

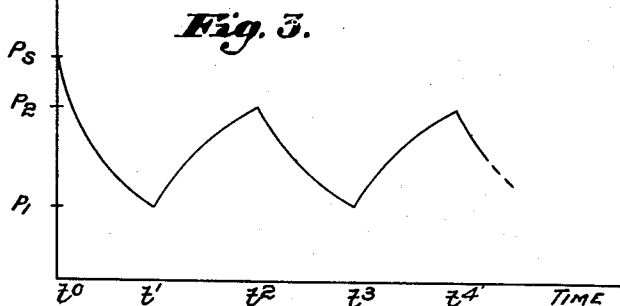
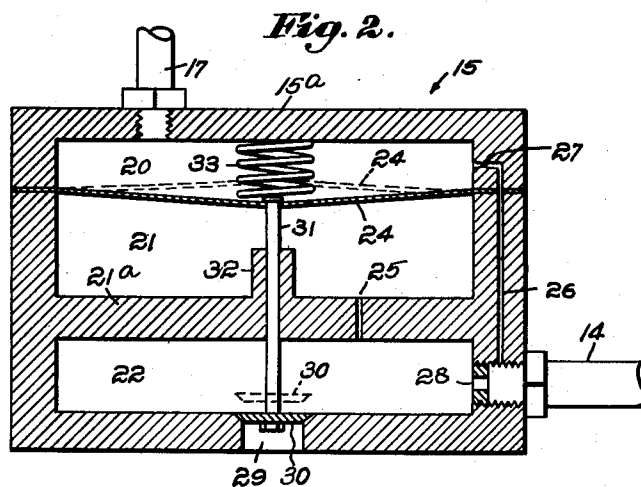
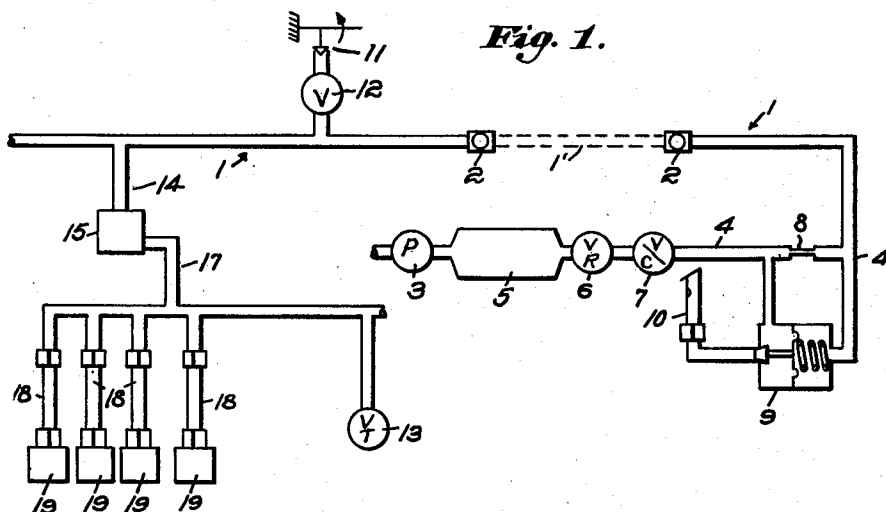
June 9, 1953

E. J. POITRAS
PNEUMATIC SIGNALING

2,641,689

Filed Jan. 12, 1950

4 Sheets-Sheet 1



INVENTOR.
Edward J. Poitras,
by Emory, Booth, Townsend, Miller & Widener
Attys.

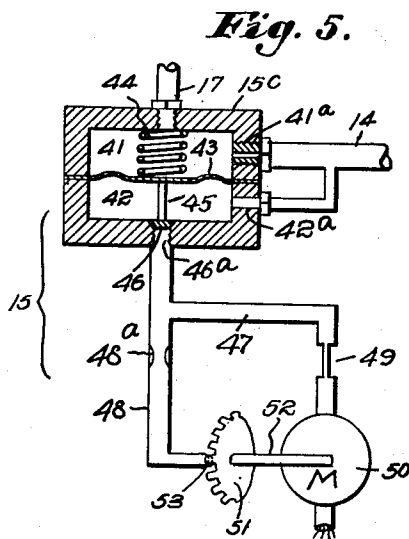
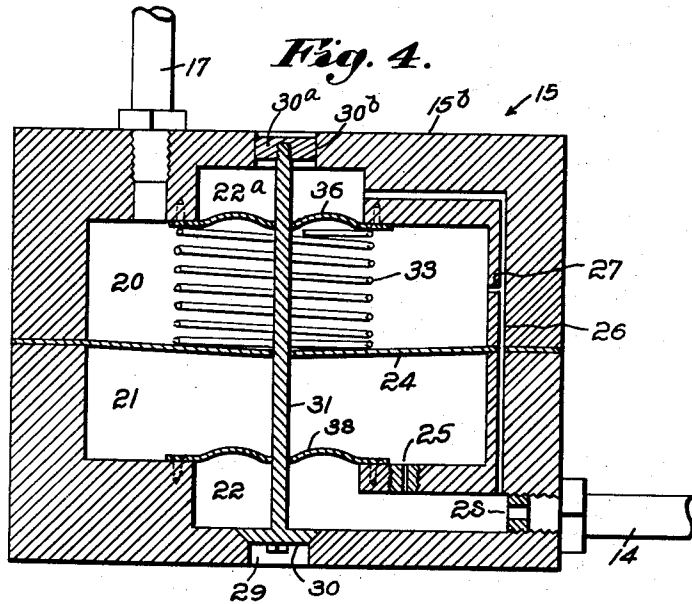
June 9, 1953

E. J. POITRAS
PNEUMATIC SIGNALING

2,641,689

Filed Jan. 12, 1950

4 Sheets-Sheet 2



INVENTOR.

Edward J. Poitras,
by Emery, Booth, Townsend, Milling & Weidner
Attys.

Filed Jan. 12, 1950

PNEUMATIC SIGNALING

4 Sheets-Sheet 3

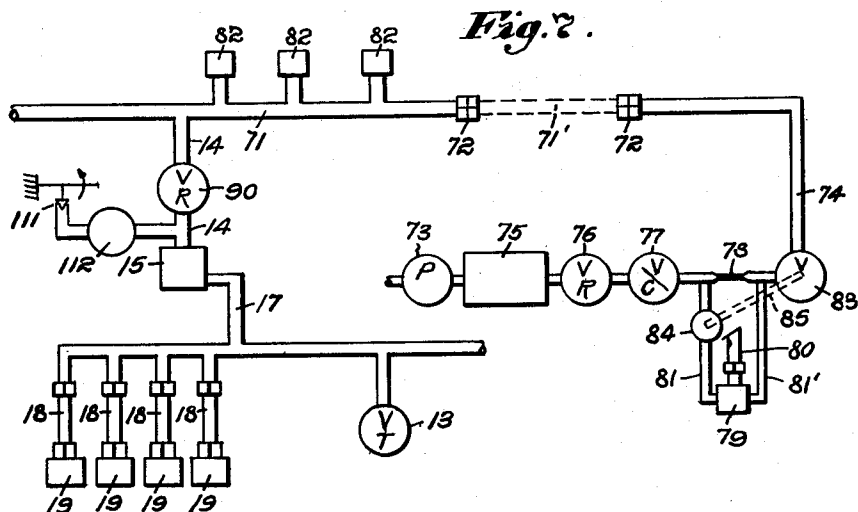
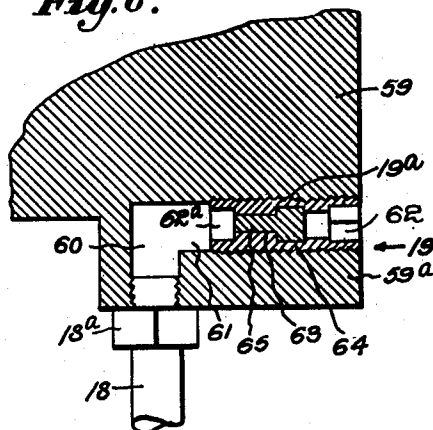


Fig. 6.



