June 1, 1965 W. M. KELLER 3,187,181

RAILWAY CAR BRAKE INSPECTION UTILIZING A RADIOACTIVE SOURCE AND DETECTOR

Filed Feb. 5, 1963 2 Sheets-Sheet 1

Fig. 1

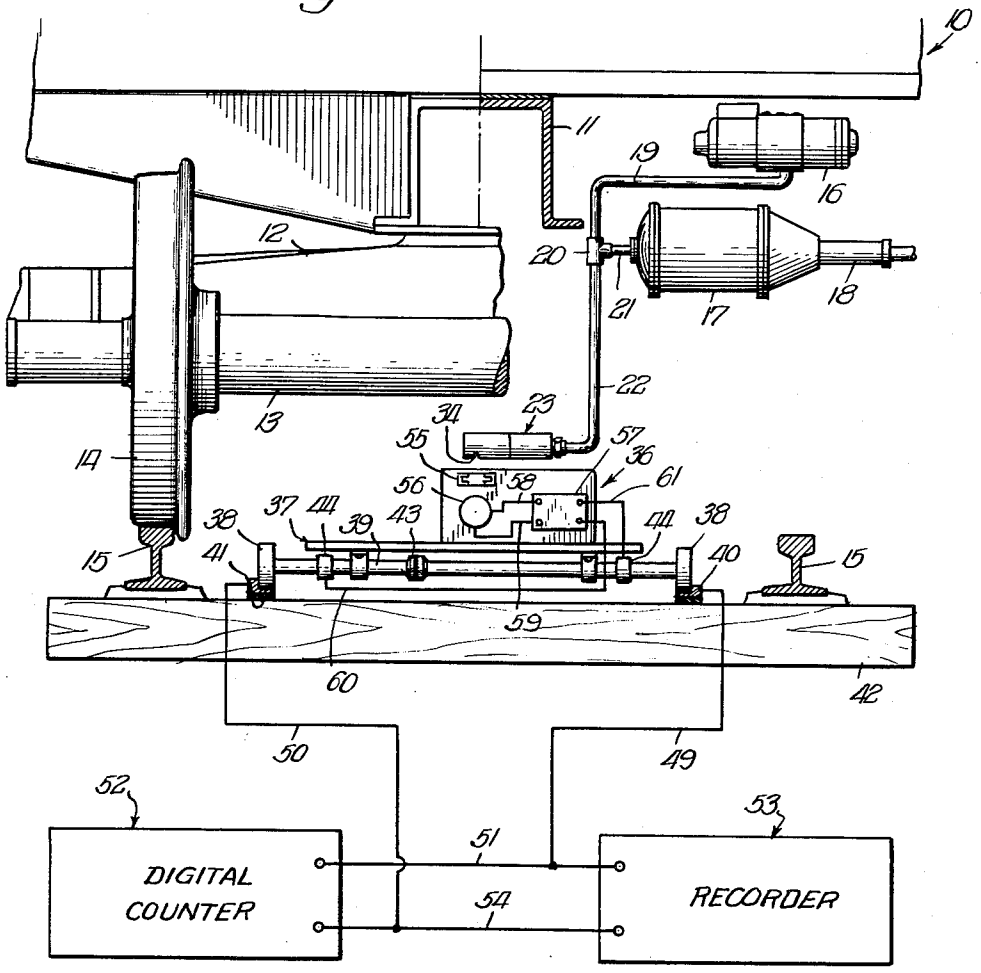

Fig. 2

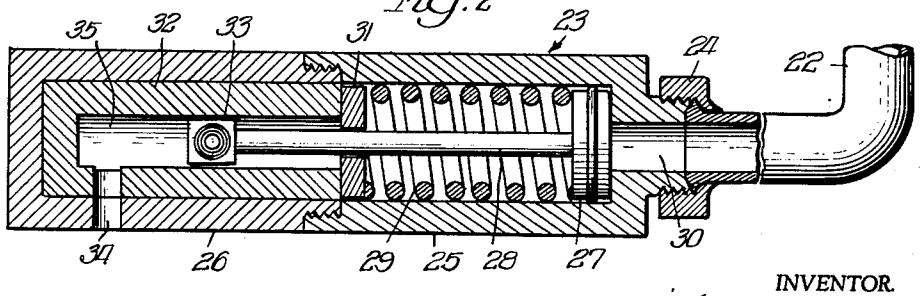

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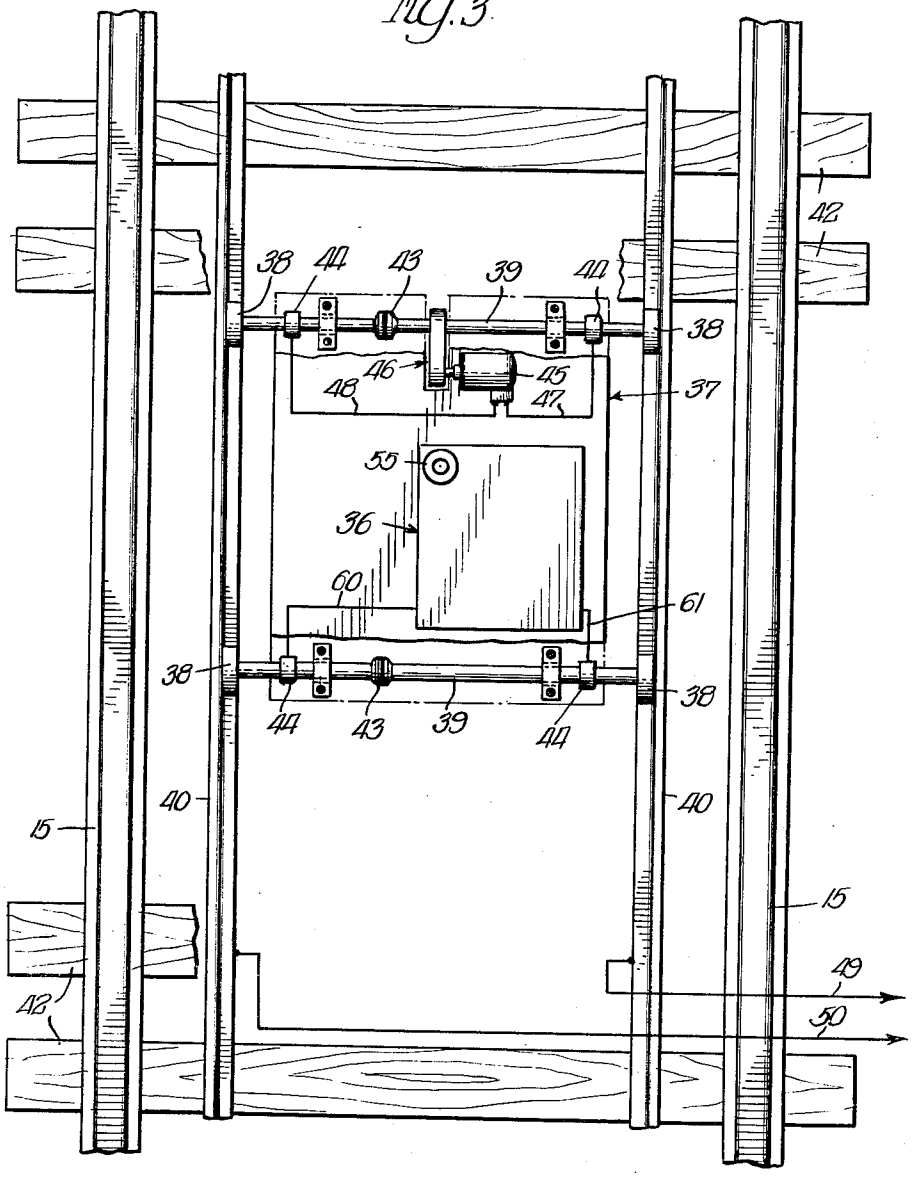
Fig. 3



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RAILWAY CAR BRAKE INSPECTION UTILIZING A RADIOACTIVE SOURCE AND DETECTOR

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This invention relates to means for automatically indicating conditions of brake application and release on each of the railway cars in a train being checked for proper brake operation.

The proper brake operation on all the railway cars in a train is extremely important because there is always a danger of grave injury or death to persons and extensive damage to equipment and lading if the brakes on all railway cars do not operate properly during train service. Consequently it is required by law that an examination of the brake system on each railway car must be made before a train departs or leaves the car yard after the train has been made up. An important part of this examination consists in checking whether or not there is proper brake application on each car during the time that the brakes are supposed to be applied and whether or not the brakes on all cars are released when the signal is given for this portion of the examination.

