May 20, 1947. G. K. NEWELL 2,420,968

HOT JOURNAL ALARM APPARATUS

Filed March 30, 1944 2 Sheets-Sheet 1

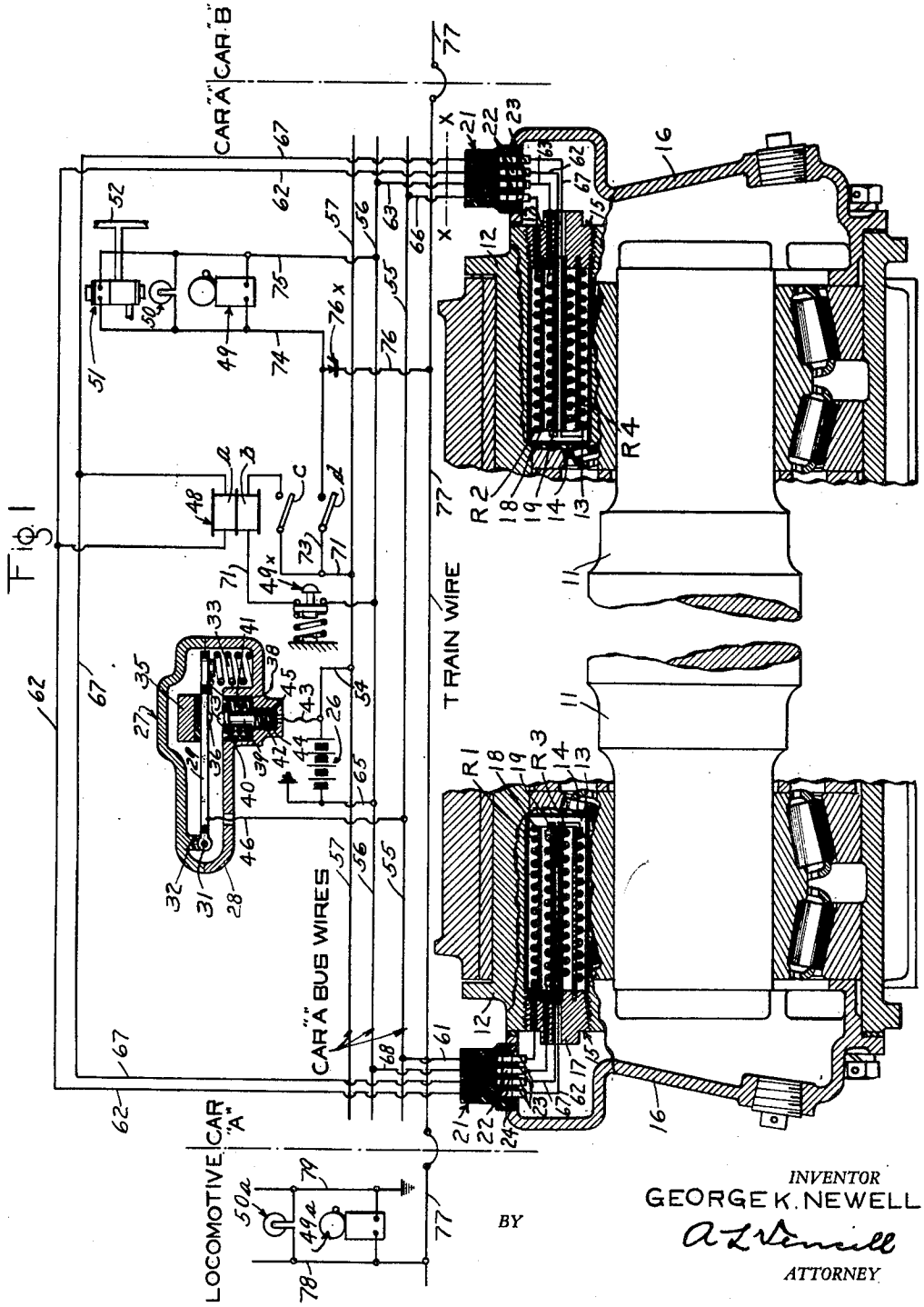


Fig. 1

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Fig. 2.

