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(54) Method and stationery system for monitoring equipment of a railway vehicle

(57) The present invention relates to a method for automatically monitoring equipment of a railway vehicle (1) with a stationary monitoring system (50), the railway vehicle including at least one equipment (12, 14, 16, 18, 20, 22, 24, 26 28, 30, 80) to be monitored that is arranged to be visible from the outside of the railway vehicle, wherein the method comprises: acquiring at least one visual image of the railway vehicle (1) from the stationary monitoring system (50) such that at least a portion of the at least one equipment (12, 14, 16, 18, 20, 22, 24, 26 28, 30, 80) is represented; acquiring at least one thermal image of the railway vehicle (1) from the stationary monitoring system (50) such that the at least a portion of the at least one equipment (12, 14, 16, 18, 20, 22, 24, 26 28, 30, 80) is represented, wherein the position of an object on the thermal image has predetermined relationship to the position of the same object on the visual image; determining the at least one equipment on the at least one visual image and/or on a first picture generated using the at least one visual image; and determining a thermal information of the at least one equipment (12, 14, 16, 18, 20, 22, 24, 26 28, 30, 80) using the predetermined relationship between the thermal image and the visual image. Further the present invention relates to a stationary system adapted to perform the method according to the invention.

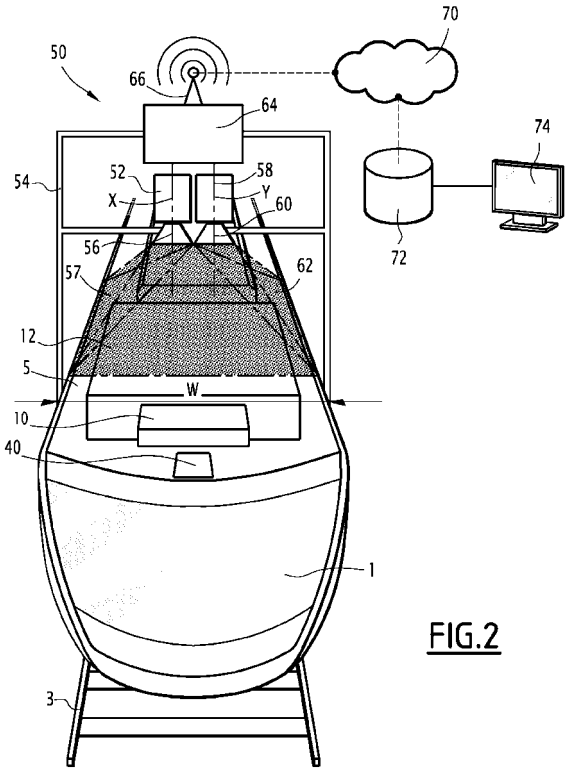

FIG.2

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Description

[0001] The present invention relates to a method for automatically monitoring equipment of a railway vehicle with a stationary monitoring system, the railway vehicle including at least one equipment to be monitored that is arranged to be visible from the outside of the railway vehicle. Further, the present invention relates to a stationary system being stationary with respect to the ground for monitoring equipment of a railway vehicle including at least one equipment to be monitored that is arranged to be visible from the outside of the railway vehicle, the system comprising a visual camera having a first field of view and a controller adapted to control the visual camera, wherein the visual camera is arranged such that that the at least one equipment passes through the first field of view, when the railway vehicle passes the visual camera.

[0002] An efficient maintenance management program is important, where maintenance is required for very complex railway vehicles, for example trains and tramways. Maintenance management for such units has to comply with a number of requirements and has to be fitted, for example, into strict time-tables.

[0003] WO 2010/086045 A2 discloses a monitoring arrangement for monitoring the operating state and wear state of a slip contact device of a pantograph. For this purpose, a camera is provided on a mast, so that an image can be captured of the slip contact device. For triggering the camera, a light barrier or a mechanical contact is used. The captured images may be transmitted via a network to a computer, so that the computer or a human operator analyses the pictures. However, such systems only detect visual defects or the wear of the slip contact device.

[0004] JP 2004/312832 discloses a solution for monitoring a pantograph shoe thickness and roof top equipment by photographing. The photographing apparatus for the pantograph shoe thickness measuring needs different light conditions compared to the photographing apparatus for the roof top equipment monitoring. Both photographing apparatus are installed on the same support structure so that the acquisition of images of the pantograph and the roof top equipment does not disturb each other.

[0005] CN 101762327 discloses an infrared temperature monitoring method and system for a catenary contact. The system acquires a visible picture with contact information and a thermal image graph temperature data by using an infrared temperature monitoring device. When a defect is found, the system triggers an alarm. This system is arranged on a moving vehicle.

[0006] Object of the invention is to provide a method and a system for monitoring equipments of a railway vehicle that simplifies a condition based maintenance of the monitored equipment.

