United States Patent [19]

Gallagher

[11] **3,767,146**

[45] **Oct. 23, 1973**

[54] **RAILWAY SAFETY SYSTEM FOR DETECTING OVERHEATED BRAKES**

[75] Inventor: **Cornelius A. Gallagher**, Syosset, N.Y.

[73] Assignee: **Servo Corporation of America**, Hicksville, N.Y.

[22] Filed: **June 22, 1972**

[21] Appl. No.: **265,346**

[52] **U.S. Cl.** .... **246/169 D**
[51] **Int. Cl.** **B61l 3/02, B61k 9/06**
[58] **Field of Search** .... 246/169 D, 169 R

[56] **References Cited**

UNITED STATES PATENTS

3,253,140 5/1966 Sibley et al. .... 246/169 D

Primary Examiner—Gerald M. Forlenza
Assistant Examiner—George H. Libman
Attorney—David S. Kane et al.

[57] **ABSTRACT**

A railway safety system is provided to detect defects on railroad rolling stock, such as sticking brakes, which are ultimately manifested by an abnormal temperature rise in the region of the railway car wheel rim. The system utilizes an infrared detector positioned along a section track and focused to scan the wheels of passing cars. Scanning is confined to an area of each wheel between the rail head and the bottom of the car brake shoes.

