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SUPERVISORY CONTROL SYSTEM USING A FERRITE TRANSFORMER AND A TRANSISTOR
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Fig. 1

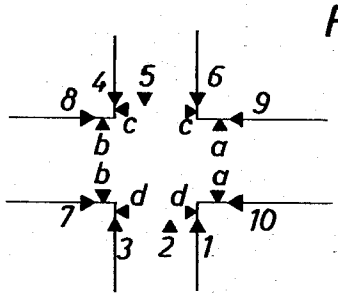
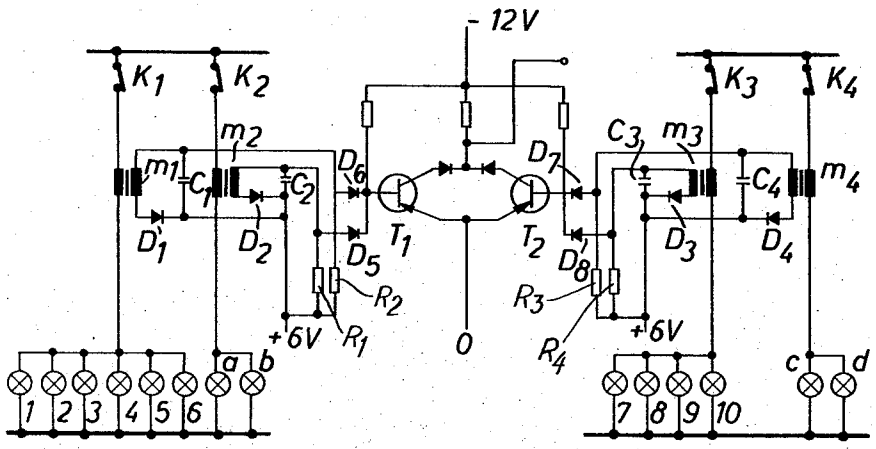


Fig. 2



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SUPERVISORY CONTROL SYSTEM USING A FERRITE TRANSFORMER AND A TRANSISTOR

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ABSTRACT OF THE DISCLOSURE

A supervisory signalling system for detecting the failure of a group of traffic lights having a common feed conductor. The primary winding of a small, ferrite core transformer is connected in series in the feed conductor and the secondary winding is connected to a switching transistor which operates in response to an interruption in the current flow through the conductor.

This invention relates to a control system for parallel switched signal lights having a control element in the common feed conductor, which, in turn, operates upon a switching device, in order to switch the latter, upon light failure. The invention concerns a substantial improvement of such control systems, in respect to simple and economical construction, as well as with reference to susceptibility to damage and functional reliability.

Control of signal lights is required in the greatest variety of technical devices. Most important is, for example, the supervision of signal lights of traffic signal installations. In crossings protected by such means there are for each direction of traffic a plurality of red lights and a plurality of green lights. It must not happen, that all the red lights of one traffic direction and all the red lights of the other traffic direction are out at the same time. It must also not happen, that the green lights of one traffic direction and the green lights of the other traffic direction are on simultaneously. Such pairs of light groups, which either must not be on simultaneously, or not off simultaneously, are called antagonistic or incompatible light groups. A device which is intended to prevent the described failure is called red supervision or green cutoff.

Several proposals have already become known for light supervision. Insofar as they provide relays in the feed conductors for the lights, these have the disadvantages that they are very susceptible to damage and are also very expensive. Insofar as the proposals concern the provision of a glow lamp in the feed conductor, which shines upon a photodiode, which in turn switches the actual control element, these solutions have the disadvantage, that on account of the nature of the glow lamps that are available in the trade, they do not always quickly and surely enough switch.

It is the object of the invention to overcome these disadvantages.

The general purpose of the invention is to provide a supervisory system, which has advantages over the present state of the art in as many respects as possible. In this sense all of the features described hereinafter, either in the specification or in the drawing, are of inventive significance, if they provide an actual advance over the state of the art.

In accordance with the invention the problem in a supervisory system of the kind first described is solved in this way, that there is provided, as a conrtol element, a ferrite core transformer, known per se, the primary winding of which is in the feed conductor, while a secondary winding operates upon the switching device. It is in this way achieved, that an economical component, without moving parts, which responds, furthermore, very rapidly and surely, is used as a supervisory element. In addition to this, ferrite core transformers on account of their enormously high overload capacity, are very well adapted for supervisory elements for light groups which consist of a plurality of parallel connected signal lights. Ferrite core transformers have previously been used almost entirely in the high frequency art, for problems which have nothing to do with the problem to which the present invention is directed. Therefore, the recognition that the property of high overload capacity, which was present in the previously known ferrite core transformers, but not used in this way, could make an improvement in the present situation, is of inventive significance. It is, in fact, the quality of high overload capacity, which makes it possible to supervise a plurality of parallel connected signal lights with a ferrite core transformer.

In accordance with a further feature of the invention, it is proposed, that the secondary winding of the ferrite core transformer be connected through a filter comprising a rectifier and a condenser, known per se, to the base of a transistor, so that the conductive state of the transistor is made dependent upon the current in the primary winding of the ferrite core transformer. Through the transistor a switching device can then be coupled, in known manner. The combination of ferrite core transformer and transistor is so advantageous, because it produces by the simplest means a switching device without movable parts, which responds instantly and at the same time is not easily damaged.