In the past it has been necessary for an inspector or team of inspectors to walk the entire length of a train to physically check the condition of the brake system on each car during brake application and to repeat this check during brake release operation. This, of course, is a time consuming and expensive process and it is a primary object of my invention to provide means for automatically inspecting railway car brakes so as to eliminate the time delay and expense involved in the present method of an inspector or inspectors walking the length of the train.

A further object of my invention is to provide means which are designed to automatically inspect the brake systems on individual railway cars in a train and transmit the results of this inspection to a track wayside station.

A still further object of my invention is to provide a source of radiation which is mounted on each railway car and which cooperates with a relatively movable track mounted radiation detector to actuate signal means at a track wayside station so as to automatically monitor the operations of brake application and brake release on each railway car in a train.

Other objects and advantages of my means for automatically inspecting railway car brakes will be apparent during the course of the following description.

In the accompanying drawings forming a part of this specification and in which like numbers are employed to designate like parts:

FIGURE 1 shows an end view of a railway car which is partially cut away to reveal the arrangement of the radiation emitter control unit that is mounted on the railway car, the associated radiation detector unit, and the instruments located in the track wayside scanning station.

FIGURE 2 shows the structural features of the radiation emitter control unit which is connected with the brake system of the railway car in the manner shown in FIGURE 1.

FIGURE 3 is a plan view of the radiation detector unit on the movable carriage.

Most railway cars now in operation on the railway lines of the United States are provided with an air brake system which is designed to be interconnected with the air brake systems of other railway cars in a train. Thus, on each railway car there is a brake pipe that extends throughout the length of the railway car with an angle cock and hose at each end of the car which are designed to be connected to the corresponding equipment on the adjacent cars. Through these pipes and fittings com-

pressed air from a source on the train engine can be supplied to a double compartment reservoir on each car. When the air brake system on each railway car is thus charged to a predetermined minimum, this energy is available for use when it is desired to apply the brakes. In order to apply the brakes on the cars in a train, the engineer reduces pressure in the brake pipe which in turn actuates valves in the so-called AB valve. This AB valve then permits an air flow from the reservoir on the car to a brake cylinder with a movable piston that operates to actuate a linkage system and apply the brake shoes to the wheels of the car. Brake release is effected by releasing the compressed air from the brake cylinder. The system thus far described is common to power brake installations on most railway cars today.

The elements of my invention, which are adapted for use with the above described railway car air brake system, consist generally of a car-mounted radiation emitter control unit which carries a source of radiation capable of emitting gamma rays or other forms of radiation, a movable track-mounted radiation detector unit designed to be responsive to the source of radiation under certain conditions of brake application, and a track wayside scanning station adapted to receive signals from the radiation detector unit and to process such signals for evaluation.

The radiation emitter control unit on each railway car is associated with the air brake cylinder of the air brake system so that when compressed air is admitted to the air brake cylinder to apply the brakes, this compressed air will also move the source of radiation to a position wherein the radiation emitted from the source can be detected by the radiation detector unit. When the brakes of the railway car are released by the reduction of air pressure in the air brake cylinder, the source of radiation is maintained by suitable means in a shielded position with respect to the radiation detector unit.

In the embodiment illustrated by the drawings, the radiation detector includes a sodium iodide crystal, a photo tube, and an amplifier. The sodium iodide crystal acts to convert gamma ray radiation into light rays which are in turn converted by the photo tube into electrical currents that can be suitably amplified by the amplifier. The radiation detector unit is designed to be moved by suitable means along insulated rails mounted on the track ties between the rails of the main track on which the train moves so that the sodium iodide crystal can scan the radiation emitter control units on each of the railway cars during its passage along the length of the train being inspected. Means are provided for transmitting the outuput signals from the amplifier of the radiation detector unit through the insulated rails to electronic instruments at a track wayside scanning station for recording and counting the signals received from the individual radiation emitter control units.

While I heretofore have referred to the fact that my system for inspecting railway car brakes is adapted for use on railway cars with an air brake system having certain components, it should be obvious that my automatic inspection system can be readily used with any type of railway car brake system in which a fluid, either gaseous or liquid, is admitted under pressure to a cylinder or housing to effect an application of the brakes, and in which a predetermined reduction of the fluid pressure in the cylinder or housing is effective to release the brakes.

In FIGURE 1 of the drawings the railway car is generally designated at 10 and includes the usual center sill 11, truck bolster 12, and a car axle 13 carrying a flanged wheel 14 adjacent each of its ends to support the car on rails 15. The specific structure of the railway car is not important with regard to my invention, and the above described features of the railway car are well known.