[0007] In the light of above, the method for automatically monitoring equipment of a railway vehicle with a stationary monitoring system is provided, the railway vehicle including at least one equipment to be monitored that is arranged to be visible from the outside of the railway vehicle, wherein the method comprises:

acquiring at least one visual image of the railway vehicle from the stationary monitoring system such that at least a portion of the at least one equipment is represented;

acquiring at least one thermal image of the railway vehicle from the stationary monitoring system such that the at least a portion of the at least one equipment is represented,

wherein the position of an object on the thermal image has predetermined relationship to the position of the same object on the visual image;

determining the at least one equipment on the at least one visual image and/or on a first picture generated using the at least one visual image; and

determining a thermal information of the at least one equipment using the predetermined relationship between the thermal image and the visual image.

[0008] According to an embodiment, the method further comprises temporally synchronizing the acquisition of the visual image and the acquisition of the thermal image.

[0009] According to another embodiment, the method further includes, generating the first picture from a plurality of visual images and/or generating a second picture from a plurality of thermal images, wherein the thermal information is determined based on the second picture.

[0010] According to an embodiment, which may be combined with other embodiments, the method further includes: identifying the railway vehicle and/or the type of the railway vehicle, in particular by identifying and recognizing a visual tag disposed on the railway vehicle on the at least one visual image and/or the first picture, wherein the visual tag includes information to identify the railway vehicle and/or the type of the railway vehicle.

[0011] According to an embodiment, which may be combined with other embodiments, the method further includes: a position determination comprising an object recognition for identifying the at least one equipment on the at least one visual image and/or on the first picture, and/or for identifying the position of the at least one equipment based on the at least one visual image and/or the first picture, wherein in particular the object recognition is a shape recognition.

[0012] According to an embodiment, which may be combined with other embodiments, the position determination further includes: providing predetermined localisation information comprising the position of the at least one equipment on the railway vehicle and/or the type of railway vehicle; determining a section on the at least one visual image and/or first picture, where the at least one equipment is supposed to be located based on the localisation information; and performing the object recognition on the determined section.

[0013] According to an embodiment, which may be combined with other embodiments, the method further includes: determining the speed of the railway vehicle; and adapting shutter speeds for acquiring visual images and thermal images based on the speed of the railway vehicle.

[0014] According to an embodiment, which may be combined with other embodiments, the at least one equipment is selected of the group consisting of: an air conditioning, a circuit breaker, a low tension cabinet, a motor supply cabinet, an inverter cabinet, a motor cooling system, a braking rheostat, a battery cabinet, a battery power switch, and a static converter.

[0015] According to an embodiment, which may be combined with other embodiments, the method further includes: sending the thermal information of the at least one equipment to a remote server.

[0016] Further, a stationary system being stationary with respect to the ground for monitoring equipment of a railway vehicle including at least one equipment to be monitored that is arranged to be visible from the outside of the railway vehicle is provided, the system includes a visual camera having a first field of view and a controller adapted to control the visual camera, wherein the visual camera is arranged such that that the at least one equipment passes through the first field of view, when the railway vehicle passes the visual camera, wherein the system further includes a thermal camera having a second field of view, wherein the first field of view and the second field of view have a predetermined relationship, such that the position of an object on an thermal image acquired by the thermal camera has predetermined relationship the position of the same object on an visual image acquired by the visual camera, and wherein the thermal camera is arranged such that that the at least one equipment of the railway vehicle passes through the second field of view, when the railway vehicle passes the thermal camera; wherein the controller is further adapted to control the thermal camera; and wherein the system is adapted to acquire at least one visual image and at least one thermal image of the railway vehicle such that the at least a portion of the at least one equipment is represented on the visual image and the thermal image, adapted to determine at least one equipment on the at least one visual image and/or on a first picture generated using the at least one visual image, and adapted to determine the thermal information of the at least one equipment using the predetermined relationship between the thermal image and the visual image.

[0017] According to an embodiment, which may be combined with other embodiments, the visual camera and the thermal camera are disposed to acquire images of the roof of the railway vehicle.

[0018] According to an embodiment, which may be combined with other embodiments, the system further comprises a communication device connected to the controller, wherein the communication device is adapted to provide the thermal information to a remote server.

[0019] According to an embodiment, which may be combined with other embodiments, the thermal camera and the visual camera have respectively an optical axis, which are substantially parallel.

[0020] According to an embodiment, which may be combined with other embodiments, wherein the system is adapted to perform a method according an embodiment disclosed herein.

[0021] Further advantages, features, aspects and details are evident from the dependent claims, the description and the drawings. The accompanying drawings relate to embodiments of the invention and are described in the following:

- Figure 1 is a schematical top view of a railway vehicle;
- Figure 2 is a schematical illustration of the system according to the invention;
- Figure 3 shows schematically an image captured by the visual camera;
- Figure 4 shows schematically an image captured by the thermal camera at the same time as the visual image of Fig. 3; and
- Figure 5 shows a flow chart of an embodiment of a method according to the invention.

[0022] The invention relates to a method and a system for monitoring equipment of a railway vehicle. For example, a railway vehicle may be a tramway or a train, for example a high speed train, an underground train, a suburban train or the like.

[0023] Figure 1 shows a schematically a top view of a railway vehicle 1 rolling on rails 3. The railway vehicle 1 of the embodiment shown in Figure 1 is a tramway.