10 Claims, 5 Drawing Figures

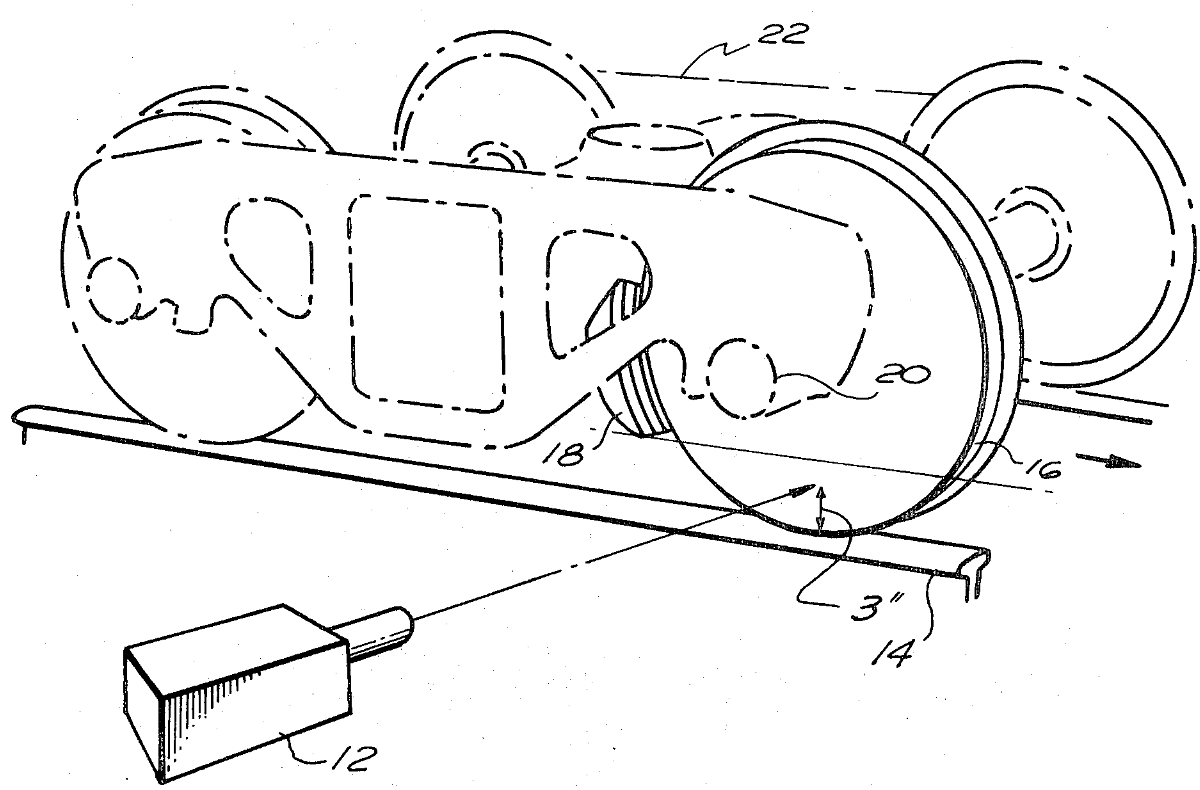


FIG. 1

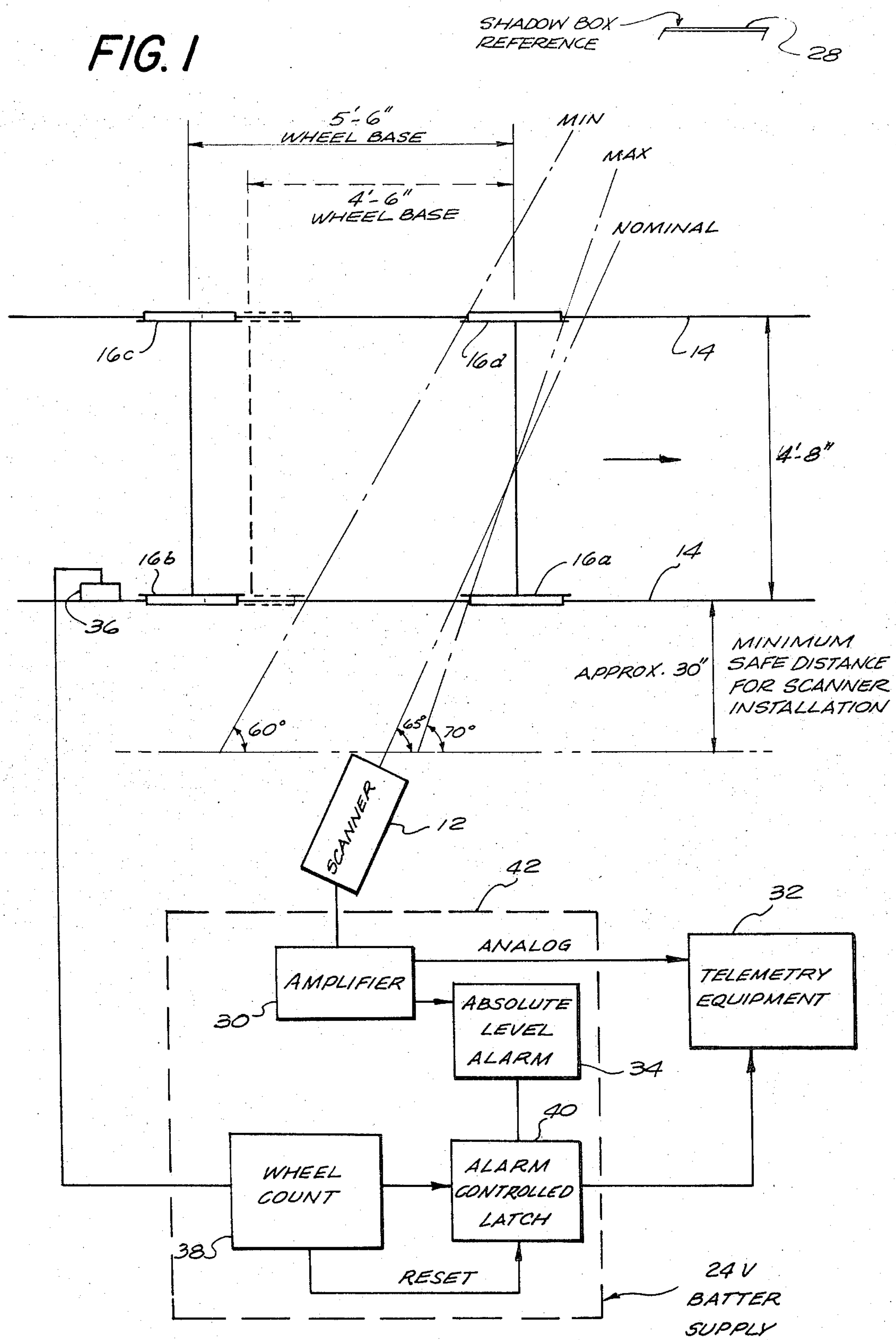

SHADOW BOX REFERENCE
28
5'-6" WHEEL BASE
4'-6" WHEEL BASE
MIN
MAX
NOMINAL
16c
16d
14
4'-8"
16b
16a
14
36
APPROX. 30"
MINIMUM SAFE DISTANCE FOR SCANNER INSTALLATION
60°
65°
70°
SCANNER
12
42
32
ANALOG
AMPLIFIER
30
ABSOLUTE LEVEL ALARM
34
TELEMETRY EQUIPMENT
40
WHEEL COUNT
ALARM CONTROLLED LATCH
38
RESET
24 V BATTER SUPPLY