INVENTOR.

Edward J Poitras,
by Emery, Booth, Townsend, Miller & Weidner
Attys.

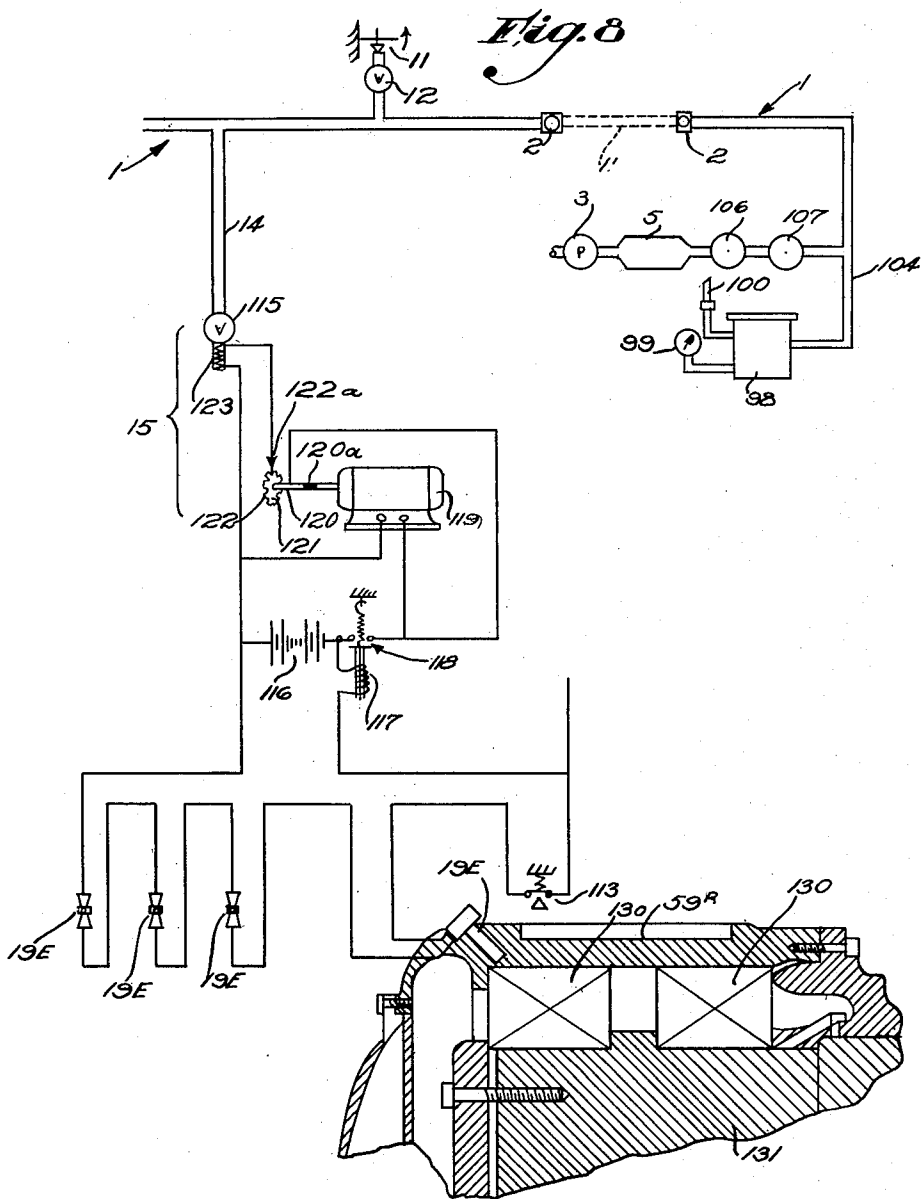
June 9, 1953

E. J. POITRAS
PNEUMATIC SIGNALING

2,641,689

Filed Jan. 12, 1950

4 Sheets-Sheet 4



Inventor
Edward J. Poitras
by Emery, Booth, Townsend, Miller & Widine
Attys.

UNITED STATES PATENT OFFICE

2,641,689

PNEUMATIC SIGNALING

Edward J. Poitras, Holliston, Mass.

Application January 12, 1950, Serial No. 138,129

16 Claims. (Cl. 246-169)

1

My present invention relates to temperature responsive alarm and signal systems and apparatus of a telegraphic character, in the general sense of transmitting intelligence more or less distantly. More particularly the invention concerns methods and means for adapting pneumatic systems, such as those generally included in standard railway train equipment, to the production of distinctive or specifically informative signals in accordance with the operative status of a thermally responsive detector as determined by an abnormal or excessive heated condition to be detected and indicated. Hence among other uses the invention is especially applicable to detecting and informing of the overheating of railway car journal bearings, the condition generally referred to as a "hot-box."

This application is a continuation-in-part of my copending application Serial No. 583,310, filed March 17, 1945.

The hot-box problem in train operation, being old and well known, requires no detailed explanation here. It is appropriate to note that this problem and the attendant dangers remain acute, particularly so under modern high-speed service and in view of the use demands upon rolling stock under existing conditions.

Various remedies have been proposed for avoiding the dangers of hot-boxes. Some of these have involved valving a pneumatic line of the train. But so far as I am aware provision has not heretofore been made for pneumatically signalling the specific intelligence that a journal box is overheated, as contrasted to some other valving or like pneumatic operation such as occurs when the line is deliberately valved by some person, or in the event of a break in the signal or other air line.

Accordingly the present invention aims to provide in association with an air line, particularly that of a train, methods and means for giving at a desired location specific intelligence of the heated condition of a part, and especially the occurrence of a hot-box or overheated journal bearing. In the instance of trains lacking signalling air lines the invention contemplates adapting the train brake air line to the stated signalling purposes. To that end the invention importantly includes the provision of pneumatic and electromagnetic-pneumatic telegraphic relays for impressing distinctively informative signals upon the system. The foregoing and other improvements in accordance with the invention will be apparent from the following description and in connection with the drawings, in which:

2

Fig. 1 is a schematic representation of an example of a system and means of the invention, suitable for practicing the method thereof, in this instance in association with railway air signal equipment which may be conventional;

Fig. 2 is a sectional view of one embodiment of a telegraphic relay such as included in Fig. 1 or Fig. 7, on a larger scale;

Fig. 3 is a graph of the pressure and time relationship within a chamber of the telegraphic relay, such as that of Fig. 2;

Fig. 4 is a partly diagrammatic sectional view of a modified form of telegraphic relay;

Fig. 5 is a schematic view, partly in section, of another alternative form of telegraphic relay;

Fig. 6 is a sectional view on a larger scale than Fig. 1 of one novel embodiment of a temperature responsive element or tampion associated with a journal bearing;

Fig. 7 is a schematic representation corresponding to Fig. 1, illustrating another system and means of the invention, suitable for practicing the method thereof, wherein conventional or other railway air brake equipment serves the dual role of the signalling as well as braking; and

Fig. 8 is in part a schematic representation of an example of a further system and means of the invention, in this instance employing an electrical detector and means of impressing a unique code signal upon railway air signal equipment, Fig. 8 also being in part a sectional view showing a typical location of one electrical detector controlling the coding means.