[0024] The railway vehicle 1 has a roof 5. Equipment for the operation of the railway vehicle 1 is disposed on the roof. For example, close to the driver cabin an air-conditioning 10 for the driver cabin is arranged. Further, a low tension cabinet 12, an inverter cabinet 14, a motor supply cabinet 16, a motor cooling system 18, a passenger air-conditioning 20 for cooling the passenger cabin, a breaking rheostat 22, a battery power switch 24, a battery cabinet 26, a static convertor 28 and a general circuit breaker 30, which is ranged close to the pantograph 32, are arranged on the roof of the railway vehicle 1. The equipments 10, 12, 14, 16, 18, 20, 22, 24, 26, 28, 30 are arranged at different positions on the roof and/or are enclosed respectively in a housing. Typically, each type of equipment or its housing has a specific shape. The equipment or the housings of the equipment are arranged such that they are visible from the exterior of the railway vehicle. In the following, for describing the invention, the term 'equipment' is used to designate the equipment or the housing of the equipment if the equipment is arranged in a housing.

[0025] The equipments have different operating temperatures and may fail if specific parts of the equipment overheat. In another example, the operational state of

one of these equipments slowly degrades so that the operating temperature slowly increases. This may give a hint that this equipment may fail soon. Thus, the equipment may be replaced or repaired before such a failure occurs. Such condition based maintenance generally improves the availability of the railway vehicle 1. In other embodiments, also the temperature distribution on the surface of the equipment may give a hint of a required maintenance of this equipment. Therefore, the temperature of the equipments 10 to 30 is monitored.

[0026] Further, according to an embodiment of the invention, an identifying tag 40 is provided on the roof 5, preferably at one end of the railway vehicle 1 in the driving direction. In the embodiments two or more identifying tags are provided on the roof. In the embodiment of Figure 1, an identifying tag 40 is provided at each end of the railway vehicle 1. In an embodiment the identifying tag 40 is an adhesive label. In other embodiments, the identifying tag 40 is painted on the roof 5 of the railway vehicle 1.

[0027] The identifying tag 40 includes a signs that enable automatic optical identifying of the railway vehicle 1 by an image processing device. In an embodiment, the identifying tag 40 includes information to determine the type of the railway vehicle 1.

[0028] The identifying tag 40 is used to provide the system for monitoring the equipment of the railway vehicle information about the identity and/or the type of the railway vehicle 1. In other embodiments, this information may be provided to the system via other means, for example via an RFID (Radio Frequency Identification) tag may be attached to the railway vehicle 1, or a radio link.

[0029] Figure 2 shows schematically the system 50 for a monitoring equipment of the railway vehicle 1. The system 50 for monitoring the equipment of the railway vehicle 1 comprises a visual camera 52, which acquires images in visual wavelength. The system 50 is stationary with respect to the ground.

[0030] The visual camera 52 is mounted on a support frame 54, such that it can acquire images of the equipment to be monitored and, in an embodiment, also the indentification tag 40, which are in the embodiments shown in Figures 1 and 2 arranged on the roof 5 of the railway vehicle 1. Thus, the visual camera 52 is mounted above the rails 3. The visual camera has an objective 56 having an optical axis X being arranged substantially orthogonal to the roof 5 of the railway vehicle 1 and/or the rails 3. The visual camera 52 is arranged and has a large field of view 57 such that it can acquire with a single image at least the complete width W of the roof 5 of the railway vehicle 1. Generally, the field of view 57 is selected, such that when the railway vehicle passes by, images of all equipment 10 to 30 to be monitored have been acquired, without moving the optical axis X of the camera 52. In an embodiment, a wide angle objective 56, for example fisheye objective, is used for that purpose.

[0031] The system 50 comprises further a thermal camera 58, for example an infrared camera, which is also mounted on the support frame 54. The thermal camera 58 acquires thermal images of the roof 5 of the railway vehicle, such that the temperature of the equipment to be monitored on the roof 5 can be identified. Typically, the thermal camera can only detect the relative temperature between different portions of the image. However, if the thermal camera 58 is calibrated, for example if a reference temperature is known, also the absolute temperature of the equipment may be identified.

[0032] The thermal camera 58 has an objective 60, which defines an optical axis Y. In the embodiment shown in Fig. 2, the optical axis Y of the thermal camera 58 is substantially parallel to the optical axis X of the visual camera 52. The objective 60 provides a field of view 62, which is substantially the same field of view 57 of the visual camera 52. The thermal camera 58 is arranged and has a large field of view 62 such that it can acquire with a single image at least the complete width W of the roof 5 of the railway vehicle 1. Generally, the field of view 62 is selected, such that when the railway vehicle passes by, images of all equipment to be monitored have been acquired, without moving the optical axis Y of the thermal camera 58

[0033] In an embodiment, the cameras 52, 58 comprise a device, for example a mirror system with at least one semitransparent mirror, such that their field of view 57, 62 is identical.

[0034] The images acquired by the cameras 52, 58 have a fixed, predetermined relationship due to the fixed arrangement of the cameras 52, 58. For example, the position of an object on an image acquired by the visual camera 52 can be determined, and subsequently the position of that object on the thermal image acquired by the thermal camera 58 can be calculated based on the position determined on the image of the visual camera 52. The position on the thermal image is therefore a function of the position on the visual image.