FIG. 2

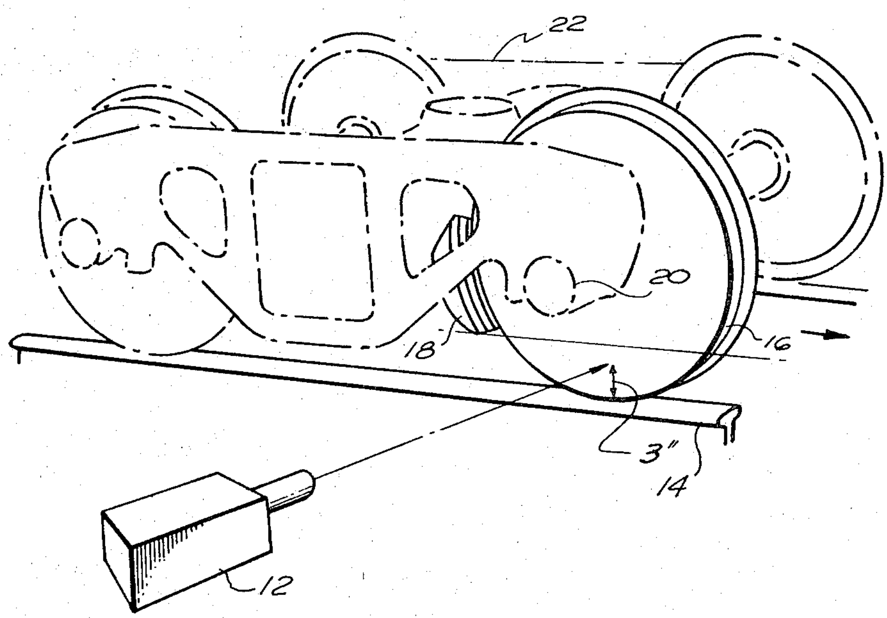


FIG. 5

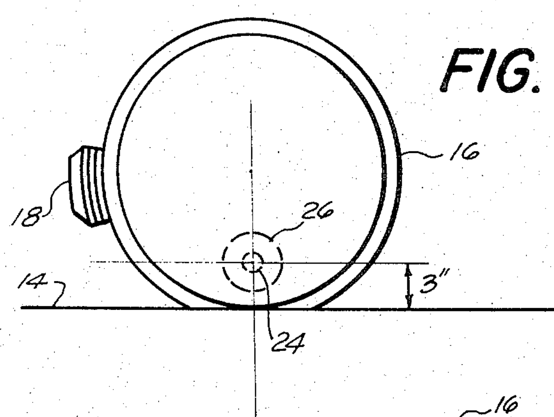


FIG. 3

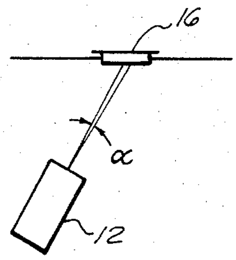
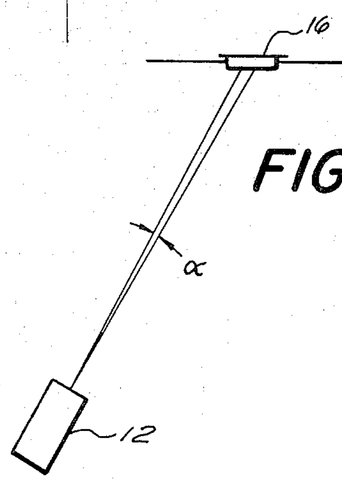


FIG. 4



RAILWAY SAFETY SYSTEM FOR DETECTING OVERHEATED BRAKES

BACKGROUND OF THE INVENTION

A major safety problem affecting railroads stems from the difficulty the railroads have detecting brake failures. Since railroad systems are fail-safe in operation, any failure in the system will result in the brakes being applied and eventually overheating. Overheated brakes can not only ignite track ties and neighboring brush causing fires but they can also cause thermal stresses and cracks to develop in the associated wheels. These cracks can eventually lead to the total failure of the wheel which, in turn, could lead to possible derailment.

