July 26, 1938. B. MISHELEVICH 2,124,626

APPARATUS FOR THE CONTROL OF HIGHWAY CROSSING SIGNALS

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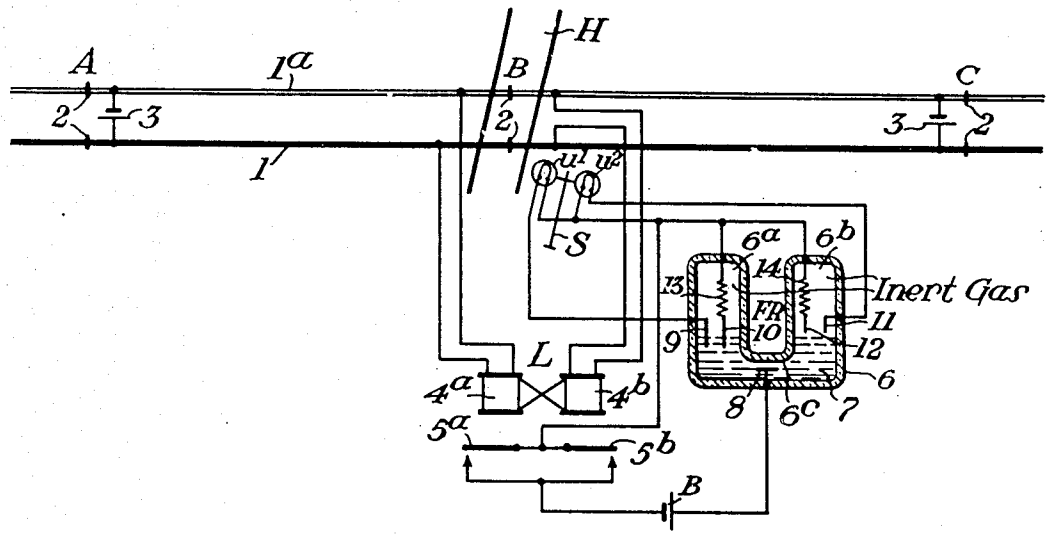


Fig. 1.

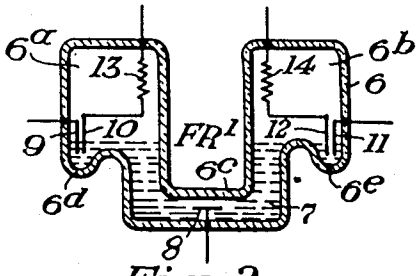


Fig. 2.

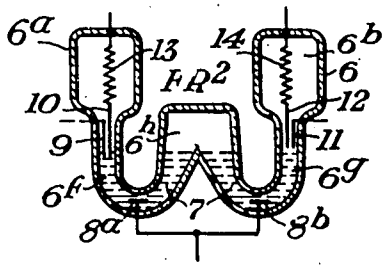


Fig. 3.

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APPARATUS FOR THE CONTROL OF HIGHWAY CROSSING SIGNALS

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2 Claims. (Cl. 200—122)

My invention relates to apparatus for the control of highway crossing signals, and particularly to apparatus for controlling the signal lights of highway crossing signals of the flashing light type.

One object of my invention is the provision, in apparatus of the type described, of a relay for controlling the light circuits in which the only moving element is a conducting liquid, such for example, as mercury.

In the accompanying drawing, Fig. 1 is a diagrammatic view illustrating one form of apparatus embodying my invention: Fig. 2 is a view showing a modified form of relay which may be used in place of the relay FR shown in Fig. 1. Fig. 3 is a view showing another form of relay which may be used in place of the relay FR shown in Fig. 1.

Similar reference characters refer to similar parts in all three views.

Referring to the drawing, the reference characters 1 and 1ª designate the track rails of a stretch of railway track over which traffic normally moves in both directions, and which is intersected by a highway H. Located adjacent the intersection of the railway and the highway is a highway crossing signal S, the function of which is to give a warning indication when a train is approaching the highway in either direction. The signal S may be of any suitable type of flashing light signal, and, as here shown, comprises two electric lamps U^1 and U^2 which are adapted to be alternately lighted when a warning is to be given.