[0035] Further, the system 50 includes a controller 64 mounted on the support frame 54 and connected to the visual camera 52 and the thermal camera 58, which is adapted to control the visual camera 52 and the thermal camera 58. In an embodiment, the control device 64 is adapted to temporally synchronize the acquisition of images of the visual camera 52 and the thermal camera 58. For example, the synchronization is performed by synchronizing the clocks of the visual camera 52 and the thermal camera 58.

[0036] In an embodiment, the controller 64 is adapted to control the shutter speeds of the cameras 52, 58, such that they are adapted to the speed of the railway vehicle 1 passing by under the cameras 52, 58.

[0037] In an embodiment, the controller 64 is adapted to analyze and to process the images provided by the visual camera 52 and the thermal camera 58. For example, in conjunction with images acquired by the visual camera 52, the controller 64 is adapted to identify the railway vehicle 1 and/or the type of the railway vehicle

using the identification tag 40. The controller 64 is adapted to recognize the equipments 10 to 30 mounted on the roof 5 of the railway vehicle 1, which is detailed later, and to determine for each equipment the respective temperature or temperature pattern using the thermal image. The temperature or temperature pattern is hereafter also called temperature information.

[0038] The system 50 further comprises a radio transmitting device 66, for example a modem, like an UMTS (Universal Mobile Telecommunications System) modem, a GPRS (General Packet Radio Service), etc., connected to the controller 64 to enable the controller 64 to provide the thermal information of the equipment 10 to 30 to be monitored of the railway vehicle 1 and/or the acquired images via the internet 70 to a server 72. In other embodiments, the controller 64 is adapted to connect to the server 72 using a fixed telephone network or another fixed network.

[0039] The server 72 is adapted to store at least partially the information provided by the controller 64 in a data base. Further, the server 72 is adapted, in an embodiment, to perform an interpretation of the acquired temperature information of the equipment of the railway vehicle 1. For example, the server 72 may compare the temperature information of a selected equipment with a reference temperature information and may decide based on the result whether a maintenance has to be performed. In an embodiment, the server 72 triggers an alarm if the temperature of a specific device is over predetermined level.

[0040] In another embodiment, the server 72 is adapted to interpolate thermal information acquired at different times of an equipment to forecast and plan a maintenance date. The server 72 is, in a further embodiment, adapted to calculate statistics based on the thermal information of the monitored equipment. The results of the calculations of the server 72 are presented by the server 72 on a display 74.

[0041] In other embodiments, the images acquired by the cameras 52 to 58 are transmitted by the controller 64 via the internet 70 to the server 72, which then performs be tasks of the image recognition and temperature information determination of the equipment.

[0042] The system 50 is statically mounted and not moving during operation. In an embodiment, the support frame 54 with the cameras 52 and 58 is ranged close to a railway station, so that the speed of the railway vehicle 1 is reduced. In an embodiment, the cameras 52, 58 and the controller 64 can be also mounted on another support structure, which is stationary during acquisition of the images, for example a bridge or a tunnel wall.

[0043] Figure 3 shows a visual image captured by the visual camera 52 of the roof 5 of the railway vehicle 1. The image shows an equipment 80 to be monitored mounted on the roof 5. The equipment 80 may be one of the equipments 10 to 30 listed with respect to Figure 1. The equipment 80 has a substantially rectangular shape 82. Figure 4 shows the thermal image required at the same time of the roof 5 of the railway vehicle 1. Thus, the images of Figures 3 and 4 show substantially the same section of the roof 5 of the railway vehicle 1. Figures 3 and 4 will be further explained in conjunction with the method according to the invention detailed below.

[0044] Figure 5 shows shematically a flow chart of an embodiment of a method for automatically monitoring equipment of a railway vehicle.

[0045] In step 100, the approach of the railway vehicle is detected. For example, the visual camera 52 is always running and the controller 64 detects when a railway vehicle 1 is entering the field of view 57 of the visual camera 52. For example, the image of the visual camera 52 is static, i.e. showing only the rails 3, until the railway vehicle 1 enters the field of view 57. Thus, when the railway vehicle enters the field of view 57, the content of the acquired images changes over the time. This change is detected by the controller 64.

[0046] At the same time, the controller 64 determines the speed of the railway vehicle 1 and selects shutter speeds of the visual camera 52 and the thermal camera 58 based on the speed of the railway vehicle 1. For example, if the speed of the railway vehicle 1 is increasing a respective short shutter speed has to be selected to obtain a sufficient sharp image.

[0047] Typically, the system 50 is arranged at a train station, such that the speed of the railway vehicle 1 is relatively low, for example between 10 to 15 km/h. In another embodiment, a minimum speed can be fixed, for example 1 km/h. In other embodiments, the speed can be higher than 15 km/h. In such embodiments, the cameras 52, 58 and the controller 64 are adapted to acquire images at a higher frequency than with lower speeds, for example around 10 km/h.

[0048] In other embodiments, also other devices may be used to detect the approach of the railway vehicle 1. For example, an induction contact arranged in the rails, a capacitor sensor or a distance measuring device may be used for that purpose that are connected to the controller 64 and in particular used to trigger the visual camera 52 and the thermal camera 58..