In the past, railway car brake shoes were conventionally made of metal. As a result, a sticking or dragging brake condition would eventually cause the metal to glow cherry red after sufficient heat was generated. The cherry red glow enabled railroad crews to readily visually detect the sticking brake conditions. Recently, plastic-absestos composition brake shoes were introduced and they are now becoming more and more prevalent in the railroad industry. Although the plastic shoes have many advantages over prior art metal shoes, one unfortunate drawback is that they do not turn a characteristic color when overheated. As a result, sticking brakes can no longer be readily detected visually.

Heat generation in moving railway car wheels generally is either a result of an overheated bearing or dragging or sticking brake. In recent years, several patents issued describing various hot railway wheel detecting systems (see, for example, U.S. Pat. Nos. Re 25,159; 3,183,350; 3,253,140; 3,294,969; 3,601,604 and British Patent 836,721). These patents disclose systems that utilize infrared detectors focused to view the hubs of passing railway car wheels for indications of excess heat regardless of the source of heat. In order to distinguish between the two major possible causes of wheel overheating, the prior art systems referred to above utilize sophisticated electronics. This differentiation of causes can be made because of the difference in the magnitude of the heat generated by a hot box as compared to a sticking brake. A hot box generates temperatures on the order of 50°F above ambient whereas a severely sticking brake usually generates temperatures of between 400°F and 700°F above ambient.

Thus, while the prior art discloses systems for detecting sticking brakes, the systems are relatively complicated and costly to install and operate. Another shortcoming of the prior art systems becomes evident in the case where a railway car has a lightly dragging brake. Such a condition may occur when the train conductor sets a car's brakes while the car is heavily loaded and does not properly reset the brakes after unloading. Under such circumstances, the brakes may engage lightly and, as a result, generate some heat but not sufficient heat to warrant stopping the train. The prior art devices discussed above cannot readily differentiate between a lightly sticking brake and an overheated journal since the heat generated by both are about the same. Thus, such prior art systems can result in undo train stoppages.

In view of the above, it is the principal object of the present invention to provide an improved safety system for railway trains designed to readily detect sticking

brakes and other defects which are manifested by abnormally high temperature in the region of the wheel rim.

Another object is to provide such a system which is relatively economic to install and operate.

SUMMARY OF THE INVENTION

The above and other beneficial objects and advantages are attained in accordance with the present invention by providing a railway safety system to detect overheated wheels in a railway car moving along a section of track. The system includes an infrared detector positioned outboard of the track. The detector is provided with a heat responsive cell that produces an electrical signal in response to incident radiant energy. The system further includes optics associated with the cell adapted to image on the wheels of passing railway cars in the zone extending between the bottom of the brake shoe of each passing wheel and the top of the track rail so as to detect overheating at the wheel periphery. A readout device responsive to the electrical signals of the detector is connected to the detector so that the overheated wheel may readily be identified.

BRIEF DESCRIPTION OF THE DRAWINGS

In the accompanying drawings:

FIG. 1 is a block diagram of the railway safety system of the present invention;

FIG. 2 is a perspective view of the detector of the present system imaged on a passing wheel;

FIGS. 3 and 4 are schematic plan views illustrating the detectors imaged respectively on the near and far wheels of a passing train; and

FIG. 5 is a plan view of a railway car wheel showing the zone of the wheel being imaged.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

The present invention is illustrated in the accompanying drawings wherein similar components bear the same reference numerals throughout the several views. Referring to FIG. 1, the railway safety system **10** of the present invention is shown comprising a detector incorporating a scanner unit **12** contained within a suitable housing and mounted along a section of track **14.** It is suggested that the present safety system be located at the entrance or exit to a freight yard so that sticking brake situations may readily be corrected after they are detected. The detector is of the infrared type such as those commonly used for hot box detection. Typical detectors are disclosed in U.S. Pat. Nos. 3,454,758 and 3,545,005 and are available commercially from the Servo Corporation of America of Hicksville, N. Y. Such detectors include a heat responsive cell imaged by a scanner provided with appropriate optics.