Referring to Fig. 1, a pneumatic signalling conduit, which may be conventional, such for example as on railroad passenger cars, is indicated generally at 1. This conduit 1 is connected as by couplings 2 to one or more similar conduits extending through adjoining cars, as indicated by broken lines at 1', and finally terminates at the engine in a conduit line 4. Air is supplied to a conventional or other accumulator 5 as by a pump 3 and is fed into the engine conduit 4, and thence to the train line 1, 1', via a regulator valve 6, a check valve 7, and a restriction 8, these latter serially arranged in the engine conduit 4. The pressures are maintained within the conduit system at some normal pressure, say, forty-five p. s. i., by the regulator 6. The state of flow in the line as a whole given by the pressure drop across the restriction 8 in the conduit 4 is measured at an engine signal valve 9 connected in parallel across this restriction. An audible warning of flow exceeding a critical amount is given by a flow of air from

3

the accumulator 5 and past the engine signal valve 9 to a whistle 10, this valve 9 being preset for opening actuation upon a particular pressure drop across the restriction 8. The valve 9, diagrammed as a spring-loaded diaphragm type, may be of any suitable form for the differential operation referred to. At convenient points, generally at least one on each car, the train line 1, 1' is provided with means whereby the crew may apply a signal upon the line. One such device is represented at the upper left in Fig. 1, comprising a conductor's manual valve 11 connected into the train air line 1 through a cut-off 12 for rendering it inoperative when desired. Valving of air from conduit 1 by hand operation of such valve 11 produces a flow through the conduits, including a flow at the restriction 8.

Connected to the main conduit 1 in parallel relationship to the usual valving attachments such as the described conductor's valve 11 is a conduit 14 communicating between the conduit 1 and a telegraphic relay device 15, to be further described in connection with Figs. 2, 4 and 5 showing alternative constructions thereof applicable in the system of the invention.

From the relay 15 there extends a conduit 17 having a number of branches and flexible conduit portions 18 disposed in parallel and each running to a thermally responsive venting means or unit 19. These latter are replaceable plug-like elements or tampions, described in more detail with reference to Fig. 6, one at each heat-subject location to be reported on, in mutual parallel relation so that each is similarly associated with the relay 15.

In the instance of railway train installations, each car may be equipped with the required number of tampions 19, generally at least one at each journal bearing of a wheel axle, renewably inserted for example in the standard "brasses" of such bearings; see Fig. 6. A given relay 15 may serve a number of cars or each car may be equipped with a relay, it being understood that an assembly of elements such as 14 to 19 of Fig. 1 may be provided wherever appropriate along the air line 1, 1' for the given train. Normally, that is, with the warning system in a state of "readiness," the conduits 17, 18, the relays 15 and the line-connected conduits 14 contain compressed air at a pressure equal to that in the train air line 1, 1', e. g. 45 p. s. i. Readily available means may be provided, for instance at each car, for testing the operative condition of the system. For this purpose I have represented in Fig. 1 a hand valve 13 inserted in the conduit 17, in parallel with the several tampions 19, and so as to be accessible inside or outside the car, or both. Manual opening of such test valve 13 releases the air under pressure in the conduits 17 and 18 and actuates the associated relay 15 in a manner characteristic of the venting of the conduits under a temperature-responsive action at any of the tampions 19. Thus the readiness of the hot-box signal system may be investigated at any time.

The system of the invention represented by way of example in Fig. 1, as applied to a train, functions automatically upon occurrence of a hot-box. The thermally responsive tampion 19 of the particular overheated brass vents air from the conduits 17, 18, reducing the assumed normal pressure of 45 p. s. i. therein substantially to atmospheric. This reduction or signal originating in the conduit 18 of the particular thermally-

4

affected tampion 19 causes the telegraphic relay 15 to begin a series of automatic operations producing an intermittent valving of air from the main line 1 via the associated lead-off conduit 14 and the relay 15 itself.

The relay means may be variously constructed and several alternative forms are described in connection with Figs. 2, 4 and 5. In each instance the construction and arrangement is such that a regular operating sequence is effective to impress upon the air line 1 a pre-established code signal. Consequently the associated alarm element, in this instance the whistle 10 in the locomotive, gives the specific information—and only that—that a hot-box is present. That is, in the system of the invention, the whistle 10 at the engine emits blasts in accordance with a predetermined code and the engineer is specifically informed of a hot-box occurrence, as distinguished from any other cause of flow in the train air line 1.

Considering now more particularly the signaling or relay-valve unit designated generally at 15 comprises a body 15a apertured at spaced locations for threaded or other attachment of the conduits 14 and 17 respectively. It contains a plurality of separated chambers including an upper chamber 20 to which the conduit 17 is connected, a lower chamber 22 having the conduit 14 attached thereto, and an intermediate chamber 21, the latter partitioned from the lower chamber 22 as at 21a. Herein such terms as "upper," "lower," etc. are merely for convenience in description and without significance as to the installed position of the relay. The intermediate chamber 21 is separated from the upper chamber 20 by a snap-acting diaphragm 24, to be further described, and has communication with the lower chamber 22 through a relatively small-diameter passage or restriction 25, shown in the partition 21a. The upper chamber 20, receiving the conduit 17, also communicates with the conduit 14 via a passage 26 along a wall of the body 15a and containing a flow-controlling restriction 27. The conduit 14 opens into the lower chamber 22 through a relatively large restriction 28. The chamber 22 provides a passage in the body 15a, between the conduit 14 and atmosphere, through a communicating port 29 having a closure means or valve 30.

The diaphragm 24 which constitutes a common wall between chambers 20 and 21 carries a valve stem 31 having the valve 30 fixed at its lower end, the stem extending through the partition 21a and being guided as by a boss 32 on the latter. The valve 30 and its stem 31 are loaded in the port closing direction by a spring 33 herein disposed in the upper chamber 20 and bearing between the diaphragm 24 and an opposite wall portion of the body or housing 15a.

In the condition of readiness, as represented by the full line position of the parts in Fig. 2, the port 29 is closed by the seated valve 30, and the conduit 17 and associated parallel conduits 18 are closed by the corresponding tampions 19. By reason of the described interconnection of the chambers 20, 21 and 22 the pressure in each of them is then equal to the assumed line pressure of 45 p. s. i.

The diaphragm 24 has been referred to as snap-acting by which I mean that an operative area of the diaphragm may be caused to snap, jump or click in a positive manner from one to the other of two transversely adjacent positions,

5

as indicated in somewhat exaggerated fashion by the full and the dotted-line positions in Fig. 2. This action, which may be termed "oil-canning," being analogous to that of an oil-can base, I have found takes place definitely, for the given diaphragm, at a characteristic critical differential in pressure at its opposite faces, and it is importantly availed of in the practice of my invention. For a diaphragm of desired area, the metal or other sheet material accordingly is selected as to gauge and stiffness to afford the characteristic "oil-canning" or snap-action at a predetermined pressure differential somewhere between the maximum and minimum pressure values attendant on operation of the particular relay, such as the minimum of approximately zero at atmospheric pressure and the maximum of 45 p. s. i. from the air line 1 in the assumed example.