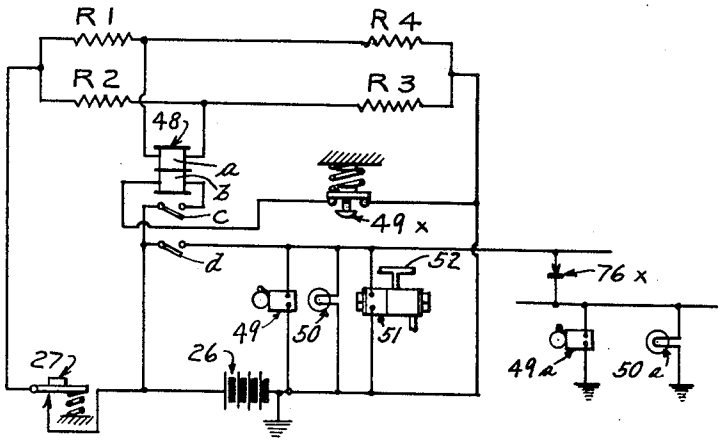
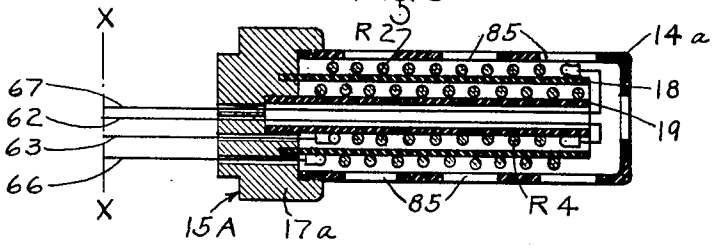


Fig. 3



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2,420,968

HOT JOURNAL ALARM APPARATUS

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Application March 30, 1944, Serial No. 528,710

2 Claims. (Cl. 177—311)

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This invention relates to hot journal alarm apparatus, that is, apparatus for giving a signal or an alarm whenever a bearing or journal approaches an abnormally hot condition, and has particular relation to hot journal alarm apparatus for railway cars and trains.

The railroads have long sought a simple and inexpensive apparatus for apprising the engineer or crew of a train of the occurrence of a hot box or hot axle journal on any of the cars of the train because hot boxes not only damage the parts of the journals but may even result in breakage of an axle and possible wreckage of the train due to derailment of a car following breakage of the axle.

Various devices and apparatus have been proposed and employed for the purpose of signaling the occurrence of a hot box on railway cars and trains. Such devices and apparatus variously employ different types of thermal-responsive elements, such as fusible elements, bi-metallic elements, gas-chambers, or thermo-couples.

It is an object of my present invention to provide a novel means for registering the heat condition in a bearing or journal, such as the axle journal of a railway car.

More particularly, it is an object of my invention to provide a Wheatstone bridge arrangement including resistance elements of relatively high temperature coefficient of resistance; and to dispose the resistance elements in a manner to be responsive to the heat condition of a plurality of journals, whereby to attain an unbalanced condition of the bridge when an abnormal heat condition of one journal with respect to the heat condition of another journal occurs.

It is another object of my invention to provide apparatus of the nature indicated in the foregoing objects characterized, however, in that some of the resistance elements of the Wheatstone bridge are exposed to ambient temperature or heat conditions as distinguished from the heat condition of a journal.

It is another object of my invention to provide apparatus of the nature indicated in the foregoing objects and further characterized by means, responsive to the travel of the car or train equipped with the apparatus, for intermittently rendering the apparatus effective, thereby conserving the amount of electrical energy required to operate the apparatus.

The above objects, and other objects of my invention which will be made apparent hereinafter, are attained by embodiments subsequently to be described and illustrated in the accompanying drawings, wherein

Fig. 1 is a diagrammatic view showing one embodiment of my invention, as applied to a pair of axle journals of a railway car truck.

Fig. 2 is a simplified schematic electrical wiring diagram corresponding to the apparatus shown in Fig. 1, and

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Fig. 3 is a fragmental sectional view showing the form of cartridge or unit which may be employed to contain several of the resistance elements of the Wheatstone bridge arrangement arranged for exposure to ambient temperature. The device shown in Fig. 3 is to be considered as joined to apparatus shown in Fig. 1 at the line marked x—x in substitution for a part of the apparatus shown in Fig. 1.