Railroad car wheels vary in diameter between 28 and 40 inches. Most wheels are 33 inches in diameter. Thus, the axis of the railroad car wheel varies from between 14 and 20 inches above the rail. To avoid hot box readings, the scanner should preferably be imaged as far from the wheel axis as possible, namely at the rail. On the other hand, it is desirable to maximize the time the scanner views the wheels so as to obtain the most reliable readings. Since viewing time is directly related to the length of the chord the scanner projects on the wheel, viewing time is minimized when the scanner is imaged at the rail and maximized when the scanner views through the axis. These divergent requirements must thus be optimized to provide the best results.

Railroad car brakes generally extend to within approximately 6 inches of the rail. That is, the lower end of the brake shoe is positioned at least 6 inches above the rail. It is not desirable to view across a passing brake shoe since the brake shoe temperature may exceed the safety limit prescribed for a wheel while the wheel itself remains below the safety limit. This is especially so in the case of lightly sticking brakes.

Thus, while the present scanner may theoretically view from the top of the rail to the bottom of the brake of each passing wheel **16**, in practice, it has been found that viewing along a line 3 inches above the track provides optimum results. As shown in FIG. **2**, this arrangement insures viewing below the brake shoe **18** and sufficiently below the journal bearing **20** so as not to view the bearing although an overheated bearing could be detected if it resulted in an overheated wheel.

Since each wheel of a railroad car has its own associated brake, it is necessary that each wheel **16** of each carriage **22** of each passing railroad car be scanned for sticking brakes. This is accomplished in accordance with the present system in the manner illustrated schematically in FIG. **1**. The distance between the rails of standard gauge track in the United States is 4 feet 8 ½ inches. The wheel base of most railway carriages in use in this country is 5 feet 6 inches although there is a very small percentage of railway cars having a wheel base of 4 feet 6 inches. The standard wheel base arrangement is shown in solid line in FIG. **1** and the rear wheels of the short wheel base carriage are shown in phantom.

Infrared detectors of the type discussed above require a viewing angle of at least 1° to insure accurate results. That is, the angle, α, of incident radiation from the scanner must describe a minimum angle of 1° as shown in FIGS. **3** and **4**. As previously mentioned, it is also necessary that the incident radiation imaged on the wheel be confined to the area between the bottom of the brake shoe **18** and the top of the rail, preferably centered along a chord 3 inches above the rail. Naturally, this is true for the incident radiation image **24** on the near wheels as well as the incident radiation image **26** on the far wheels. To insure that the incident radiation image remains within the above set confines, the scanner should be set as close to the track as possible. However, safety procedures require equipment be maintained a sufficient distance from the track to avoid damage to or by overhanging equipment. It has been found that by locating the scanner approximately 30 inches from the track, both the above requirements can be attained. That is, the scanner is sufficiently far from the track so as to pose no safety problems and sufficiently close so that the incident radiation on each passing wheel is completely confined to the area between the rail and bottom of the brake shoe. As shown, the outside surfaces of the inboard wheels **16*a*** and **16*b*** are scanned and the inside surfaces of the outboard wheels **16*c*** and **16*d*** are scanned.

In order to enable scanning of each wheel of each passing car, it has been found that the scanner must be set at an angle of between approximately 50° and 70° (from a line 30 inches from the tracks) for larger wheel base carriages and between 60° and 70° for smaller wheel base carriages. It has been found that an angle of 65° provides optimum results and insures proper viewing of each passing wheel regardless of the wheel base of the passing car.

In addition to the scanner **12**, the present system includes a shadow box **28** mounted across the track from the detector along the line of sight of the detector. The inner face of the shadow box is painted black so as to provide a known reference for the detector. That is, the detector "sees" the black inside of the shadow box in the absence of a car wheel and thereby receives a relatively constant input (in the absence of a wheel) regardless of the time of day or season of the year.

The present system further includes appropriate electronics to transform the output of the scanner into useful information. Accordingly, the output of the scanner passes first through an amplifier **30** and then to suitable telemetry means **32** and alarm means **34**. The alarm means will be understood to function above a preset threshold signal representing a safety limit for sticking brakes. As previously mentioned, it may not be desirable to stop a passing train to correct a lightly sticking brake situation and thus the threshold must be chosen at a level sufficiently high to exclude such light sticking brake situations.