[0049] In step 102, the thermal camera 58 is activated by the controller 64. When the system uses another detection method than image processing of the visual camera for detecting the approach of the railway vehicle, also the visual camera 52 is activated in step 102. Both cameras 52, 58 remain activated and acquire images until the railway vehicle has passed.

[0050] In step 104, the railway vehicle 1 is identified by identifying on the visual images acquired by the visual camera 52 the identifying tag 40 disposed on the roof 5 of the railway vehicle 1. For that purpose, the controller 64 performs an image recognition on the visual images. Typically, the approximate position of the identifying tag 40 is known by the controller and identical for each railway vehicle to accelerate the identification procedure. The identifying step 104 may be also performed after step 106. In other embodiments, the train may be iden-

tified by other devices, for example a radio frequency identification (RFID) tag disposed on the railway vehicle 1. In that case, the controller 64 is connected to a device for emitting radio frequency signals and receiving the response of the radio frequency identification tag.

[0051] In an embodiment, the railway vehicle identification is used to determine the type of the railway vehicle 1 passing by.

[0052] As an option, in an embodiment, an image undistortion step is carried out after the acquisition of the images by the visual and the thermal camera 52, 58. The image undistortion should compensate the distortion generated by the objectives 56, 60 and/or enable an assembling of the images to a single picture showing the complete roof 5 of the railway vehicle 1. In an embodiment, the undistortion step is alternatively or additionally compensating the different perspectives of the cameras 52, 58, such that the position on the visual image of an object acquired by the visual camera is after the undistortion step corresponds to the position on the thermal image after the undistortion step. Thus, later, a calculation of the position on the thermal image for each equipment may be avoided, as after such an undistortion step the positions are identical. Also, in an embodiment, the thermal and the visual images can be superimposed after such an undistortion step. Fig. 3 and 4 show schematically an visual image and a thermal image after the undistortion step.

[0053] In step 106, the images of the visual camera 52 and of the thermal camera 58 are respectively assembled together, such that the complete roof 5 of the railway vehicle 1 is provided on a single picture. Preferably, the visual and thermal images are not distorted, e.g. have been subject to the undistortion step. Thus, at the end of the step 106, the controller 64 has generated two pictures, namely a first picture assembled from the visual images required by the visual camera 52, and a second picture assembled by the thermal images acquired by the thermal camera 58. In an embodiment, the first picture and the second picture are subsequently superimposed.

[0054] In step 108, the equipment to be monitored disposed on the roof 5 of the railway vehicle 1 is recognized by the controller 64 using an image recognition, for example an object recognition. In an embodiment, the equipment is recognized on the acquired visual images, the first picture and/or the superimposed picture by an automatic shape recognition of the respective equipment. For example in Figure 3, the equipment 80 may be identified via its rectangular shape 82. Thus, the controller 64 knows exactly the position of the equipment 80 on the roof 5 of the railway vehicle. A similar recognition of the shapes of the respect equipment is performed for the other equipment to be monitored.

[0055] In an embodiment, the controller 64 has a stored a map of the equipments 10 to 30 mounted on the roof of the railway vehicle 1 for each railway vehicle or each type of railway vehicle. Thus, after the railway vehicle 1 or the type or railway vehicle is identified in step 104, the controller 64 loads or consults the respective map. In an embodiment, the map is provided by the server 72. After having loaded the map, the controller 64 knows approximately a section on the roof 5 of the railway vehicle 1, where each equipment to be monitored is disposed. Subsequently, the image recognition as disclosed above is carried out this section. As the section on which the image recognition has to be carried out on the first picture or the visual images is smaller than the complete roof 5 of the railway vehicle, the speed of the image recognition can be improved.

[0056] In step 110, the identified shape 82 of the equipment 80 on the first, visual picture is next transferred to the second, thermal picture, as shown in Figure 4. In case that the undistortion step has been carried out, the shape 82 of the equipment can be simply mapped on the second, thermal picture. Otherwise, a calculation has to be carried out to determine the shape on the second picture based on the shape 82 on the first picture. In case of the usage of a superimposed picture, the shape has not to be transferred to thermal picture as the thermal and the visual information are both included in a single picture.

[0057] In step 112, the temperature information of the equipment 80 is determined. For example, the mean temperature, the maximal temperature, the minimal temperature and/or the temperature pattern of the area enclosed by the shape 82 may be used for this purpose. Hence, the system 50 has determined the temperature information of the equipment 80 to be monitored.

[0058] The temperature information of the equipment 80 and/or the identification of the railway vehicle 1 is sent to the server 72 using the radio transmitting device 66 in step 114.

[0059] The server 72 determines in step 116 by comparing the temperature information of the equipment 80 with a reference temperature information whether maintenance is required and/or may schedule a maintenance. In an embodiment, the reference temperature is fixed by the user or is calculated using the mean of one specified time period. Further, the server 72 may generate an overheating alarm if the maximal temperature of the equipment exceeds a reference temperature. In another embodiment, the server 72 may inform the maintenance personnel only about significant events and may help to solve problems or failure of equipments before it happens.