Description

Referring to Fig. 1, there is shown a railway car wheel axle 11 broken at the middle and having similar roller bearing journal casings 12 at opposite ends thereof. In each of the journal casings 12 at a point outside the bearing races is a bore 13, in substantially parallel relation to the axle 11, forming a heat well, the heat in which is indicative of the heat in the journal. The bores 13 are lined with suitable insulating material 14 to prevent grounding of parts of a thermal-responsive device received therein and hereinafter referred to as a resistance cartridge or unit 15.

Each resistance cartridge or unit 15 comprises a screw plug 17 that is screwed into the outer threaded end of the bore 13 receiving it and is enclosed by an end cover 16 that is removably secured to the journal casing. Two concentric tubular members 18 and 19 of insulating material are secured to screw plug 17 and extend generally in parallel relation to the axle 11. Wound on and secured to the outer tubular member 18 and the inner tubular member 19 are resistance elements or coils of resistance wire, such as iron wire, having a relatively high temperature coefficient of resistance (.005 for iron wire).

The four resistance elements in the two cartridges are designated respectively as R1, R2, R3, and R4.

As shown in Fig. 1, resistance elements R1 and R3 are disposed on the outer and inner tubular members 18 and 19 respectively of cartridge 15 associated with the left-hand journal. The resistance elements R2 and R4 are disposed on the outer and inner tubular members 18 and 19 of the cartridge 15 associated with the right-hand journal.

Resistance elements R1, R2, R3, and R4 are connected in a Wheatstone bridge arrangement as shown in Fig. 2. Suitable wires, hereinafter identified, are connected to opposite ends of each resistance element respectively, making a total of four wires connected to each cartridge unit 15. The screw plug 17 of each cartridge is provided with suitable openings through which these lead wires extend, in insulated relation to the resistance elements.

External circuit connections are made to the

resistance elements by means of suitable electric coupling devices or plugs 21 having contact prongs 22 that telescope in suitable sleeve contacts 23 carried in an insulating bushing 24 supported in the end cover 16. Suitable means, not shown, but similar to that employed on radio tubes, is provided for insuring proper connections through the coupling devices at all times.

As in the case of any Wheatstone bridge, a suitable source of current, illustrated as a storage battery 26, is provided. In the case of a train of cars an individual battery 26 is provided for each car, which battery may be the usual car lighting battery.

For the purpose of conserving the energy required from the battery 26, I have provided an intermittently operative switch device 27 for momentarily connecting the battery 26 to the Wheatstone bridge circuit at intervals.

The switch device 27 may comprise a separable casing 28 attached to a part of the car, such as the car truck, which is subject to pronounced road shock. As diagrammatically shown, switch device 27 may further comprise a contact arm 29 pivoted at one end, as by a pin 31, to a boss 32 on the interior of the casing 28 and supported at the opposite end by a coil spring 33 interposed between the end thereof and the lower wall of the casing 28. For the purpose of imparting a pronounced inertia characteristic to the contact arm 29, a suitable weight 35 is secured thereto.

The contact arm 29 has an intermediate portion insulated entirely from the casing 28, which portion carries a contact 36 for cooperation with a spring-biased contact 37 supported in a recess 38 in the casing 28 at point below the arm 29.

The contact 37 is carried on the end of a pin 39 having a collar 40 thereon which is guided in an insulating bushing 41 lining the recess 38. The lower end of the pin 39 is guided in an insulating bushing 42 lining the lower portion of the recess 38 of reduced diameter.

An electrical connection is made to the pin 39 by means of a wire 43 connected to a small metallic disk 44 at the base of the recess 38 and in insulated relation to the casing 28, a coil spring 45 being interposed between the disk 44 and the lower end of the pin 39. A constant electrical connection is thus made to the pin and contact 37, notwithstanding the oscillatory movement of the pin 39, without flexing the wire 43 and causing breakage thereof.

An insulated wire 46 extends through a suitable opening or bushing in the casing 28 and is connected to the intermediate or insulated portion of contact arm 29.