The track rails 1 and 1ª are divided, by means of insulated joints 2, to form two track sections A—B and B—C, the junction of which is preferably located at or near the highway H. Connected across the rails of each section at the end farthest away from the highway is a suitable source of current, here shown as a battery 3, and connected across the rails of section A—B at the end nearest the highway is one magnet 4ª of an interlocking relay L, the other magnet 4ᵇ of which is connected across the rails of section B—C at the end nearest the highway. The interlocking relay L may be of any of the well-known types, such for example, as the relay illustrated in Letters Patent of the United States No. 799,452, granted to W. W. Coleman, on September 12, 1905, and as here shown is provided with a back contact 5 controlled by magnet 4ª, and a back 5ᵇ controlled by magnet 4ᵇ. The contacts 5ª and 5ᵇ are interconnected by interlocking apparatus (not shown) in such manner that if magnet 4ᵇ becomes deenergized after magnet 4ª becomes deenergized, as when a train moving from left to right traverses sections A—B and B—C, back contact 5ª will become closed but back contact 5ᵇ will remain open, and that, if magnet 4ᵇ becomes deenergized before magnet 4ª, as when a train moves from right to left over sections B—C and A—B, back contact 5ᵇ will becomes closed but back contact 5ª will remain open.

Associated with the signal S and relay L is a relay device FR embodying my present invention, which relay device I will now describe. As here shown, the device FR comprises a container 6 of non-conducting material, such as glass, provided with two chambers 6ª and 6ᵇ connected together at their lower ends by a connecting portion 6ᶜ. The connecting portion 6ᶜ and the lower portions of the chambers 6ª and 6ᵇ contain a conducting liquid 7, preferably mercury, which is free to flow from one chamber to the other through the connecting portion, while the upper portion of each chamber is filled with an inert gas, such for example, as hydrogen. Two contact members 9 and 10 are disposed in the chamber 6ª in such manner that when the conducting liquid 7 is at its normal level in this chamber, as shown in the drawing, these contact members will both project downwardly into the conducting liquid, and two other contact members 11 and 12 are disposed in the chamber 6ᵇ in such manner that when the conducting liquid is at its normal level in this chamber, these latter contact members will be disposed above the level of the liquid, while a fifth contact member 8 is disposed within the connecting portion 6ᶜ in such manner that this latter contact member is constantly immersed in the liquid. The chambers 6ª and 6ᵇ also contain heating elements 13 and 14, respectively, which are connected with the contact members 10 and 12, respectively, and which serve, when current is supplied to these elements, to heat the gas in the associated chamber.

The operation of the relay FR is as follows: When the heating elements 13 and 14 are both deenergized, and the gas in the two chambers 6ª and 6ᵇ is at the same temperature, as will normally be the case, the gas in both chambers will have the same pressure, and the liquid 7 will then have the same level in both chambers, as shown in the drawing. Under these conditions, the conducting liquid 7 will connect the two contact members 9 and 10 with the contact member 8, but the two contact members 11 and

12 will be disconnected from the contact member 8. When it is desired to operate the relay, the heating element 13 is connected in a control circuit which is completed through the two contact members 10 and 8 and the conducting liquid, and the heating element 14 is connected in a similar control circuit which is completed through two contact members 12 and 8 and the conducting liquid. By virtue of the control circuit for the heating element 13, current will flow through this heating element, and the heat which is generated in this heating element will expand the gas in the chamber 6^a and will thus cause the level of the liquid in chamber 6^a to become lowered, and the level of the liquid in chamber 6^b to rise. The gas will continue to expand until the level of the liquid in chamber 6^a moves downwardly to the point where the contact formed by the two contact members 10 and 8 and the conducting liquid becomes broken, at which time the heating element 13 will become deenergized. The parts are so proportioned that when the liquid in the chamber 6^a is at the level at which the contact formed by the contact members 10 and 8 and the conducting liquid 7 becomes broken, the contact formed by the contact members 8 and 9 and the conducting liquid, the contact formed by the contact members 8 and 12 and the conducting liquid, and the contact formed by the contact members 8 and 11 and the conducting liquid will all be open, but that a slight additional rise in the level of the liquid in the chamber 6^b will cause the contact formed by the contact members 8 and 12 and the conducting liquid 7, the contact formed by the contact members 8 and 11 and the conducting liquid to both become closed. It will be apparent that when the heating element 13 becomes deenergized, it will not immediately cool, and it follows, therefore, that after the circuit for the heating element 13 becomes broken, the level of the liquid in chamber 6^b will continue to rise a sufficient amount to complete the contacts formed by the members 8 and 12 and the liquid and the members 8 and 11 and the liquid. As soon as the contact formed by the members 8 an 12 and the liquid becomes closed, the heating element 14 will become energized and will cause the gas in the chamber 6^b to start to expand. The gas in the chamber 6^a will be simultaneously cooling, and as a result after a time interval sufficient liquid will flow from chamber 6^b into chamber 6^a to reestablish the contacts formed by the members 8 and 9 and the liquid and the members 8 and 10 and the liquid, and to break the contacts formed by the members 8 and 12 and the liquid and the members 8 and 11 and the liquid. As soon as the contact formed by the contact members 8 and 12 and the liquid becomes broken, the heating element 14 will start to cool, and as soon as the contacts formed by the contact members 8 and 12 and the liquid become made, the element 13 will again start to heat, thus causing the cycle to repeat itself. It will be apparent, therefore, that the relay may be made to alternately make and break the contacts formed by the members 8 and 9 and the liquid and the members 8 and 11 and the liquid at a measured time interval which depends upon the proportioning of the parts, and that by varying the proportioning of the parts this time interval may be adjusted to different values. It will also be apparent that the heating elements 13 and 14 correspond to the operating winding of the usual electromagnetic relay, while the contacts formed by the contact members 8 and 9 and the liquid, and the contact members 8 and 11 and the liquid, correspond to the control contacts of the usual electromagnetic relay.

