of heat from the heating element **220** to the screed plate **202**.

In yet another embodiment, the heat-up time may be determined based on a time required for the temperature of the screed plate **202** to reach the predetermined temperature. In such a case, the readings on the timer **226** at the start of heating the screed plate **202** and when the temperature reaches the predetermined temperature may be noted to determine the heat-up time.

Other combinations of methods such as using the temperature signal to determine the start of heating and using the signal from the heating element **220** to determine end of the heating may be used to determine the heat-up time. Moreover, multiple heat-up times may be calculated based on the methodologies described according to various embodiments. Further, the lowest among these may be considered as the heat-up time of the screed plate **202**.

At step **304**, the method **300** includes comparing the heat-up time to the predetermined time. At step **306**, the method includes providing a signal indicating that the screed plate **202** needs to be replaced if the heat-up time is less than or equal to the predetermined time. The screed plate **202** may present a less volume for the heating element **220** to heat the screed plate **202** upon wear and/or tear. As such, the screed plate **202** of considerably less volume may require less time to heat-up. Such a determination may be used to determine the condition of the screed plates **202**.

Moreover, all the screed plates **202**A, **202**B, **202**C, **202**D or the screed plates **202** that are more prone to wear may be equipped with the temperature sensors **222**. Further, the life of these screed plates **202** may be determined with implementation of the method and/or the system. The condition of the screed plate **202** may be determined during normal operation of the machine and by using existing process of heating the screed plates **202**. As such, non-operational time of the machine to check the screed plates **202** separately may be reduced.

While aspects of the present disclosure have been particularly shown and described with reference to the embodiments above, it will be understood by those skilled in the art that various additional embodiments may be contemplated by the modification of the disclosed machines, systems and methods without departing from the spirit and scope of what is disclosed. Such embodiments should be understood to fall within the scope of the present disclosure as determined based upon the claims and any equivalents thereof.

What is claimed is:

1. A system for monitoring a condition of a paving machine, the system comprising:
- a screed plate;
- a heating element for heating the screed plate; and
- a controller configured to:
  - determine a heat-up time for the screed plate;
  - compare the heat-up time to a predetermined time; and
  - provide a signal indicating that the screed plate needs to be replaced if the heat-up time is less than or equal to the predetermined time.

2. The system of claim **1** further comprising a temperature sensor for providing a screed plate temperature.

3. The system of claim **2**, wherein the controller is further configured to:
- receive a signal indicative of the screed plate temperature from the temperature sensor; and
- determine the heat-up time based on the signal received from the temperature sensor.

4. The system of claim **2**, wherein the temperature sensor includes a plurality of temperature sensors disposed on multiple locations on the screed plate.

5. The system of claim **4**, wherein the controller is further configured to:
- receive, from the plurality of temperature sensors, a plurality of temperatures corresponding to multiple locations on the screed plate;
- determine individual time durations of each of the plurality of temperatures corresponding to the multiple locations to reach a predetermined temperature; and
- determine the heat-up time of the screed plate as a lowest time duration among the individual time durations.

6. The system of claim **1**, wherein the controller is further configured to provide an energizing signal for commanding the heating element to heat the screed plate and a de-energizing signal for commanding the heating element to turn off, and the controller determines the heat-up time based on the energizing signal and the de-energizing signal from the heating element.

7. The system of claim **1**, wherein the controller is configured to determine the heat-up time based on a time required for a screed plate temperature to reach a predetermined temperature.

8. The system of claim **1**, wherein the controller is configured to determine the heat-up time based on a starting time and an end time for heating the screed plate.

9. The system of claim **8**, wherein the controller is configured to determine the starting time based on at least one of an energizing signal from the heating element and a signal from a temperature sensor disposed on the screed plate.

10. The system of claim **8**, wherein the controller is configured to determine the end time based on at least one of a de-energizing signal from the heating element and a signal from a temperature sensor disposed on the screed plate.

11. A method of monitoring a condition of a paving machine, the method comprising:
- determining a heat-up time for a screed plate of the paving machine;
- comparing the heat-up time to a predetermined time; and
- providing a signal indicating that the screed plate needs to be replaced if the heat-up time is less than or equal to the predetermined time.

12. The method of claim **11** further comprising:
- receiving a signal indicative of a temperature of the screed plate from a temperature sensor disposed on the screed plate; and
- determining the heat-up time based on the signal from the temperature sensor.

13. The method of claim **11**, wherein the heat-up time is determined based on a time required for a temperature of the screed plate to reach a predetermined temperature.

14. The method of claim **11** further comprising receiving at least one of an energizing signal and a de-energizing signal from a heating element, the heating element configured to heat the screed plate.

15. The method of claim **14**, wherein the heat-up time is determined based on a time duration between the energizing signal and the de-energizing signal.

16. The method of claim **14**, wherein the heat-up time is determined based on a combination of signals from a temperature sensor and the signals from the heating element.

17. A system for monitoring a condition of a screed plate of a paving machine, the system comprising:
- a heating element for heating the screed plate; and
- a controller configured to:
  - determine a heat-up time for the screed plate;
  - compare the heat-up time to a predetermined time; and
  - provide a signal indicating that the screed plate needs to be replaced if the heat-up time is less than or equal to the predetermined time.

18. The system of claim **17** further comprising a temperature sensor for providing a screed plate temperature, wherein the controller is further configured to:
- receive a signal indicative of the screed plate temperature from the temperature sensor; and
- determine the heat-up time based on the signal received from the temperature sensor.

19. The system of claim **17**, wherein the controller is further configured to provide an energizing signal for commanding the heating element to heat the screed plate and a de-energizing signal for commanding the heating element to turn off, and the controller determines the heat-up time based on the energizing signal and the de-energizing signal from the heating element.

20. The system of claim **17**, wherein the controller is configured to determine the heat-up time based on a time required for a screed plate temperature to reach a predetermined temperature.

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