The railway car 10 is equipped with a brake system, a

portion of which is shown in FIGURE 1. This portion includes the AB brake valve 16 or other suitable valve through which compressed air is admitted to or released from the air brake sylinder designated at 17. A portion of the air brake cylinder piston rod is shown at 18. The other elements of the railway brake system for the car are not shown but as previously mentioned and briefly described, such system is well known in the art. The AB brake valve 16 is connected through air line 19 to a T 20 and there is a connection from the T 20 to the air brake cylinder 17 through air line 21. Also extending from T 20 there is a connection through air line 22 to the radiation emitter control unit generally designated at 23.

As more specifically described below, the radiation emitter control unit 23, forming a part of the means for automatically inspecting railway car brakes, contains a movable source of radioactive radiation, and while the description hereinafter refers to the emission of gamma rays from this source of radiation, my invention contemplates the use of other forms of radiation with a track-mounted radiation detector unit which is designed to detect these particular forms of radiation. As an example, it is within the scope of my invention to provide a movable source of light rays within the radiation emitter control unit 23 which could be associated with a track-mounted radiation detector unit having a photo tube.

The details of the radiation emitter control unit 23 are shown in FIGURE 2 and it can be seen that air line 22 is secured to the radiation emitter control unit at one end thereof by means of an internally threaded cap 24. The radiation emitter control unit includes a cylindrical housing portion 25 which is threaded to a second housing portion 26. A piston 27 having a piston rod 28 is slidably received within the housing portions 25 and 26. The piston 27 is urged by coil spring 29 to a position as illustrated in FIGURE 2 so as to close an opening 30 that is aligned with an open end of air line 22. The other end of the coil spring 29 rests against a collar 31 which in turn is supported by a shield insert 32 received within the second housing portion 26 of the radiation emitter control unit 23. The shield insert 32 is of lead or suitable radioactive radiation insulating material to provide a shield for the source of radiation which is indicated at 33 and which is carried at the end of piston rod 28. It will be noted that near one end of second housing portion 26 there is a window 34 extending completely through the second housing portion 26 and the shield insert 32 to provide an opening from the cavity 35 in which the source of radiation 33 is movable.

In considering the use of the above described radiation emitter control unit in conjunction with the brake system of the railway car, it should be apparent that the AB brake valve 16 controls the introduction and release of compressed air not only to the air brake cylinder 17, but also to opening 30 in the radiation emitter control unit. When there is no introduction of compressed air to the air brake cylinder 17, the brakes of the car air brake system will normally be in brake release position and at this time coil spring 29 of the radiation emitter control unit will be effective to maintain the piston 27 at the position shown in FIGURE 2. In this position the source of radiation 33 is in a location remote from the window 34 so that the shield insert 32 is effective to stop any appreciable gamma ray radiation outside of the radiation emitter control unit 23. However, when the AB brake valve 16 is operated to admit compressed air to the air brake cylinder 17, compressed air will also be delivered through air line 22 and opening 30 to act against piston 27 and the piston rod 28 will be forced away from opening 30 against the restraining influence of the coil spring 29. As the source of radiation 33 is carried at the end of piston rod 28, this movement of piston rod 28 will move the source of radiation 33 to a position in alignment with the window 34 and gamma rays will be emitted through this window 34.

The detector unit for detecting gamma rays emitted from the radiation emitter control unit 23 is generally designated at 36. The detector unit 36 is mounted on a movable carriage generally indicated at 37. The movable carriage 37 has steel wheels 38 which are mounted on axles 39 so as to ride on rails 40, and these rails 40 are in turn mounted on insulation pieces 41 carried along the ties 42 of the railroad track. Axles 39 have insulated joints at 43 so that the two steel wheels 38 on each of the axles 39 are electrically isolated or insulated from each other. Each portion of the axle 39 on opposite sides of each of the insulated joints 43 carries a slip ring 44, which slip ring can be of well known construction to provide for an electrical contact to the axle 39.

The carriage 37 can be moved along rails 40 by a suitable means such as an electric motor drive to the steel wheels 38 of the movable carriage 37 or by any other means such as a cable drive or other mechanical means. In FIGURE 3 I have shown the use of electric motor 45 to rotate axle 39 through a chain drive, generally indicated at 46. Electric current for electric motor 45 can be furnished through rails 40, steel wheels 38 and axle 39 to each of the slip rings 44 mounted on the axle. Electric wires 47 and 48 are connected between these slip rings and the electric motor 45 to deliver electric power to the electric motor.

