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SPARK EXTINGUISHING IN DIRECT CURRENT CIRCUIT

Filed March 8, 1938

Fig. 1

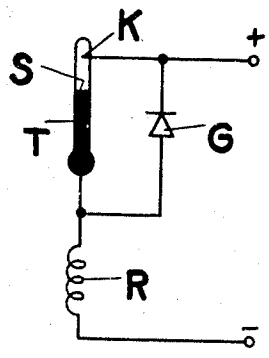
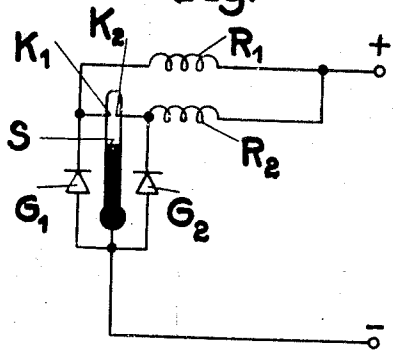


Fig. 2



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SPARK EXTINGUISHING IN DIRECT CURRENT CIRCUIT

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1 Claim. (Cl. 175—294)

For controlling the temperature, temperature regulators are used which incorporate with mercury thermometer, in which the contacts are melted (fused) so that at a certain temperature the circuit through the thermometer is completed. Difficulties frequently result if the output to be controlled by such a regulator is great, because the opening or gap between the contacts of the regulator is very small. Relays controlled by the regulators are self-inductive and an arc therefore easily remains when the contact opens which arc affects the regulating procedure and may even result in destruction of the contacts. In order to overcome these disadvantages complicated arrangements have been proposed whereby an electrolytic rectifier or rectifier tubes have been built in together with resistances, condensers and so forth. It has also been proposed to prevent sparking by building in condensers alone. No satisfactory result has been achieved by this measure, but on the contrary it has been necessary to use intermediary relays in the case of great output with the consequent drawback of increased cost.

The present invention has for an object to provide an extraordinarily simple and cheap installation, by means of which a very considerable increase of the output to be controlled by the contacts of the temperature regulator is possible, so that in all cases intermediary relays may be avoided.

The invention resides in the fact that parallel to the contact of the temperature regulator, a rectifier—preferably a dry rectifier—is installed in such a way that the rectifier can be traversed by the current only during the opening operation. It has been proved that with this arrangement no sparks occur during the opening of the contact. This rectifier G is of the type wherein if a breakdown occurs in the direction opposite the arrow, that is from top to bottom, no injury will occur to the rectifier but it will continue to function immediately upon the cessation of the arcing between contacts K and S.

Figures 1 and 2 show the application of the invention. T is a mercury thermometer, S indicates the mercury filling and K, K1 and K2 respectively as shown in Figure 2, are indicated the contacts. R is the coil of a relay possessing self-induction, G is a dry rectifier which is connected in parallel to the switch contact of the temperature regulator. The form of the illustration of the rectifier is known and shows that a current can pass only in the direction of the arrow, that is to say from the bottom towards the top. The arrangement is connected to the positive network by the upper terminal and to the negative network by the lower terminal.

If the temperature has risen sufficiently, the mercury column S reaches the contact K and thus closes the current circuit for the relay coil R from the positive network through the temperature regulator, the relay coil to the negative network. No current can flow through the rectifier since the direction of flow permitted by this rectifier is opposite that through the thermometer.

If the temperature is subsequently decreased, the circuit between K and S is interrupted and the relay coil R is currentless at a certain moment caused by the shortening of the mercury column S. By quick suppression of the current from its normal value to zero, a counter E. M. F. is generated in the relay coil R by its self-inductance, which without the existence of the rectifier G would reach momentarily a high value and break down the air gap between S and K. If no special switching measures are provided, this counter E. M. F. reaches momentarily a very high value. A rectifier of the kind provided is effective however in its rectifying direction only up to a certain voltage value and passes current in said direction if the voltage rises over this value. As soon as the induction voltage generated by the switching off rises over the voltage value in which the rectifier is still effective, an equilibrium takes place in the rectifying direction, which prevents an appreciable further increase of the induction voltage. In this way the undesirable sparking at the contact K is avoided.

For practical reasons such temperature regulators are mostly employed in accordance with Figure 2, in which a plurality of contacts K1 or K2 respectively are fused in the glass tube of the mercury thermometer, which open or close respectively at the equal temperature and of which each controls a relay R1 or R2 respectively.

The invention provides that with this arrangement a rectifier G1 or G2 is placed parallel to each interrupting point K1 or K2 respectively.

The arrangement is carried out in such a way that a network current cannot flow through the rectifier, but the latter may only pass an excess voltage which is generated at the opening of the current circuit.

The action of the so-called rectifiers G, possibly better referred to as cells, is based upon the fact that such constructions exhibit a different resistance in one direction than in the other direction. This resistance is very slight in the direction indicated by the arrowhead so that practically all current is allowed to pass. In the other direction the resistance is great. The effectiveness of the resistance, however, is not unchanged under any and all circumstances, but depends largely on the strength of the voltage. Up to a certain value of this voltage, that is, the rectifying voltage, the resistance is so great that there will actually result a rectifying or blocking action. If the voltage exceeds this value, then the resistance of the rectifying cell becomes smaller with the increase of voltage, and the rectifying cell is more and more traversed by the current in the rectifying direction under such increase in voltage.

Such a voltage, increasing beyond the rectifying voltage, develops, however, by cutting out an impedance. That is to say, the voltage becomes so much the greater as the resistance, opposed to the flow of compensation current, increases. When the current circuit is simply opened, the air gap will form a considerable resistance so that the impedance voltage will increase to a high value and thus finally break down the gap. It is at this point that the invention becomes effective, through the provision of a rectifying cell disposed parallel to the gap by switching it in such a direction that, within the range of normal voltage—for example, battery voltage—, the rectifying cell has an absolutely rectifying action. Within the range of this voltage, therefore, the resistance in the rectifying direction is great. However, when, by opening the switching contact, an impedance voltage is developed, then the resistance in the rectifying direction becomes smaller and smaller, with the increase of impedance voltage and finally the discharge will take place in the rectifying direction across the remaining comparatively slight resistance. With continued discharge, the impedance voltage becomes smaller, and as a result, the resistance in the rectifying direction again increases until it is finally capable of complete rectifying or blocking action.

What is claimed to be new is:

In a thermally actuated control for the purpose described, a circuit having positive and negative leads and including a relay coil and a mercury thermometer in series with the coil and having spaced contacts positioned for bridging by the mercury in the thermometer upon the mercury expanding under thermal influence, and a dry rectifier conductively connected in parallel to the thermometer, said positive lead being directly connected to one of said contacts and the negative lead being connected to the other contact through the coil, said rectifier having one side connected to the positive lead and its other side connected between the coil and thermometer and being positioned to prevent flow from the positive to the negative lead.

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