Referring still to Fig. 2 and also to Fig. 1, assume now that a tampion 19 lets go in response to a hot-box, or that an operating test is made by manually operating valve 13. The air in conduit 17 being thus released to atmosphere, the pressure in chamber 20 is correspondingly reduced from the norm of 45 p. s. i. Consequently the valve 30 is forced open by the relatively greater pressure remaining in the chamber 21 and acting on the diaphragm 24. The lower chamber 22 is thus opened to atmosphere and the conduit 14 and hence the train line 1 is vented through chamber 22 and the relatively large restriction 28. It will be understood that the strength of spring 33 is selected to permit snap-action or oil-canning of the diaphragm at the predetermined pressure differential, for opening of the valve 30 under the stated circumstances and for closure thereof under the normal equal pressure conditions in chambers 20 and 21. In this connection the effective area of the valve 30 may be relatively small in comparison with that of the diaphragm 24. The restriction 28 between the lower chamber 22 and the conduit 14 has a diameter sufficiently large to insure that a signal is impressed on the main line 1 upon opening of the valve 30 as described. For example, it preferably has an orifice area at least substantially equal to that of the valve face of the usual conductor's manual valve represented at 11 in Fig. 1.

With the valve 30 open, as shown dotted in Fig. 2, the pressure in the intermediate chamber 21 falls exponentially towards atmospheric, the air being released to the now open chamber 22 via the restriction 25. The pressure differential at the diaphragm 24 in the valve-opening direction thus is reduced. When it reaches the predetermined value between the assumed maximum of 45 p. s. i. and the minimum or zero value at substantially atmospheric pressure, the spring 33 effects snap-action of the diaphragm 24 and forces valve 30 onto its seat, reclosing the port 29. Air from the conduit 14 now again raises the pressure in the lower chamber 22, toward the 45 p. s. i. supply pressure. Attendant the pressure in the intermediate chamber 21 rises exponentially toward that in the chamber 22. In the course of this increase, upon arrival of the critical pressure differential, the diaphragm 24 again reacts to open the valve 30 whereupon the cycle of operation is repeated. This distinctive operation or signalling continues so long as either a tampion 19 or a test valve 13 remains open. Because the diaphragm 24 is made to respond at a selected critical pressure differential the relay is afforded a regular and sequentially repeating operating

6

cycle uniquely determined by the volume of the intermediate chamber 21, the size of the restriction 25 and the spring 33.

The chart of Fig. 3 depicts the conditions in chamber 21 accompanying the production of a signal series consequent on the described operations, the pressure variation being represented as a function of time. For concreteness, let it be assumed that the force applied by the spring 33 to the diaphragm 24 has a value such that the equivalent pressure thereon is P_F ; also that the selected critical pressure differential for snap-warping or oil-canning action of the diaphragm similarly expressed has a value P_W ; and that P_S is the supply pressure as at the beginning of a cycle, assumed in the previous example as 45 p. s. i.

At a time t_0 on the graph of Fig. 3 a tampion 19 blows in response to a hot-box (or test valve 13 is opened). The relay 15 accordingly is actuated. The pressure chamber 21 drops exponentially to a value P_1 at time t_1 . This pressure is determined and represented by the expression $P_F - P_W = P_1$. At the pressure-time value $P_1 t_1$ the valve 30 closes and the pressure in chamber 21 builds up exponentially to a determined characteristic value P_2 at time t_2 , which latter conditions are represented by the expression

$$P_F - P_W = P_2$$

At the pressure-time conditions P_2, t_2 the valve 30 again opens and the cycle repeats. It will be noted with reference to Fig. 3 that the valve opening occurs at times designated $t_0, t_2, t_4, \dots, t_{2n}$ and that closing is at the times $t_1, t_3, t_5, \dots, t_{2n+1}$. By the choice of the values of P_F and P_W , for a given P_S , the time ratio of flow and non-flow in the air line 1 and consequently the ratio of the on and the off time for the whistle 10 is determined.

Thus the telegraphic relay 15 acts to vent the train line 1 intermittently, in a patterned manner, and with a definitely determined frequency. By pre-establishing the value for this frequency, for example by varying the size of the restriction 25 and by appropriate selection of the values P_F and P_W for the spring and the diaphragm respectively, the pneumatic signal is coded to indicate solely the detected abnormal or undesired operating condition of a mechanism, such as an overheated bearing or hot-box condition in the case of a train.

Fig. 4 illustrates a modified form of telegraphic relay similarly applicable in the system of Fig. 1, or that of Fig. 7 later described. The same reference numerals as in Fig. 2 are applied to corresponding parts of the Fig. 4 relay, in which the signalling cycle and sequence of operations is generally similar as in the Fig. 2 device. The relay body 15b contains main compartment volumes or chambers 20 and 21 separated by a movable wall or snap-warping diaphragm 24. A valve-operating rod or stem is affixed centrally to the diaphragm 24 and is extended at both sides of the latter to opposed chambers 22 and 22a provided in the body or housing 15b, the chamber 22 communicating with the conduit 14 through a sizeable restriction 28, as in Fig. 2.

The valve stem 31 is supported and laterally constrained adjacent its opposite ends by equal-area corrugated diaphragms 36 and 38 respectively separating the chambers 20 and 22a and the chambers 21 and 22. The chamber 22, as in Fig. 2, is ported to atmosphere at 29, and the adjacent end of the valve stem 31 has a valve head 30 for closing and opening this port. At

the other end the valve stem 31 carries a compensating piston 30a slidable in a bore 30b in the relay body 15b. Similarly as in Fig. 2 the supply pressure such as 45 p. s. i. is normally maintained in all of the chambers 20, 21, 22 and 22a. The interconnections include a passage 26 on the relay body extending between the chamber 22a and the opposite chamber 22, and communicating also with the chamber 20 through a bleeder restriction 27. Chamber 21 and the adjacent chamber 22 are interconnected around the diaphragm 38 by a restriction 25 similar to that in the partition 21a of Fig. 2. A spring 33 bears between the main diaphragm 24 and the valve body 15b in a generally similar manner as in Fig. 2.

Referring still to Fig. 4, assume now that pressure in conduit 17 is reduced to atmospheric or substantially so by a failure or abnormality in the operating condition of a tended part, as by temperature-responsive opening of a tampion 19 at a journal bearing (or by test opening of a valve 13). Pressure in the chamber 20 correspondingly falls, and the then greater pressure in the chamber volume 21 upon the diaphragm 24 snaps or click-warps the latter to open the port 29 by unseating the valve 30. The chamber 22 volume is thereby freed to atmospheric pressure and the conduit 14 is vented through the restriction 28 so as to impress a signal on the pneumatic system, here the signal system of a train.

The opposite chamber volume 22a is reduced to the same pressure as that of chambers 20 and 22 by means of the interconnections 26 and 27. The diaphragms 36 and 38 associated with these chambers 22a and 22 each have the same area, as stated. Likewise the face of piston 30a is of equal area to that of the valve head 30. Consequently the forces upon the valve stem 31 other than those due to the spring 33 and to pressures upon the diaphragm 24 are fully compensated.