It will thus be seen that when the contact arm 29 is driven downwardly by the inertia of the weight 35 in response to road shock, contacts 36 and 37 become engaged and thereby complete a circuit from the wire 43 to the wire 46. Upon termination of the shock which will be of momentary extent, the spring 33 restores the arm 29 upwardly and separates the contacts 36 and 37. Assuming that a sufficient road shock is imparted to the weight 35 each time a car wheel passes over a rail joint, it will be seen that the frequency of engagement of the contacts 36 and 37 will be relatively high but that the length of time that the contacts 36 and 37 are engaged relative to the total travel time of the train will be relatively small.

For the purpose of registering the balanced or unbalanced condition of the Wheatstone bridge arrangement, I have provided a two-winding alternating-current type of relay 48. As diagrammatically shown in Fig. 1, the relay 48 comprises two windings, designated *a* and *b* respectively, and two front contacts *c* and *d* respectively. The winding *a* is the pickup winding and is connected into the Wheatstone bridge circuit in the manner hereinafter to be described so as to be responsive to a predetermined unbalanced voltage condition thereof in a manner to actuate the front contacts *c* and *d* from their normally dropped-out or open position to their picked-up or closed position.

The winding *b* of the relay 48 is a holding or "stick" winding, the energizing circuit for which is established over the front contact *c* which serves as a self-holding contact.

A normally closed reset switch 49 which may be of the push-button type as shown, is provided in the circuit of the holding winding *b* of relay 48 and is effective when opened to interrupt the circuit for the holding winding and thereby effect restoration of the relay 48 to its dropped-out position.

The character of the relay 48 is such that contacts *c* and *d* are actuated to their picked-up positions in response to energization of the pick-up winding *a* by a current exceeding a certain value and flowing in either direction through the winding, for a reason hereinafter explained.

The contact *d* of the relay 48 controls a circuit for energizing a plurality of signal devices, illustrated as an alarm bell 49, a signal lamp 50, and a magnet valve 51. The magnet valve 51 may be of any suitable type effective upon energization of the winding thereof to vent fluid under pressure from a device to be controlled, such as the brake pipe 52 on the train, to initiate brake application.

As indicated in Fig. 1 and Fig. 2, the contact *d* of the relay 48 is also effective to energize other signal devices, illustrated as an alarm bell 49*a* and signal lamp 50*a* disposed in the cab of the locomotive or power car of the train.

Operation

In order to describe the operation of the apparatus let it be assumed that a train including a locomotive, car A, and car B, as indicated in Fig. 1, is traveling along the road and that the axle journals have attained their normal operating temperatures. Let it now also be assumed that the intermittently operative switch device 27 is operated and that the contacts 36 and 37 thereof are engaged. In such case, the battery 26 is connected to the Wheatstone bridge circuit and a flow of current occurs therein. Referring to Fig. 1 the Wheatstone bridge circuit may be traced from the positive terminal of the battery 26 by way of a wire 54, wire 43, contacts 37 and 36 of the switch device 27, contact arm 29, wire 46, to a bus wire 55 local to car A, where the circuit divides into two parallel branches; one of the branches extending by way of a wire 61, resistance element R1, wire 62, resistance element R4, wire 63, to a bus wire 56 local to car A that is connected by a branch wire 65 to the negative and grounded terminal of the battery 26, the other branch extending from the bus wire 55 by way of a wire 66, resistance element R2, wire 67, resistance element R3, and a wire 68 to the bus wire 56, and thence by way of the branch wire 65 to the negative terminal of the battery 26. This circuit will be more readily apparent in Fig. 2.

If the respective temperatures of the two axle

journals are substantially the same, as they will be if operating at their normal temperatures, the Wheatstone bridge will be in a balanced condition. In such case, therefore, no current or substantially no current will flow through the pick-up winding *a* of the relay **48** because no unbalanced voltage is impressed on the pick-up winding that is connected across the wires **62** and **67**.

As long as both axle journals remain at normal operating temperature, the relay **48** will remain dropped-out notwithstanding the frequent establishment of the flow of current in the Wheatstone bridge by the operation of the switch device **27**.