The heating element 13 of relay FR is included in a control circuit which passes from one terminal of a suitable source of current, here shown as a battery B, through the contacts 5^a and 5^b of relay L connected in multiple, heating element 13, contact 10, conducting liquid 7, and contact member 8 to the other terminal of battery B, while the heating element 14 is included in a similar control circuit which passes from one terminal of battery B through the contacts 5^a and 5^b of relay L connected in multiple, heating element 14, contact member 12, conducting liquid 7, and contact member 8 to the other terminal of battery B.

The lamp U^1 of signal S is provided with an energizing circuit which passes from battery B through the contacts 5^a and 5^b of relay L in multiple, the filament of lamp U^1, contact member 9, conducting liquid 7, and contact member 8 back to battery B. The lamp U^2 of signal S is provided with a similar energizing circuit which passes from battery B through the contacts 5^a and 5^b of relay L in multiple, the filament of lamp U^2, contact member 11, conducting liquid 7, and contact member 8 back to battery B.

The operation of the apparatus as a whole is as follows: When contacts 5^a and 5^b of relay L are both open, as is the case when sections A—B and B—C are both unoccupied, the circuits for the heating elements 13 and 14 of relay FR, and the circuits for the lamps U^1 and U^2 will all be open at these contacts, and the heating elements will, therefore, be deenergized and the lamps will be extinguished. When, however, either one of these contacts becomes closed, the circuit for heating element 13 will become closed, and will thus start the relay FR operating in a manner which will be readily understood from an inspection of the drawing and from the foregoing description, thereby causing the contact formed by the contact members 8 and 9 and the conducting liquid, and the contact formed by the contact members 8 and 11 and the conducting liquid, to become alternately opened and closed, and, hence, the lights U^1 and U^2 to alternately flash as long as either contact 5^a or 5^b remains closed. Assuming, for example, that the operation of the apparatus was started by a train entering section A—B from the left and causing contact 5^a to become closed, it is obvious that the operation of the apparatus will stop as soon as the rear end of the train passes point B and permits contact 5^a to again open. Likewise, if the operation of the apparatus had been started by a train entering section B—C from the right and causing contact 5^b to become closed, the operation of the apparatus under these conditions will be terminated as soon as the rear end of the train passes point B.

Referring now to Fig. 2, I have here shown a modified form of relay FR^1 which may be used in place of the relay FR shown in Fig. 1. The relay FR^1 differs from the relay FR in that the shapes of the chambers 6^a and 6^b have been changed to form two wells 6^d and 6^e, respectively, both of which wells are constantly filled with conducting liquid. The well 6^d is disposed at a slightly lower level than the well 6^e so that when

the gas pressure is the same in the two chambers 6^a and 6^b, the conducting fluid in the connecting portion 6^c will make contact with that in the well 6^d but not with that in the well 6^e, whereas when the gas pressure is higher in the chamber 6^a than in the well 6^b, the conducting liquid in the connecting portion will then make contact with that in the well 6^e, but not with that in the well 6^d. Furthermore, the contact members 9 and 10 are so disposed that these members constantly make contact with the fluid in the well 6^d, and the contact members 11 and 12 are so disposed that these contact members constantly make contact with the fluid in the well 6^e.

The operation of the relay FR^1 is similar in all respects to that of the relay FR with the exception that the making and breaking of the circuits in which the various contacts are included is effected by the fluid in the connecting portion moving into or out of contact with that in the wells rather than through the fluid making and breaking contact directly with the contact members 9 and 10 and the contact members 11 and 12, respectively. This is important since the contact openings in this type or relay will usually be relatively small.

The operation of the apparatus as a whole when the relay FR^1 is used in place of the relay FR is identical with that previously described, and will be understood from the foregoing description without further detailed description.