On lowering of the pressure in chamber 22 in the open status of the valve 30 the pressure in chamber 21 drops exponentially via the leak constriction 25 between these chambers. As the pressure in chamber 21 falls a critical differential value is reached (see condition P_1, t_1 of Fig. 3) at which the spring 33 overbalances the chamber 21 pressure and the stiffness of the snap-acting diaphragm 24, so that the latter recloses the valve 30. The pressure thereupon builds up in chambers 22 (and 22a) and, via the restriction 25, in the chamber 21, exponentially as to the latter. When again the pressure value at the effective area of the snap-action diaphragm 24 exceeds the spring force and the diaphragm stiffness, then, at this critical and preselective value (see condition P_{2t} of Fig. 3) the diaphragm 24 snaps reversely and again opens the valve 30. This cycle of operation automatically repeats again and again until the pressure within the chamber 20 communicating with conduit 17 can build up to the supply or line pressure (e. g. 45 p. s. i.). This latter will occur upon reclosure of the point of air venting from the conduit 17, as by replacement of the blown tampion 19 which instituted the signalling cycles (or by reclosing the test valve 13 where opening thereof was the initiating cause).

Referring now to Fig. 5, I have there shown another form of telegraphic relay 15, again embodying means for intermittently venting a pneumatic signal system so as to impress on it a

predeterminedly coded signal indicative of an abnormal condition such as the excessive heating of a journal bearing or other part, and in particular the occurrence of a hot-box in train operation. In this instance the relay mechanism comprises a starting mechanism or valve including a body or housing 15c divided into chambers 41 and 42 by a flexible corrugated diaphragm 43. A spring 44 in chamber 41 bears between the diaphragm 43 and the valve body 15c, the diaphragm having rigidly secured to it a connecting rod or valve stem 45 carrying a valve 46 adapted to close or open an outlet port 46a from the chamber 42.

A venting conduit 17 corresponding to that of the previous views is connected into the chamber 41. Both chambers 41 and 42 are shown as subject to the pressure within the supply-line lead-off conduit 14, the latter being connected to chamber 41 via a relatively small restriction 41a, and to chamber 42 through a less restricted passage 42a having an effective area comparable to that of the valve-controlled port 46a. Since the restriction 41a between chamber 41 and the conduit 14 has a substantially less area, the major flow is confined to that into or through the chamber 42. Thus when the pressure in chamber 41 is reduced through the conduit 17, as by venting thereof to atmosphere at a tampion 19 or a test valve 13, the pressure differential resultant from the then greater pressure in chamber 42 will deflect the diaphragm 43 to compress the spring 44 and unseat the valve head 46. Thus spring 44 exerts a force on the diaphragm 43 equivalent to a pressure differential which is a small fraction of the supply pressure in conduit 14.

Connected to the outlet 46 of chamber 42 are branching conduits 47 and 48. Conduit 47 contains a relatively narrow restriction 49 markedly limiting any flow therein and beyond this restriction it is connected into an air motor 50 which discharges to atmosphere. Under air flow from the supply in conduit 14 via the chamber 42 and the branch conduit 47 past the limiting restriction 49 the motor 50 acts to drive a movable cam 51, diagrammatically illustrated as a rotary element operatively connected to the motor 50 by a mechanical movement 52.

The other conduit branch 48 from the outlet 46 of chamber 42, having a flow-controlling restriction 48a of relatively larger area than the restriction 49 of the motor conduit 47, terminates in a port 53 opposite and so associated with the cam 51 as to be vented or closed thereby in accordance with the pattern or configuration of the controlling face or peripheral portion of the cam. The air motor and the venting control cam may be assembled with the body or housing 15c or arranged as a connected unit.

Referring still to Fig. 5, upon venting of the conduit 17 as at a tampion 19 or a test valve 13, the pressure in chamber volume 41 drops substantially to atmospheric. The resulting pressure differential as between volumes 41 and 42 causes the valve head 46 to be unseated and accordingly to vent the conduit 14 through the passages 42a, 42 and 46a to the branching conduits 47 and 48. It should be noted that since spring 44 exerts on diaphragm 43 a force equivalent to a small fraction of the supply pressure, the valve head 46 remains unseated during the whole time conduit 17 is vented. The cam-associated conduit 48 receives the major outflow by reason of the more limiting size of the restriction 49 in the motor conduit 47. However, the pressure difference as between that in conduit 47

9

and the atmospheric outlet of the motor causes the latter to drive the cam 51, alternately presenting closing and opening portions thereof in cooperative relation to the outlet 53 of the conduit 48, thereby venting the latter intermittently in predeterminedly controlled fashion. Hence a signal or signal series is impressed on the train air line or other pneumatic signal system via the conduit 14, as regulated by the particular sequence of the venting and closing formations of the cam. These may be proportioned and arranged, or different cams interchangeably installed, to afford any desired ratio of on and off time for the pneumatic indicator or whistle 10, for example to effect any desired sequence of long and short blasts preselected as informative of the particular deleterious or overheated condition, such as a hot-box. From the foregoing it will be understood that the air flow at the restriction 49 and any possible leakage at the cam nozzle 53 when the latter is closed is insufficient to cause operation of the engine signal valve 9; also that the valve head 46, once opened in response to venting of the conduit 17, remains open for the duration of such venting.

Turning now to Fig. 6, I have there illustrated one of the thermally responsive venting elements or tampions, indicated as a whole at 19. In Fig. 6 a portion of a standard or other brass, such as bears upon an axle of a railway car, is indicated at 59. A thrust lug 59a of the brass is cross-drilled as at 60 and 61 and tapped to receive at one of these apertured portions the coupling nut 18a of a flexible conduit section 18, and to receive the tampion unit 19 in the other apertured portion. It will be understood that the "brass" 59 of which a portion is shown in horizontal section in Fig. 6 is in heat-subject relation to the particular part of which the temperature condition is to be indicated, in this instance a railway wheel journal, as more fully indicated in Fig. 8.

The improved tampion as here illustrated comprises a generally cylindrical and externally threaded body 19a of a material of high thermal conductivity. The tampion body is axially bored and is countersunk at either end, as at 62, 62a, such formation at the outer end 62 being of a non-round or internal hex form to fit a wrench for installing or removing the tampion with respect to the brass 59.

The bore of the tampion body, between the countersunk portions, includes a reduced cylindrical vent 63 and a communicating radially enlarged portion as at 64 providing a seat, shown at the end of the vent 63 which is nearer the outer end of the tampion. The vent 63 and the associated seat 64 are filled with an eutectic alloy 65 selected to have a characteristic temperature of melting or liquifying as appropriate to the particular use, as for example 350° F. for the car journal bearing installations.

Thus in the embodiment of Fig. 6 should the brass 59 become heated to a temperature of 350° F., under improper lubrication or other fault, the body of the valve or tampion 19 quickly conducts such heat to the contained eutectic alloy and causes it to liquify, the boundary region of the alloy contiguous to the containing body melting before the internal region. If a difference of pressure exists between the two ends or countersunk portions 62, 62a of the tampion, the melted alloy will be expelled. However, the alloy at the relatively narrower vent portion 63 completely liquifies ahead of that in the relatively voluminous seat 64. Hence the alloy en-

10

largement or collar in the seat 64 temporarily reinforces the alloy structure in the vent 63 against the force attendant on the differential pressure, and then upon the delayed liquification of the collar portion the entire alloy plug or structure in the bore portions 63 and 64 will suddenly let go and blow clean.