If, however, one of the axle journals such as the left-hand journal in Fig. 1, starts to heat-up and reaches or approaches a temperature which may cause damage to the parts of the journal, the increased resistance of the resistance elements R1 and R3 produces an unbalanced voltage condition in the Wheatstone bridge upon connection of the battery **26** thereto by operation of the switch device **27**. It will be apparent that by reason of the arrangement of the two resistance elements R1 and R3 in the Wheatstone bridge and their disposition in the same heat detector cartridge **15**, a maximum unbalance of the bridge circuit is attained for a given rise in temperature of the axle journal affected. In other words, by exposing two of the resistance elements, such as R1 and R3, to the same variation of temperature or heat condition, twice the amount of unbalanced voltage is created across the terminals of the pick-up winding *a* of the relay **48** as would be the case if only one resistance element such as the resistance element R1 were effected by the equivalent temperature or heat change. This specific arrangement is accordingly one of the particular features of my invention by reason of the sensitivity it imparts in the apparatus to temperature changes in the axle journals.

The resistance of the resistance elements R1, R2, R3, and R4 when cold is preferably of uniform value and is so selected, with respect to the voltage of the battery **26** impressed on the Wheatstone bridge circuit, as to provide a sufficient voltage-drop across the pick-up winding *a* of relay **48** to cause actuation of the contacts of the relay to their picked-up position only after the temperature in one of the axle journals rises a predetermined amount above the normal operating temperature thereof as exemplified by the temperature of the unaffected journal. The exact degree of temperature rise above normal operating temperature of the axle journal at which the pick-up of the relay **48** is effected may be any desired amount dependent upon the degree of safety factor desired. It should be so selected, however, as to be sufficiently below the danger point at which severe damage may occur so as to provide adequate time for a train to be brought to a stop and suitable measures taken to restore the temperature of the affected journal to normal and to prevent recurrence of the abnormal heat condition.

Once the contacts of the relay **48** are picked-up, they are thereafter maintained in their picked-up position by the action of the holding winding *b*, the energizing circuit for which is established upon closure of the contact *c*. The circuit for energizing the holding winding *b* of relay **48** may be traced from the positive terminal of the battery **26** by way of the wire **54**, a bus wire **57** local to car A, a wire **71** including the contact *c* of relay **48**, holding winding *b*, and the reset switch **49***x* in series relation therein, and bus wire **56** and wire **65** to the negative terminal of the battery **26**.

Contact *d* of the relay **48** is effective, when closed, to establish a circuit for energizing and causing actuation of the alarm bell **49**, the signal lamp **50**, and the magnet winding of the magnet valve **51** on car A, as well as the alarm bell **49***a* and the signal lamp **50***a* in the cab on the locomotive. This circuit may be traced from the positive terminal of the battery **26** by way of the wire **54**, bus wire **57**, branch wire **71**, a branch wire **73**, contact *d* of relay **48**, a wire **74**, thence in parallel through the operating winding of the alarm bell **49**, signal lamp **50**, and the magnet winding of the magnet valve **51** to a wire **75**, which is in turn connected to the negative terminal of the battery **26** by way of the bus wire **55** and wire **65**. This circuit also extends from the contact *d* of relay **48** by way of the wire **74**, a branch wire **76** including an asymmetric device **76***x*, such as a dry disk or tube type of rectifier, to a train wire **77**, thence to the locomotive and by way of a branch wire **78**, in parallel through the operating winding of the alarm bell **49***a* and signal lamp **50***a* to a wire **79** which is connected to the negative terminal of the battery **26** as through a ground connection in the manner shown. It will thus be seen that upon the pick-up of the relay **48** due to an abnormal rise of temperature in one of the axle journals, various signal devices on the individual car are actuated as well as those on the locomotive.

As previously indicated, energization of the winding of the magnet valve **51** causes a reduction of the pressure in the brake pipe **52** resulting in an automatic application of the brakes on the train, thereby forcing the engineer to shut off the propulsion power and bring the train to a stop at once. If desired, the magnet valve **51** may be omitted, in which case the automatic application of the brakes on the train in response to pick-up of the relay **48** is not effected.