As shown in FIGURE 1, the rails 40 are also connected through wires 49 and 50 to electronic instruments at a track wayside station. Wire 49 is connected to wire 51, and wire 51 provides a common connection to a digital counter generally indicated at 52 and to a recorder generally indicated at 53. Wire 50 is connected to wire 54 providing a common connection between digital counter 52 and recorder 53. The digital counter 52 and recorder 53 are generally indicated and as units of this general type are known in the art, it is not felt that any specific description of these units need be given here. With the use of the digital counter 52 and recorder 53 it is possible to count the cars as the radiation detector unit scans the radiation emitter control unit on each car and the recorder 53 would show by an indication on a chart whether or not the brakes were applied. One method of accomplishing these results would be to use a stepping relay (not shown) on the digital counter 52 and have this relay actuate a double-acting relay (not shown) which would show a mark on the recorder 53 for each car in the train to indicate whether or not the brakes on that car are applied.

The detector unit 36 includes a sodium iodide crystal 55, an associated photo tube 56 and a suitable amplifier 57. As previously mentioned, the sodium iodide crystal 55 has the ability to convert gamma rays to light rays and these light rays are of sufficient intensity to activate the photo tube 56 disposed adjacent the sodium iodide crystal 55. Electrical impulses from the photo tube 56 are transmitted through wires 58 and 59 to amplifier 57. Amplifiers for amplifying the electric current output of a photo tube such as 56 are well known in the art and therefore no specific description of the circuitry of such an amplifier is deemed necessary. The electric current output of the amplifier 57 is fed through wires 60 and 61 to slip rings 44 on the axle 39 which is not driven by electric motor 45. The electric current path continues from slip rings 44 through axle 39 and steel wheels 38 to rails 40. Wires 49 and 50 are connected to rails 40 so as to transmit the electric currents or signals from amplifier 57 to the digital counter 52 and recorder 53 at the wayside scanning station.

It should be noted that rails 40 provide electrical circuit means for the supply of electric current to the electric motor 45 and also for the electrical output of the radiation detector unit which is being fed to the digital counter 52 and recorder 53.

The operation of my automatic brake inspection device should now be apparent from the above description. The line of individual railway cars comprising the train will be

spotted on the section of track having the insulated rails 40 for carrying movable carriage 37. This movable carriage 37 can be moved along rails 40 by suitable means such as electric motor 45 to carry the detector unit 36 along rails 40 for the entire length of the train to monitor the condition of brake application. After the signal for the brake release operation, movable carriage 37 can be moved back along the entire length of the train to monitor the condition of brake release. If desired, the train can be moved during the time of brake release and the movable carriage 37 can be maintained at one position to scan the passing radiation emitter control units on the individual railway cars.

The sodium iodide crystal 55 of detector unit 36 must, of course, be positioned so that as there is a relative movement between the carriage 37 and each of the cars in the train, sodium iodide crystal 55 will pass directly adjacent the radiation emitter control unit 23 and the sodium iodide crystal 55 will be generally aligned with the window 34 in the radiation emitter control unit 23. Thus in the first passage of the movable carriage 37 along the entire length of the train, the sodium iodide crystal 55 successively passes the windows 34 of each of the radiation emitter control units 23 mounted on each car of the train. During this passage the air brake system has been activated so that the AB brake valve 16 on each car has supposedly operated to supply compressed air to the air brake cylinder 17 on each car and also supply compressed air to move the piston 27 and piston rod 28 of radiation emitter control unit 23 on each car to a position where the source of radiation 33 is aligned with window 34. Thus, assuming that the brakes on all cars of the train have been properly applied through the supply of compressed air to each of the air brake cylinders 17, then the sodium iodide crystal 55 will receive gamma ray radiation from each of the radiation emitter control units 23 on each of the railway cars in the train. This gamma ray radiation will be converted to electrical currents or signals which are transmitted to the track wayside scanning station having the digital counter 52 and recorder 53 for processing. If for some reason there has not been an application of compressed air to the air brake cylinder 17 on a particular car so as to apply the brakes, then the source of radiation 33 will remain in the shielded position as indicated in FIGURE 2 and the sodium iodide crystal 55 will receive no gamma ray transmission from that particular radiation emitter control unit 23 on that car. This fact will, of course, be noted by the digital counter 52 and the recorder 53 at the track wayside scanning station so that corrective action can be initiated.