Referring now to Fig. 3, I have here shown still another form of relay which may be used in place of the relay FR shown in Fig. 1. This relay, which relay is designated as a whole by the reference character FR^2, is similar to the relay FR with the exception that the lower ends of the chambers 6^a and 6^b, instead of being connected by a straight connecting portion, are connected by two U-shaped connecting portions 6^f and 6^g, one leg of each of which communicates at its upper end with a third chamber 6^h in such manner that the two legs at the point where they are joined form a sharp ridge. The two U-shaped portions are each partly filled with a conducting liquid 7, and disposed in the lower ends of these portions are two contact members 8^a and 8^b which are constantly immersed in the conducting liquid contained in the associated U-shaped portion. The auxiliary chamber 6^h is filled with an inert gas, and the parts are so proportioned that when the pressures of the gases in the two chambers 6^a and 6^b are equal, as will normally be the case when the heating elements 13 and 14 are both deenergized, the liquid in the connecting portion 6^f will connect the contact members 9 and 10 with the contact member 8^a, while the liquid in the connecting portion 6^g will be out of engagement with the contact members 11 and 12, so that the contact members 11 and 12 will be disconnected from the contact 8^b. The parts are further so proportioned that energization of the heating element 13 will cause the gas in the chamber 6^a to expand a sufficient amount to lower the level of the liquid in the left-hand leg of the connecting portion 6^f to the point where the liquid breaks contact with the contact members 9 and 10, and that the lowering of the liquid to this point will cause sufficient fluid to flow out of the connecting portion 6^f and into the connecting portion 6^g to raise the level of the liquid in this latter connecting portion to the point where it connects the contact members 11 and 12 with the contact member 8^b. The parts are still further so proportioned that energization of the heating element 14 will cause the liquid in the two connecting portions to return to the levels shown. The operation of the relay FR^2 will be readily understood from the foregoing description and from an inspection of the drawing without further description.

When the relay shown in Fig. 3 is used in place of the relay FR shown in Fig. 1, the relay will be connected with the remainder of the apparatus in the same manner that the relay FR is connected with the apparatus with the exception that the wire which leads from battery B to the contact member 8 in Fig. 1 will be connected with both contact members 8^a and 8^b of the relay in the manner indicated in Fig. 3. The operation of the apparatus as a whole when provided with the relay FR^2 is similar in all respects to that of the apparatus shown in Fig. 1.

Although I have herein shown and described only three forms of apparatus embodying my invention, it is understood that various changes and modifications may be made therein within the scope of the appended claims without departing from the spirit and scope of my invention.

Having thus described my invention, what I claim is:

1. A relay comprising a container of non-conducting material provided with two main chambers connected together at their lower ends by two U-shaped connecting portions one leg of each of which communicates with an auxiliary chamber, a conducting liquid in each connecting portion, an inert gas in each chamber, a contact member in each main chamber, the parts being so proportioned that when the temperature of the gas in both main chambers is the same the contact member in the one main chamber will make contact with the conducting liquid in the associated U-shaped connecting portion and the contact member in the other main chamber will be out of contact with the conducting liquid in the associated U-shaped connecting portion but that if the temperature of the gas in the one main chamber is increased to the point where the conducting liquid in the associated U-shaped connecting portion breaks contact with the associated contact member sufficient fluid will flow into the other U-shaped connecting portion to cause the fluid in this latter connecting portion to make contact with the contact member in the other main chamber, a heating element in each main chamber for controlling the temperature of the gas in such chamber connected at one end with the associated contact member, and other contact members constantly immersed in the liquid in the U-shaped connecting portions.

2. A relay comprising a container of non-conducting material provided with two main chambers connected together at their lower ends by two U-shaped connecting portions one leg of each of which communicates with an auxiliary chamber, a conducting liquid in each connecting portion, an inert gas in each chamber, a contact member in each main chamber, the parts being so proportioned that when the temperature of the gas in both main chambers is the same the contact member in the one main chamber will make contact with the conducting liquid in the associated U-shaped connecting portion and the contact member in the other main chamber will be out of contact with the conducting liquid in the associated U-shaped connecting portion but that if the temperature of the gas in the one main chamber is increased to the point where the conducting liquid in the associated U-shaped con-

necting portion breaks contact with the associated contact member sufficient fluid will flow into the other U-shaped connecting portion to cause the fluid in this latter connecting portion to make contact with the contact member in the other main chamber, a heating element in each main chamber for controlling the temperature of the gas in such chamber connected at one end with the associated contact member, other contact members constantly immersed in the liquid in the U-shaped connecting portions, and still other contact members adapted to make and break contact with the liquid in the two U-shaped portions according to the level of the fluid in these portions.

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