The arrangement of the asymmetric devices **76***x* is such as to permit the flow of current from a battery on a car to the train wire **77** but to prevent the reverse flow of current from the train wire to the signal devices on a car from the train wire. It will thus be apparent that when the train wire **77** is energized by flow of current therein due to pick-up of the relay **48** on one car, such as car A, the signal devices **49**, **50**, and **51** on another car, such as car B, are not affected because current cannot flow from the train wire **77** past the rectifier or asymmetric device **76***x* on car B to those signal devices on car B.

I have previously disclosed and claimed this general arrangement for causing a signal to be simultaneously produced on a car having a hot journal and on the locomotive while preventing the actuation of signal devices on cars not having a hot journal in my prior copending application, Serial No. 528,709, filed March 30, 1944, and assigned to the assignee of the present application. I accordingly make no claim to this feature in the present application.

In order to cause termination of the audible and visible signals on the cars and on the locomotive, the engineer and crew of a train will not intentionally disregard the occurrence of a hot box condition on any car of the train since it is a clear indication of their neglect to take the necessary steps to alleviate the condition. In the present instance, let it now be assumed that due to the automatic application of the brakes

effected by operation of the magnet valve **51** or, in the absence of the magnet valve **51**, due to the application of the brakes on the train initiated by the engineer on the locomotive, upon receipt of a signal, the train is brought to a stop and the necessary measures taken to alleviate the hot box condition.

It is desirable that it be mandatory, on the part of the engineer or some member of the train crew, to take some positive steps toward alleviation of the hot box condition in order to cause termination of the audible and visible signal on the car and on the locomotive. Such an arrangement is disclosed and claimed in my prior copending application above mentioned. In the present application, I have indicated a so-called reset switch **49***x* in the circuit of the holding winding *b* of the relay **48**. Although not so shown in the drawings, switch **49***x* is preferably located at a point which cannot be reached unless a positive step is taken toward alleviation of the hot box condition, such as on the interior of the end cover **16** of the axle journal casing. I have, for simplicity, not indicated such a location for the reset switch **49***x*, but it will be understood that in accordance with the principles taught in my prior copending application above mentioned, such location of the reset switch **49***x* may be selected.

It will be apparent, therefore, that in order to operate the reset switch **49***x* to open position, it will be necessary to remove the end cover **16**, thereby automatically insuring that a positive step will be taken toward alleviation of the hot box condition.

Upon opening of the reset switch **49***x*, the holding winding *b* of the relay is deenergized and, in the absence of any energization of the pick-up winding *a* of the relay **48**, as presently explained, the relay will be restored to its dropped-out position, thereby interrupting the circuit for energizing the signal devices on the cars on the locomotive.

It will be seen that with the train stopped, the switch **27** will remain in open position, thus disconnecting the battery **26** from the Wheatstone bridge circuit. Consequently there will be no voltage available to pick-up the relay **48**. Consumption of energy from battery **26** will thus be conserved. With the train stopped, therefore, operation of the reset switch **49***x* to its open position results in restoration of the relay **48** to its dropped-out position.

It should be apparent that by reason of the non-directional characteristic of the pick-up winding of relay **48**, the relay **48** will be picked-up in response to the occurrence of an abnormal heat condition in either of the axle journals. In the case of an abnormal heat condition occurring in the right-hand journal, therefore, notwithstanding the fact that the polarity of the unbalanced voltage impressed on the pick-up winding *a* of relay **48** will be reversed with respect to that which exists in the case of an abnormal heat condition occurring in the left-hand axle journal, relay **48** will be picked-up.

In Fig. 1 I have shown only one pair of axle journals, but it will be understood that the resistance elements in the heat detector cartridges **15** of other pairs of axle journals associated with a common axle on the same car are connected to the bus wires **55** and **56** in parallel relation to those shown in Fig. 1. Thus, a single battery **26** may serve as a common voltage source for a plurality of Wheatstone bridge circuits, subject to

the control of a single intermittently operated switch device **27**. In such case, however, the contacts *d* of the several relays **48** associated with each Wheatstone bridge respectively must of necessity be connected in parallel if it is desired to employ only one set of signal devices, such as the alarm bell **49**, signal lamp **50**, and magnet valve **51**, on each car. If desired, however, each Wheatstone bridge arrangement on each car may have its own set of signal devices controlled by its corresponding relay **48**.