On the return trip of the movable carriage 37 or when the train of cars is moved over this carriage, the sodium iodide crystal 55 will be scanning each of the radiation emitter control units 23 on the individual cars of the train to ascertain whether the source of radiation 33 is in the shielded position to indicate a brake release condition. If, for example, the condition is such that there is an application of compressed air to the air brake cylinder 17 during this time when there should be a brake release condition, then the source of radiation 33 will be maintained at a position in alignment with window 34 and gamma ray radiation will be detected by a sodium iodide crystal 55 and transmitted to the digital counter 52 and recorder 53 where the condition will be noted.

The foregoing description of my invention is made for the purpose of disclosure and to illustrate the principles involved, and will suggest various substitutions and changes that may be made under my basic concept. The right is reserved to all such substitutions and modifications that lie within the scope of the appended claims.

I claim:

1. An automatic inspection system for railway car brakes, comprising first means associated with a brake cylinder and piston, said first means including a source of radiation, second means relatively movable with respect to said first means and adapted to convert radiation received from said first means into electrical currents, said source of radiation being urged to a shielded position with respect to said second means in the absence of a fluid pressure application against the brake cylinder piston, said source being moved from said shielded position to another position wherein radiation from said source impinges upon said second means when there is a fluid pressure application against the brake cylinder piston, and means associated with said second means to process and record said electrical currents.

2. An inspection system for use with a railway car brake system including a source of gamma rays associated with a brake cylinder and piston, means for converting gamma rays into electrical currents and being movable relative to said source, second means for receiving said electrical currents and processing said currents to indicate brake application or release on the railway car, said source being shielded from said means during normal brake release conditions and being moved to a position to emit radiation to said means during normal conditions of brake application.

3. An inspection system for indicating brake application and release on a railway car, including a source of gamma rays associated with the car air brake system and movable to a first position during proper brake application and movable to a second position during proper brake release condition, a detector for converting gamma ray emission to electrical currents, said gamma rays affecting said detector in said first position, and means associated with said detector to process and record said electrical currents.

4. An inspecting system for indicating brake application and release on a railway car, including first means associated with the brake cylinder of the railway car brake system, a second means movable relative to said first means, said first means including a source of gamma rays which is shielded from said second means during the period of normal brake release and which impinges gamma ray radiation on said second means during the period of normal brake application, said second means being capable of converting the gamma rays received from said first means into electrical currents.

5. The system as specified in claim 4 wherein said first means includes a housing with a slidable piston and piston rod therein, said piston rod carrying said source of gamma rays at one end thereof, resilient means urging said piston to a first position where said source of gamma rays is shielded from said second means during periods of normal brake release, and an air line connected from the brake cylinder to the housing so that the application of compressed fluid to said brake cylinder, which normally effects brake application, is also effective to force said piston and source of gamma rays to a second position where the gamma rays impinge on said second means.

6. The system as specified in claim 5 wherein said second means includes a sodium iodide crystal and associated photo tube which is operatively connected through an amplifier to a wayside scanning station having signal processing means therein.

7. The system as specified in claim 6 wherein said signal processing means includes a digital counter and a recorder.

8. Apparatus for inspection of brake application and brake release on each of a plurality of railway cars connected in a train with an air brake system, including a source of radiation on each car to emit gamma rays, said source being associated with the air brake cylinder on the car, second means mounted adjacent the train for progressive movement past each car of the train, said second means carrying a detector unit adapted to convert the gamma rays received from the source of radiation into electrical impulses for actuating signal means, said source of radiation being urged to a trans-

mitting position with regard to said second means during the periods of normal brake application and being urged to a shielded position with regard to said second means during periods of normal brake release.

9. The apparatus as defined in claim **7** wherein said second means is mounted for movement on rails disposed beneath the cars of the train and wherein the source of radiation is mounted on the underside of each car in operative relationship to said second means movable along said rails.

10. An inspection system for indicating brake application and release on the railway cars in a train including, a source of radiation associated with the air brake system on each car, a detector means for converting radiation received from said source to electrical currents, said source being urged to an inoperative position with respect to said detector means during periods of normal

brake release and being movable to an operative position by a fluid pressure application in the car air brake system designed to effect a normal brake application.

11. The system as defined in claim **10** wherein said detector means is adapted to be relatively moved with respect to the railway cars of the train.

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