In order to determine which particular wheel or wheels of a passing train has a sticking brake problem, the present safety system employs a wheel counting arrangement. The arrangement includes a wheel trip **36** mounted on the track for actuation by the first wheel of a passing train. The trip may be one of a number of varieties such as those commercially available and sold by the Servo Corporation of Hicksville, N.Y. In general, the trip comprises a magnetic circuit including a gap which is transiently closed by the flange of a passing wheel. A winding coupled to this magnetic circuit develops the trip signal. Upon receipt of the trip signal, a wheel counter **38** is activated. If the threshold value of the absolute alarm is exceeded, the alarm is triggered to activate an alarm controlled latch **40**. From the wheel triggering the alarm until the last wheel of the train, the wheel count is gated with the output of the absolute alarm through the latch and fed to the telemetry equipment. Thus, by counting backward from the last scanned wheel of the train, the problem wheel can be determined. After the last wheel passes, the wheel count resets the latch circuit to await the next train. The electronic equipment may conveniently be mounted in a trackside chassis **42** and appropriately powered by a battery power supply.

With the above described arrangement, the telemetry equipment is only utilized in the event a hot brake situation is detected. If desired, the telemetry equipment can readily be connected directly to the amplifier output for constant monitoring.

The output of the telemetry equipment may take many forms, as for example, a strip chart record may be kept in a central office in the yard. Alternately, some type of audible or visual alarm such as an overhead gantry mounted display may be provided to give immediate warning to the train crew of the sticking brake. Such arrangements are well-known in the art and commonly used in conjunction with hot box detector systems.

Thus, in accordance with the above, a relatively simple railway safety system is provided to detect troublesome sticking brakes on moving railway trains. With the arrangement of the present invention, readings caused by overheating hot boxes are eliminated from consideration by the system and discrimination is provided between lightly sticking brakes which pose no problem and severely sticking brakes which are troublesome and dangerous.

While only a preferred form of the present invention is described, it will be understood that modifications may be made within the scope of the invention as defined in the following claims.

Having thus described the invention, what is claimed is:

1. A railway safety system to detect defects in the brakes and/or wheels of trains moving along a section of track, said defects being manifested by an abnormal temperature rise in the area of the wheel rim, said system comprising: (a) a detector positioned along said track section, said detector including a heat responsive cell producing an electrical signal in response to incident radiant energy and a scanner imaged toward said track and adapted to transmit the radiant energy of wheels passing along said track to said cell, said scanner being imaged at each passing wheel only in the zone extending between the bottom of the brake of each passing wheel and the top of the track; and (b) a readout device responsive to said electrical signal connected to said detector.

2. The system in accordance with claim **1** wherein said detector is positioned with respect to said track to discretely image each wheel of each passing train.

3. The system in accordance with claim **2** wherein said detector images each wheel of each passing train at a viewing angle of approximately 1°.

4. The system in accordance with claim **3** wherein said scanner is imaged in a horizontal plane offset from said track by an angle of between 50° and 70°.

5. The system in accordance with claim **4** wherein said scanner is spaced approximately 30 inches from the closest rail of said track.

6. The system in accordance with claim **1** wherein

said scanner is imaged along a chord of each wheel parallel to said track, approximately 3 inches above said track and the imaged area of each wheel of each passing train is entirely below the brake associated with that wheel and above the track.

7. The invention in accordance with claim **1** wherein said system further includes wheel actuated switch means mounted along said track and means interconnecting said readout means and said switch means whereby said readout means are actuated only upon the passage of a train wheel past said switch means.

8. The system in accordance with claim **1** further including reference means mounted across track from said scanner along the line of sight of said scanner, said reference means including a blackened surface directed at said scanner adapted to provide fixed reference for said scanner in the absence of a railway car wheel.

9. The method of detecting defects in the brakes and/or wheels of a railway car moving along a section of track past a fixed location, said defects being manifested by an abnormal temperature rise in the area of the wheel rim, said method comprising the steps of:

a. discretely imaging each wheel of said car with an infrared scanner only in the zone extending between the top of the track and the brake associated with said wheel;

b. transmitting the radiant energy of each passing wheel to a heat responsive cell adapted to produce an electrical signal in response to incident radiant energy; and

c. feeding said electrical signal to a readout device adapted to trigger an alarm in the event said signal exceeds a predetermined level.

10. The method in accordance with claim **9** further comprising the modified step of viewing each wheel along a viewing angle of substantially 1°.

* * * * *