[0060] Thus according to the invention, temperature information of the equipment mounted on the roof of a railway vehicle is collected in a non intrusive way. The system according to the invention determines automatically the thermal status of the equipment and thus provides the flexibility of an automatic system.

[0061] With the system of the method according to the invention, the maintenance activities may be based on the acquired thermal information and/or the statistical results thereof, such that the efficiency and time response in front of eventualities is improved. Further, the acquired thermal information of the equipment is used for analyz-

ing the behavior of the railway vehicle and its components.

[0062] The automatic monitoring system for roof mounted equipment of a railway vehicle of the invention is based on the visual and thermal vision technologies working in conjunction. Thus, the invention provides a solution to a complex problem in the scope of a predictive maintenance process of railway vehicles by automatic identification of the roof mounted equipment and the thermal inspection thereof without interference into the normal timetable on the rail road, and by providing alarms and statistics in a centralized data base containing the required thermal information for railway vehicle inspected by the system.

Claims

1. Method for automatically monitoring equipment of a railway vehicle (1) with a stationary monitoring system (50), the railway vehicle including at least one equipment (12, 14, 16, 18, 20, 22, 24, 26 28, 30, 80) to be monitored that is arranged to be visible from the outside of the railway vehicle, wherein the method comprises:

   acquiring at least one visual image of the railway vehicle (1) from the stationary monitoring system (50) such that at least a portion of the at least one equipment (12, 14, 16, 18, 20, 22, 24, 26 28, 30, 80) is represented;
   acquiring at least one thermal image of the railway vehicle (1) from the stationary monitoring system (50) such that the at least a portion of the at least one equipment (12, 14, 16, 18, 20, 22, 24, 26 28, 30, 80) is represented, wherein the position of an object on the thermal image has predetermined relationship to the position of the same object on the visual image;
   determining the at least one equipment on the at least one visual image and/or on a first picture generated using the at least one visual image; and
   determining a thermal information of the at least one equipment (12, 14, 16, 18, 20, 22, 24, 26 28, 30, 80) using the predetermined relationship between the thermal image and the visual image.

2. Method according to claim 1, further comprising:

   temporally synchronizing the acquisition of the visual image and the acquisition of the thermal image.

3. Method according to one of the preceding claims further comprising:

   generating the first picture from a plurality of visual images and/or generating a second picture from a plurality of thermal images, wherein the thermal information is determined based on the second picture.

4. Method according to one of the preceding claims, further comprising:

   identifying the railway vehicle (1) and/or the type of the railway vehicle (1), in particular by identifying and recognizing a visual tag (40) disposed on the railway vehicle (1) on the at least one visual image and/or the first picture, wherein the visual tag (40) includes information to identify the railway vehicle (1) and/or the type of the railway vehicle (1).

5. Method according to one of the preceding claim, wherein it includes a position determination comprising an object recognition for identifying the at least one equipment (12, 14, 16, 18, 20, 22, 24, 26 28, 30, 80) on the at least one visual image and/or on the first picture, and/or for identifying the position of the at least one equipment (12, 14, 16, 18, 20, 22, 24, 26 28, 30, 80) based on the at least one visual image and/or the first picture, wherein in particular the object recognition is a shape recognition.

6. Method according to claim 5, wherein the position determination further comprises:

   providing predetermined localisation information comprising the position of the at least one equipment (12, 14, 16, 18, 20, 22, 24, 26 28, 30, 80) on the railway vehicle and/or the type of railway vehicle (1);
   determining a section on the at least one visual image and/or first picture, where the at least one equipment (12, 14, 16, 18, 20, 22, 24, 26 28, 30, 80) is supposed to be located based on the localisation information; and
   performing the object recognition on the determined section.

7. Method according to one of the preceding claims, further comprising:

   determining the speed of the railway vehicle (1); and
   adapting shutter speeds for acquiring visual images and thermal images based on the speed of the railway vehicle.

8. Method according to one of the preceding claims, wherein the at least one equipment is selected of the group consisting of: an air conditioning (10, 20), a circuit breaker (30), a low tension cabinet (12), a mo-

tor supply cabinet (16), an inverter cabinet (14), a motor cooling system (18), a braking rheostat (22), a battery cabinet (26), a battery power switch (24), and a static converter (28).

9. Method according to one of the preceding claims, further comprising:

sending the thermal information of the at least one equipment (12, 14, 16, 18, 20, 22, 24, 26 28, 30, 80) to a remote server (72).