From the foregoing description of the improved heat-responsive tampion or valve means of Fig. 6 and in connection with the description of Figs. 1 to 5, it is evident that the supply-line pressure, assumed for example as 45 p. s. i., creates a pressure differential of corresponding value across the alloy insert 65 when the particular conduit 18 is sealed off by a tampion 19. The signal system is then in a state of readiness. On arrival of the specified temperature the alloy insert melts and blows, dumping the conduits 17 and 18 and thereby actuating a corresponding telegraphic relay 15 in the manner already described.

In connection with Fig. 1 the invention has been disclosed with reference to a pneumatic signalling system, particularly a train air signal system. Some railway cars, particularly freight cars, are not equipped with air signal lines. In such case, or alternatively even where an air signal line is present, the principles and means of the invention may be incorporated with the conventional train air brake system, adapting the latter to serve the dual role of distinctive or pre-coded signalling as well as that of braking.

Accordingly, referring now to Fig. 7, I have there shown a conventional or other air brake conduit 71, continuing through any desired number of cars as indicated by the dotted lines at 71' and having the usual couplings as at 72. Air brake units associated in the customary or preferred manner with the air brake line 71, 71' are indicated at 82. The line conduit 71, 71' through the various cars terminates at the locomotive in a conduit 74. Connecting into the latter, in similar serial manner as in Fig. 1, are a supply pump 73, a compressor 75, a regulator valve 76 and a check valve 77. These elements may be the conventional components of a train air brake system. In combination with them and with the air brake line 71, 71' and the engine conduit 74 I have shown in Fig. 7 further devices whereby the pneumatic braking system is adapted to serve additionally for signalling, and particularly as an overheated journal bearing or hot-box alarm system.

To that end there is further provided at the locomotive, in the conduit 74, a flow restriction 78, and shunted across the latter in a conduit 81, 81' a signalling valve 79 adapted to measure the pressure drop across the restriction 78 should a flow of air occur. Operatively connected to the valve 79 is a whistle 80 for giving an audible warning should this pressure drop exceed a critical value. The restriction 78, the signalling or pressure-drop measuring valve 79 and the whistle 80 have the similar function as the corresponding elements 8, 9 and 10 of Fig. 1.

Branching from the air brake line 71, 71' at appropriate locations (such as one for each car and preferably at each truck) is a signal conduit 14 and associated relay, conduit and tampion elements 15, 17, 18, 19, with if desired a manual test valve 13. Each such assembly of elements is disposed in parallel relation to the brake elements 82. Similar reference characters as in Fig. 1 are applied to corresponding elements 14-19 of Fig. 7, emphasizing the similarity in this respect in the systems of both these figures,

11

In Fig. 7 there is additionally included in the assembly of signalling parts a regulator valve 90 of conventional or preferred construction, inserted in the conduits 14 ahead of each relay 15, that is, between them and the air brake line 71.

As stated, the pneumatic conduit 71, 71' of Fig. 7 represents a train air brake line communicating at the locomotive with the conduit 74 and the described elements 73 to 81. Also at that location the brake valve 83 is inserted in the conduit 74, for venting the line in the customary manner to set the brakes 82 either manually or automatically. It is desirable that the release of air pressure to the brakes by operation of the valve 83 does not at the same time sound the whistle 80. For this purpose there is inserted in the conduit 81 of the signal valve 79 a cut-out cock 84 mechanically or otherwise connected to an operating member of the brake-controlling valve 83, as indicated at 85. Any preferred form of cut-out means 84-85 may be employed, that shown being similar to known cut-out arrangements, such as illustrated for example in Fig. 6 of U. S. Patent No. 823,114 of June 12, 1906, to Gerard.

The regulator 90 previously mentioned, shown in Fig. 7 installed ahead of the relay or signalling valve 15 desirably is provided in order that venting of the tampion conduits 17, 18 will not cause the brakes to be applied. Such regulator 90 serves to limit the pressure drop in the brake conduit 71 to a value sufficient for the distinctive signalling purposes of the invention but not such as to cause any setting of the brakes 82. Assume for example that the regulator valve 76 at the locomotive normally maintains a pressure of approximately 60 p. s. i. in the system; also that the brakes 82 will start to be set only when the pressure in the air brake line 71, 71', 74 falls to say 40 p. s. i. In such cases the relay-associated regulators 90 will be adjusted to prevent a pressure drop in the line below say 50 p. s. i. Correspondingly the engine signal valve 79 is set for actuation by a pressure drop across the restriction 78 of something less than 10 p. s. i. Thus the code signalling attendant on heat release of a tampion 19 and the action of the associated relay 15 is free to produce the predetermined signal at the whistle 80 similarly as explained in reference to Figs. 1 to 6, wholly without interference with the braking function of the pneumatic line.

With the brake valve 83 at the locomotive in its normal inoperative (brake-released) position, the cut-out 84 then being open by reason of the connection 85, the signal valve 79 is ready to detect a flow at the restriction 78 and accordingly to sound the whistle 80. If now a tampion 19 at one of the bearing brasses is thermally released in response to an overheated condition there, the corresponding conduits 12 and 17 are vented and the relay 15 acts to vent the conduit 14 in the determined intermittent fashion as described in connection with Figs. 2 to 5. The air brake line 71 is thereby vented through the relay 15 to impose on the line a distinctive signal in accordance with the pre-established code. The attendant pressure drop in the conduit 71 is restricted by the regulator valve 90 to a value substantially in excess of the assumed 40 p. s. i. braking pressure limit, such excess value being 50 p. s. i. in the given example.

This pressure reduction of 10 p. s. i. from the normal 60 p. s. i. value maintained in the line 75

12

71 by the regulator 76 institutes a flow at the restriction 78, measured by the signal valve 79 which accordingly actuates the audible signal or whistle 80, similarly as in the system of Fig. 1. Thus the whistle 80 will emit blasts at all times when the pressure in the air brake conduit 71 is reduced in accordance with the operation of a relay 15. Since the latter in turn is activated by a thermally responsive tampion 19 at a bearing brass, the distinctive coded signal thus impressed on the conduit 71 through the medium of a relay 15 conveys the specific intelligence—and only that particular information—that an overheated bearing or hot-box condition exists. This distinctive signalling will continue until the initiating tampion 19 is replaced.

In some instances, as for example on freight trains not equipped with air signal lines, it may be desirable to include provision for signalling through the medium of the air brake line for purposes other than automatically informing of a particular abnormal condition such as a hot box. In accordance with the invention as disclosed for example in connection with Fig. 7 the described provisions for utilizing a determined upper fraction of the air brake pressure make such other signalling readily available. For this purpose, referring to Fig. 7, a supplemental valve 111, including if desired a cut-off 112, which may be similar to the conductor's manual valve 11 and cut-off 12 of Fig. 1, may be connected into each or any of the signal conduits 14 behind the corresponding regulator 90, that is, between the latter and the automatic signalling means or relay 15, as indicated at the upper left in Fig. 7. Manual or other operation of such valve 111, which is in parallel to the particular relay and hot-box alarm means, will effect a corresponding signal at the locomotive by sounding the whistle 80 in the example illustrated. Such signalling venting as at a valve 111 may be in accordance with a prearranged telegraphic or other code or otherwise.

Fig. 8 depicts a still further embodiment of the invention and of means for practicing the same. As with Fig. 1 a pneumatic signalling conduit is indicated generally at 1. This conduit 1 is connected as by couplings 2 to one or more similar conduits extending through adjoining cars, as indicated by broken lines at 1', and finally terminates at the locomotive in a conduit line 104. Air is supplied to a conventional accumulator 5 as by a pump 3 and is fed via a reducing valve 106 where the pressure is reduced to a standard value and via a combined strainer, check valve and "choke" 107 to the engine conduit 104 and thence to the train line 1, 1'. A branch of the conduit 104 is connected to the locomotive signal valve 98, and another branch to the train signal pipe 1. The locomotive signal valve is provided with a whistle 109 and a pressure gauge 99.