It is deemed unnecessary to describe in detail the schematic diagram of the equipment as shown in Fig. 2, since corresponding parts in Figs. 1 and 2 are designated by the same reference numerals. Fig. 2 serves more readily than does Fig. 1 to convey an understanding of the arrangement of the resistor elements R1, R2, R3, and R4 in a Wheatstone bridge circuit, as well as of the relative points of connection of the relay **48** and the battery **26** to the Wheatstone bridge circuit.

Figure 3

In Fig. 3, I have indicated a modification of the arrangement shown in Fig. 1, characterized by a heat detector cartridge **15***a* provided in the place of the heat detector cartridge **15** associated with the right-hand axle journal in Fig. 1.

The cartridge **15A** is essentially the same in structure as the cartridge **15**, except for a modified form of base **17***a* substituted for the screw plug **17** and an outer enclosure in the form of a tubular housing **14***a* of insulating material attached to the base. In order to expose the interior of the tubular housing **14***a* to the ambient temperature, the housing has a plurality of holes or openings **85** therein.

The heat detector cartridge **15A** may be disposed and mounted in any convenient location. In the case of a railway car, it may be disposed within the car body so as not to be exposed to extremely low temperature during cold weather, thereby preventing a premature pick-up of the relay **48** due to the initial differential in the resistance of the resistance elements of the heat detector cartridge **15A** with respect to the resistance of the resistance elements in the cartridge **15** associated with an axle journal at normal operating temperatures.

The arrangement employing the heat detector cartridge **15A** exposed to ambient temperature is not as desirable for railway car trucks as the two journal arrangement shown in Fig. 1 because it requires twice the number of heat detector cartridges as the arrangement shown in Fig. 1, two detector cartridges being required for each axle journal instead of one as in Fig. 1.

The arrangement including the heat detector cartridge **15A** may be employed to advantage, however, in other situations where it is desired to have an indication of abnormal heat condition in a single journal or single bearing of a particular machine, such as a large generator or motor in an electrical power station.

There being no difference in the character of the operation, when employing the cartridge **15A**, with respect to the operation previously described in connection with the embodiment shown in Fig. 1, no further description of this modification is deemed to be required.

Having now described my invention, what I claim as new and desire to secure by Letters Patent, is:

1. Apparatus for registering the heat condition in a given zone, said apparatus comprising a Wheatstone bridge circuit having a separate

resistance element in each of the four legs thereof, two of said resistance elements being exposed to the heat condition in the given zone and the remaining two resistance elements being exposed to the heat condition in a different zone, means for intermittently impressing a voltage on said bridge circuit, said resistance elements being so arranged and connected that an unbalanced voltage is produced in said circuit while said voltage is impressed thereon upon a variation in the heat condition in the said given zone with respect to the heat condition in the said different zone, electrical relay means operatively responsive to the said unbalanced voltage when in excess of a certain value, means for maintaining said relay in its picked-up position notwithstanding cessation of the unbalanced voltage in said bridge circuit, signal means controlled by said relay, and means for restoring said relay to its dropped-out position.

2. Apparatus for registering the heat condition in a given zone, said apparatus comprising a Wheatstone bridge circuit having a separate resistance element in each of the four legs thereof, two of said resistance elements being exposed to the heat condition in the given zone and the remaining two resistance elements being exposed to the heat condition in a different zone, means for intermittently impressing a voltage on said bridge circuit, said resistance elements being so arranged and connected that an unbalanced voltage is produced in said circuit while said voltage is impressed thereon, upon a variation in the heat condition in the said given zone with respect to the heat condition in the said different zone, an electrical relay having a pick-up winding and a holding winding, said pick-up winding being energized in response to a predetermined unbalanced voltage produced in said bridge circuit to cause actuation of the relay from its dropped-out to its picked-up position, said holding winding of the relay being energized to maintain the relay picked-up in response to pick-up of said relay, signal means operated so long as said relay is picked-up, and manually operated switch means for effecting deenergization of the holding winding of the relay and the consequent restoration of the relay to its dropped-out position to terminate operation of the signal means.

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