10. Stationary system (50) being stationary with respect to the ground for monitoring equipment of a railway vehicle including at least one equipment (12, 14, 16, 18, 20, 22, 24, 26 28, 30, 80) to be monitored that is arranged to be visible from the outside of the railway vehicle, the system comprising a visual camera (52) having a first field of view (57) and a controller (64) adapted to control the visual camera (52), wherein the visual camera (52) is arranged such that that the at least one equipment (12, 14, 16, 18, 20, 22, 24, 26 28, 30, 80) passes through the first field of view (57), when the railway vehicle (1) passes the visual camera (52), **characterized in that**
the system further comprises a thermal camera (58) having a second field of view (62),
wherein the first field of view (57) and the second field of view (62) have a predetermined relationship, such that the position of an object on an thermal image acquired by the thermal camera has predetermined relationship the position of the same object on an visual image acquired by the visual camera, and wherein the thermal camera is arranged such that that the at least one equipment (12, 14, 16, 18, 20, 22, 24, 26 28, 30, 80) of the railway vehicle (1) passes through the second field of view (62), when the railway vehicle passes the thermal camera (58);
wherein
the controller (64) is further adapted to control the thermal camera (58); and wherein the system is adapted to acquire at least one visual image and at least one thermal image of the railway vehicle such that the at least a portion of the at least one equipment (12, 14, 16, 18, 20, 22, 24, 26 28, 30, 80) is represented on the visual image and the thermal image, adapted to determine at least one equipment on the at least one visual image and/or on a first picture generated using the at least one visual image, and adapted to determine the thermal information of the at least one equipment using the predetermined relationship between the thermal image and the visual image.

11. System according to claim 10, wherein the visual camera (52) and the thermal camera (58) are disposed to acquire images of the roof (5) of the railway vehicle (1).

12. System according to claim 10 or 11, further comprising a communication device (66) connected to the controller (64), wherein the communication device is adapted to provide the thermal information to a remote server (72).

13. System according to any of the claims 10 to 12, wherein the thermal camera (58) and the visual camera (52) have respectively an optical axis (X, Y), which are substantially parallel.