As in the previous embodiments already described the air line 1 may be equipped with a conductor's signal valve 11, 12, generally one or more for each car. Connected to the main conduit 1 in parallel relationship to the usual valving attachments such as the conductor's valve 11 is a conduit 14 communicating between the conduit 1 and a telegraphic relay device here designated generally by the numeral 15, similarly as in the preceding instances. In this example of Fig. 8 the relay device 15, to be more fully described, is an electro-magnetic version of the all pneumatic relay of Fig. 5.

Connected in actuating relationship with this

13

relay 15 is a series of electrical thermostatic switch or detector elements desirably selected for rugged and jar-resistant construction and repeat capacity as well as good thermal performance, these preferably being such as disclosed in U. S. Patents Nos. 2,090,407 and 2,257,990, to W. J. Turenne and dated August 17, 1937, and October 7, 1941, respectively. Since these detector elements here serve the similar function in this electrically detecting embodiment of my invention as do elements 19 in the all pneumatic embodiments of Figs. 1 through 7, these thermally responsive units are designated by the same numeral 19 as in the previous views with the addition of an exponent E.

These thermal detector switches 19E are placed in intimate relationship with the bearing structure of the particular journal box (or other part to be protected) and are interconnected electrically in series relationship. Preferably the thermal detector switches 19E are of the normally closed type, that is, which open a circuit upon arrival of the abnormal heat condition, the switches returning to the usual closed status when cool.

In the system of Fig. 8 the thermal detector units 19E in the normal condition of readiness establish a continuous circuit between one another, a battery 116 or other electric source and an electro-magnetic relay 117. A manual test switch 113 may also be included in the series circuit. Thus with the series detector circuit in ready condition the detector units 19E are closed and the electro-magnetic relay 117 is opened, as in Fig. 8.

When the relay 117 is de-energized associated contacts 118 close and establish two parallel circuits through the battery or power source 116. One such circuit is through the electric motor 119 which operates the signal coding means. The other circuit is from the battery to the outer end of the motor shaft 120, insulated from the motor by insulating material 120a, to a rotary cam switch 121 on the motor shaft 120 provided with contact points or segments 122 wiped by a contactor 122a connected to a solenoid 123 of a solenoid valve 115, the other side of the solenoid being connected to the battery 116. This solenoid valve 115 controls the conduit 14 leading from the main line 1 and thus is pneumatically coupled to that line. The venting orifice of this solenoid valve 115 has an area similar to that of the conductor's hand valve 11, thereby to vent the train line 1 in response to call by a detector unit 19E or under opening of the test switch 113.

In operation, assuming that a thermally responsive unit 19E is actuated by arrival of the abnormal condition, a "hot-box" in the illustrated instance, the circuit containing the elements 19E accordingly is broken, the relay 117 is de-energized and the contacts 118 close. The described two circuits there established cause actuation of the motor 119 and set up a circuit through the rotary cam switch 121, its points 122 and the valve-operating solenoid 123. Rotation of the cam 121 by the motor 119 causes periodic making and breaking of the circuit at the contactor 122a with corresponding periodic energizing of the solenoid 123 and resultant periodic venting of the conduit 14 by the electro-magnetic valve 115, in a generally similar manner as taught in connection with Figs. 1 to 7. By selected arrangement of the segments or points 122 circumferentially about the cam 121 any desired predetermined code may be impressed upon

14

the air signal line. The ratio of the time of venting to that of non-venting may be adjusted to avoid objectionable depletion of the train line.

As illustrated at the lower right portion of Fig. 8 the thermally responsive electrical switch units 19E are disposed in position to respond to overheating of the bearing element 130, 130 of the railway car journal 131, such bearing being conventionally indicated on Fig. 8 as of the roller type generally comprising inner and outer races having the bearing rollers between them. In such case the switch units 19E are installed preferably by embedding them as shown in the bearing housing 59R in which are mounted the roller bearings 130, 130. Where plain bearings are used, commonly known as "brasses," the switch units 19E may be embedded therein as previously referred to in connection with Fig. 6. It will be understood that alternative circuits are available in the practice of the invention, the air line signal coding means 15 being arranged in a thermally responsive circuit which is either made or broken on arrival of the abnormal condition thereby to institute the coded signalling.

My invention is not limited either as to method or means to the particular steps or embodiments as illustrated and/or described herein, its scope being pointed out in the appended claims.

I claim:

1. In combination with a railway car including the trucks, wheel axles and their journal bearings, the car equipped with a pneumatic line adapted for signalling, normally closed venting means in heat-subject relation to one or more of the bearings for opening in response to overheating thereof, and telegraphic pneumatic relay means comprising a chambered body having a port and a conduit therefrom to the venting means for actuation of the relay means thereby, said body having a passage connected in communication with the pneumatic line of the car and leading from the body to atmosphere thereby to vent the line to impress a signal thereon, closure means controlling and normally blocking signalling venting of the passage, and periodic pressure-responsive means associated with the body for so predeterminedly operating the closure means on opening of the heat-subject venting means as to distinctively code the signal impressed on the pneumatic line, said relay means being interposed directly between the venting means and the pneumatic line.

2. The combination according to claim 1 in which the periodic pressure-responsive means comprises a snap-action diaphragm forming a chamber wall in the body and responsive to pressure differentials thereon, and a restriction interconnecting the chamber and the passage leading from the body to atmosphere thereby alternately to relieve and to create a pressure differential effective on the diaphragm in accordance with a pre-established time factor.

3. The combination according to claim 1 wherein the periodic pressure-responsive means comprises an air motor, and a movable cam operatively connected with the motor and presenting venting orifices of a selected pattern, the passage leading from the body to atmosphere extending to and cooperating with the cam for venting thereby.

4. In a fluid-pressure signal system associated with a part at which undue heating is to be determined, in combination, a thermo-responsive device in heat-subject relation to the part, a fluid-pressure cycling relay device for imposing

15

predetermined signals on the system, said cycling relay device comprising a valve chamber having a fluid pressure supply inlet, an outlet to atmosphere and an outlet valve; a snap-action diaphragm operatively connected to the valve; a chamber wherein the diaphragm defines a common wall between opposed volumes; spring means biasing the diaphragm for valve closing under substantially equalized pressure of the opposed volumes; passage means including restrictions for admitting the pressure fluid to one volume and for admitting it to or releasing it from the other volume accordingly as the valve is closed or open respectively; and port means controlled by the thermo-responsive device to vent the first-mentioned volume thereby to institute and continue during such venting a periodic opening and closing of the valve according to a time factor conjointly predetermined by the spring means, said other volume and the admission-relief restriction thereof, the cycling relay device being interposed between the thermo-responsive device and the fluid-pressure signal system so that the imposed signals characterize occurrence of undue heating.

5. In a fluid-pressure signal system associated with a part at which undue heating is to be determined, in combination, a thermo-responsive device in heat-subject relation to the part, a fluid-pressure cycling relay device for imposing predetermined signals on the system, said cycling relay device comprising a valve chamber having a fluid pressure supply inlet, an outlet to atmosphere and an outlet valve; a snap-action diaphragm operatively connected to the valve; a chamber wherein the diaphragm defines a common wall between opposed fluid-pressure volumes; spring means biasing the diaphragm for valve closing in the absence of an overbalancing pressure differential in the opening direction; restrictions communicating between the supply and both volumes normally to create substantially equal pressures therein, the restriction at one side of the diaphragm reversely operable to relieve the pressure thereat when the valve is open thereby to permit reclosing of the valve under spring-influenced snap-action of the diaphragm; and venting port means at one side of the diaphragm and controlled by the thermo-responsive device so as to create an overbalancing pressure differential in the valve-opening direction thereby to initiate and continue during operation of said means alternate opening and closing of the valve in predeterminedly timed sequence, the cycling relay device being interposed between the thermo-responsive device and the fluid-pressure signal system so that the imposed signals characterize occurrence of undue heating.

6. In combination with a railway car including the trucks, wheel axles and their journal bearings, the car equipped with a pneumatic line adapted for signalling, thermo-responsive means in heat-subject relation to one or more of the bearings for actuation in response to overheating thereof, an automatic telegraphic signal-coding relay device including a pneumatic outlet to atmosphere and a conduit connecting the relay device into the pneumatic line, the relay device further including a movable closure element for the outlet intermittently to vent and to restrict the same according to a predetermined time pattern imposing distinctively coded signalling impulses on the pneumatic line, a motor governing the intermitting action of the movable closure

16

element, and control means for the motor subject to the thermo-responsive means whereby actuation of the latter on overheating of a bearing starts and continues operation of the motor.

7. In a fluid-pressure signal system associated with a part at which undue heating is to be determined, the system including a pressure-fluid line having signal transmitting capacity, an automatic telegraphic signal-coding relay device operatively interposed between such part and the pressure-fluid line, said device comprising a hollow body containing first and second pressure volumes and a diaphragm defining a common wall between them, inlet and outlet passage means for the respective pressure volumes, the inlet passage means leading from the pressure-fluid line and the outlet passage means leading to atmosphere, the outlet passage means of the first pressure volume having thermo-responsive openable closure means operatively subject to the mentioned part and normally closed in the absence of undue heating of such part, the outlet passage means of the second pressure volume having a normally closed valve connected to the diaphragm for operation thereby on thermo-responsive opening of the first-pressure-volume outlet passage means, and periodic flow-modifying means for the passage means of one of said pressure volumes for so predeterminedly modifying the flow thereat as to intermit in distinctive coded manner the signals relayed onto the fluid-pressure line.

8. The combination according to claim 7 wherein the periodic flow-modifying means comprises a calculated restriction in the passage means of the second pressure volume, the body of the relay device including a rigid wall carrying said restriction, said wall presenting slide-bearing means for the valve.

9. The combination according to claim 7 wherein the periodic flow-modifying means comprises a calculated restriction in the passage means of the second pressure volume, and the valve is connected to the diaphragm by a stem extending through both pressure volumes and having a pressure-compensating piston at the end thereof remote from the valve.

10. The combination according to claim 7 wherein the periodic flow-modifying means comprises an air motor receiving actuating pressure from the outlet passage means of the second pressure volume, and a movable cam connected for operation by the motor and presenting vent orifices of a selected pattern, said outlet passage means of the second pressure volume including a conduit extending to the cam for venting by the orifices thereof.

11. In combination with a railway car and an air brake system therefor including a brake-applying valve, the car having trucks, wheel axles and journal bearings, a thermo-responsive detecting device in heat-subject relation to a journal bearing of the car and having a venting outlet for the air brake system, coding relay means for characteristically intermittently venting the air brake system via said outlet upon thermal response by the detecting device, regulator means limiting the pressure drop in the air brake system under such venting by the relay means to a selected value less than that for actuation of the brakes of the system, said relay means interposed between the thermal responsive device and said regulator means, a signal element operatively connected in the system and adapted for actuation in response to such limited pressure drop, a cut-off for the signal element, and means opera-

tively connecting the cut-off and the brake-applying valve.

12. In a fluid-pressure signal system associated with a part at which undue heating is to be determined, the system including a pressure-fluid line having signal transmitting capacity, a thermo-responsive electrical switch in heat-subject relation to said part, a conduit connected into the pressure-fluid line and providing a venting outlet to atmosphere for imposing signal impulses on the line, and automatic telegraphic signal-coding relay means operatively between the thermo-responsive switch and the venting outlet and comprising a solenoid-operated valve for said outlet, an operating circuit containing said valve, a coding circuit and electrical means therein controlling the valve operating circuit to cause the valve intermittently to vent and to restrict the outlet according to a predetermined time pattern distinctively coding the signal impulses on the line, and an electrical circuit controller in circuit with the thermo-responsive switch whereby actuation of the latter on overheating of the heat-subject part activates the valve operating and the coding circuits.

13. Apparatus for imposing on a fluid pressure system having signalling capacity signals to indicate undue heating of an associated heat-labile part, comprising a thermo-responsive electrical detector switch in heat-subject relation to such part, a valve for venting the system, a solenoid and coding control means therefor for operating the valve so as to impose distinctively coded signals on the system to characteristically indicate heating of such part, and electric initiating means responsive to the detector switch to activate the valve solenoid and the coding control means.

14. Apparatus according to claim 13 wherein the coding control means comprises a periodic make-and-break device for the valve-operating solenoid in a circuit therewith subject to the electric initiating means.

15. Apparatus according to claim 14 in which the periodic make-and-break device includes an electric operator therefor also in a circuit subject to the electric initiating means.

16. In a fluid-pressure signal system associated

with a part at which undue heating is to be determined, a thermo-responsive electrical switch in heat-subject relation to the part, a solenoid-operated valve connected into the system to vent and to close it thereby to impose signal impulses thereon, a solenoid operating circuit including periodic make-and-break means, an electric device to actuate the make-and-break means, a circuit containing said device, and circuit control means for said circuits governed by the thermo-responsive electrical switch thereby to establish determined periodic operation of the valve and characteristic coding of the signal impulses imposed thereby upon undue heating of the mentioned part.

EDWARD J. POITRAS.

References Cited in the file of this patent

UNITED STATES PATENTS

Number	Name	Date
679,945	Christensen	Aug. 6, 1901
700,766	Harris et al.	May 27, 1902
800,751	Marrs	Oct. 3, 1905
823,114	Gerard	June 12, 1906
928,459	Kieselhorst	July 20, 1909
1,001,084	Sauvage	Aug. 22, 1911
1,058,993	Marvin	Apr. 15, 1913
1,068,675	Lightfoot	July 29, 1913
1,270,954	Jordan et al.	July 2, 1918
1,318,369	Fischer	Oct. 14, 1919
1,512,456	Carmen	Oct. 21, 1924
1,600,527	Woodring	Sept. 21, 1926
1,758,711	McCune	May 13, 1930
1,820,147	McCune	Aug. 25, 1931
1,910,513	Yancy	May 23, 1933
2,114,762	Edmonds	Apr. 19, 1938
2,181,225	Campbell	Nov. 28, 1939
2,187,958	Vigne et al.	Jan. 23, 1940
2,304,839	Matheson	Dec. 15, 1942
2,339,436	Stephenson	Jan. 18, 1944
2,357,620	Thomas	Sept. 5, 1944
2,385,487	Baughman	Sept. 25, 1945
2,420,924	Whittaker	May 20, 1947
2,429,817	Jones	Oct. 28, 1947
2,486,546	Austin	Nov. 1, 1949