14. System according to any of the claims 10 to 13 adapted to perform a method according to any of the claims 1 to 9.

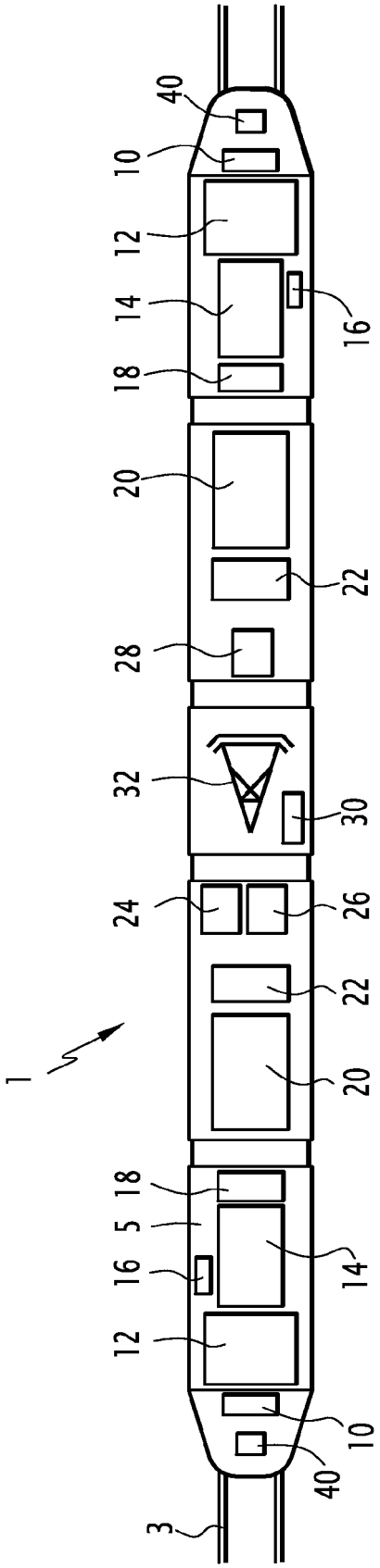

FIG.1

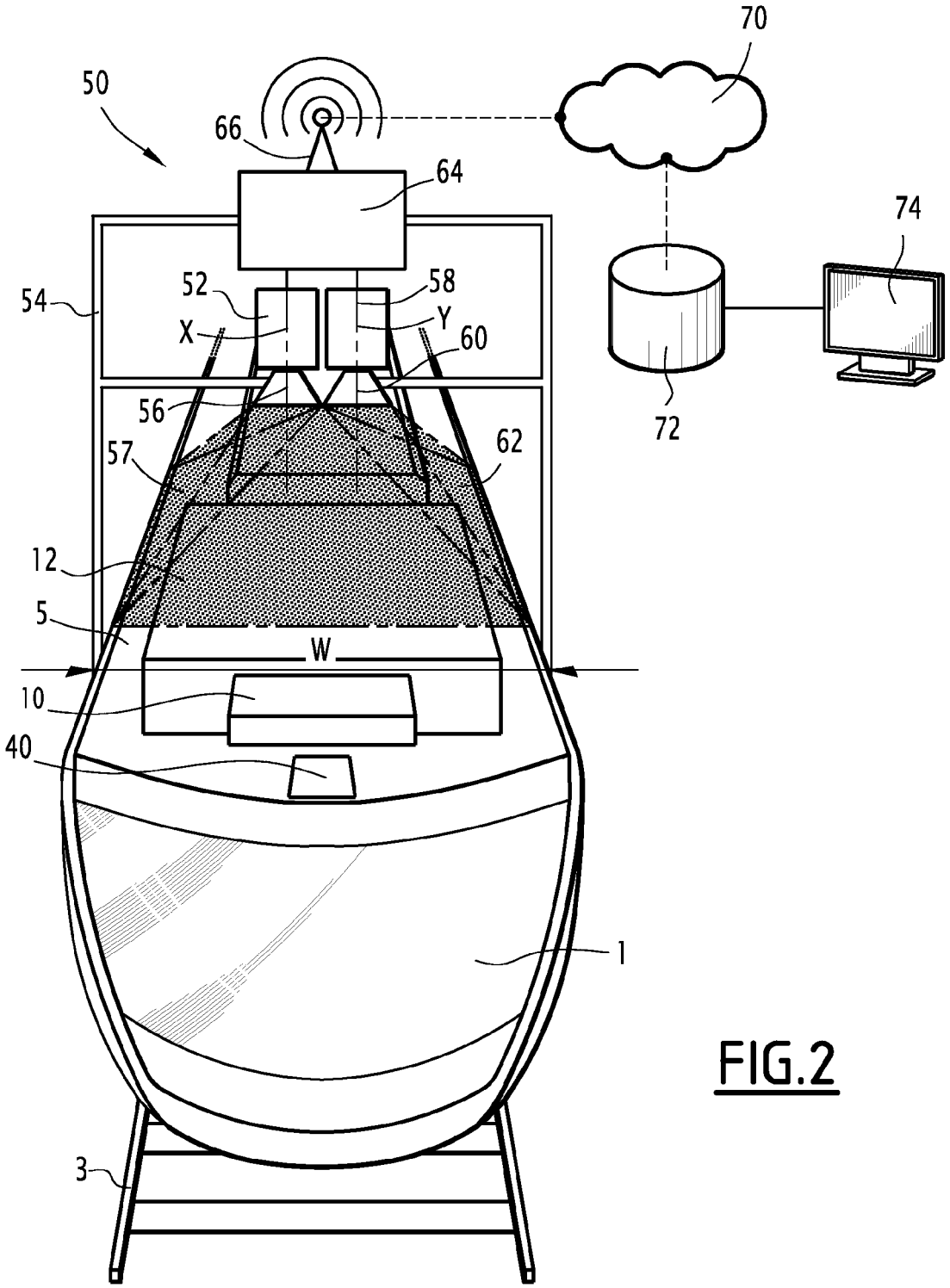

FIG.2

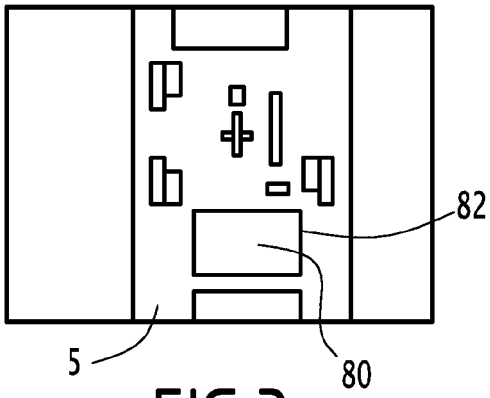

FIG.3

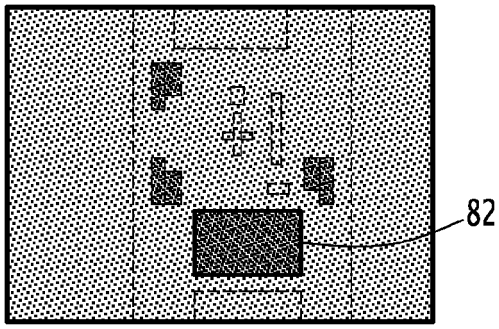

FIG.4

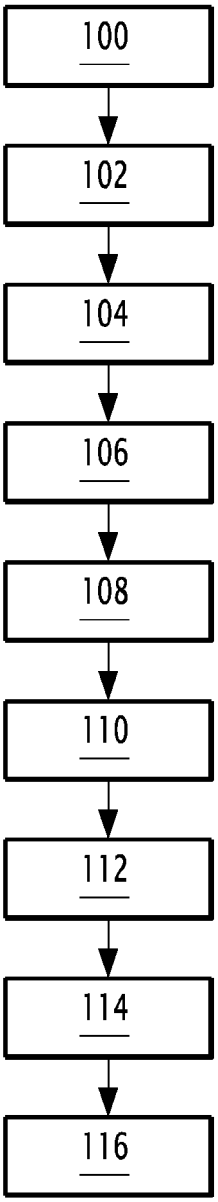

FIG.5

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EUROPEAN SEARCH REPORT

Application Number
EP 11 30 5910

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X	EP 1 600 351 A1 (HEURISTICS GMBH [CH]) 30 November 2005 (2005-11-30) * paragraph [0088] * * paragraph [0105] - paragraph [0107] * * paragraph [0195] * * paragraph [0201] - paragraph [0215] * * paragraph [0379] - paragraph [0423] * * paragraph [0485] - paragraph [0528]; figures 1-3,10,21 *	1-4,7, 9-14	INV. B61K9/00 B61L27/00
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TECHNICAL FIELDS SEARCHED (IPC)

B61K
B61L

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
The Hague	7 December 2011	Chlosta, Peter

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