In accordance with a further feature of the invention it is proposed that for supervision of a plurality of light groups which are not incompatible with each other, each of said light groups be provided with a ferrite transformer and filter network for itself, and that the secondary windings of the ferrite transformers be connected in parallel to each other, through diode gates, to the base of a single transistor. By this arrangement it is achieved, that the previously mentioned advantage is available also if a plurality of light groups which are not incompatible are to be supervised, each one of which groups is provided with a ferrite core transformer.

In accordance with a further feature of the invention it is proposed, for supervision of a plurality of incompatible light groups, each light group be associated with a transistor through the ferrite core transformer and filter network and that the collector-emitter path of both transistors be connected in parallel to each other. Thereby it is achieved, that even incompatible light groups can be supervised with the previously described advantages.

The invention is described in more detail in the following specification, with reference to the accompanying drawings showing an illustrative embodiment.

FIGURE 1 is a schematic diagram to show the supervision problem of a street crossing, and

FIGURE 2 is a wiring diagram of the supervisory system for the red lights in FIGURE 1.

In FIGURE 1 one of the streets is protected in one direction of traffic by red lights **1**, **2**, **3** and red pedestrian lights *d*, *d*; from the other side by red lights **4**, **5**, **6** and red pedestrian lights *c*, *c*. The other street is protected by red lights **7**, **8** and by red pedestrian lights *b*, *b* at one side and by red lights **9**, **10** and red pedestrian lights, *a*, *a* at the other side.

The green lights—and usually present amber lights—are not shown, in order to improve the clarity of the drawing. For the red light supervision a group control is used in most cases. That is, that with two red lights for one traffic direction the control should only respond if both lights go out. In FIGURE 2 it is evident that the red lights **1–6** are controlled by contact **K1**, while the red lights *a*, *b*, are

controlled by the contact K2. The red lights 1–6, on the one hand and *a, b,* on the other hand, form two light groups, which are not incompatible. Of the light groups incompatible with them, the group 7–10 are controlled by contact K3 and group *c, d* by contact K4. It is evident that the red lights 1–6 and *a, b* must not fail at the same time as the red lights 7–10 and *c, d,* which are incompatible with them.

In each light circuit connected through one of the contacts K1, K2, K3, or K4, there is a ferrite core transformer *m*1, *m*2, *m*3, or *m*4, respectively. These special transformers are so designed as to be capable of sustaining the different loadings. This is made possible by the fact that ferrite core transformers can be highly overloaded. The voltage generated by, for example, the ferrite core transformer *m*1 is rectified by a diode D1 and filtered by condenser C1. The direct voltages so generated by the different ferrite core transformers *m*1, *m*2, *m*3, and *m*4 are applied through diode gates D6, D5, or D8, D7, to the bases of the related transistors T1 or T2, respectively. The contact groups K1, K2 and K3, K4 are normally operated in an alternating fashion to switch the traffic from one street to the other. The negative pole of the ferrite core transformers *m*1, *m*2, *m*3, and *m*4 are connected through diodes D6, D5, or D8, D7 to the bases of the related transistors T1 or T2. In this condition both transistors T1 and T2 are conducting. The signal so generated is transmitted through the customary amplifier (not shown). The output signal can be used in any desired manner, either for suppressing the green signals of the green signals lights (not shown), or for switching the system to blinking amber by the amber signal light (not shown).

If, for example, contact K2 is opened, the negative voltage of ferrite core transformer *m*2 drops out. On account of this the base of transistor T1 has positive voltage applied to it through resistance R1 and diode D5. The output signal through transistor T2 remains, however, unchanged. If, however, in addition contact K4 is opened, the base of transistor T2 will also receive positive voltage through R3 and D7. Transistor T2 is then cut off likewise. In such a case, namely, if both transistors T1 and T2 are cut off, the output signal is switched.

It is evident that the same effect will occur if the red light groups fail for any reason, whether it be for the previously mentioned opening of a contact or the breakage of the filaments of the red lights.

Naturally, the system can also be set up in such a way that the starting signal is switched even if only a part of the red lights in each of the incompatible light groups fails. What arrangement is used in a particular case will depend principally upon the regulations of the particular traffic authorities.

The important thing is this: If in any traffic period the green signal light is lit, the red signal light must not be lit at the same time. Conversely, if the red signal light is out the green signal light may be lit. Therefore, if the red signal lights of crossing traffic lanes are out on both traffic lanes, this means that the green signal lights of both traffic lanes may be lit. This case must also not happen. It would be equally as dangerous as if there were red light defects at both traffic lanes. The cutting out of the green lights required to overcome this danger, results automatically from the system according to the invention; that is to say, if the green lights of two crossing street lanes should be lit simultaneously, the red signal lights of both of those crossing lanes would necessarily be out. But this is exactly the situation in the abovedescribed supervision of red lights, which provide an output signal used either for suppressing the green signal or for switching the system to blinking amber. The supervision system in accordance with the invention therefore provides not only a necessary red lamp supervision, but also a reliable green control, which is, in effect, equivalent to green cut off. Only in a single situation does the supervising system afford no

output signal, if two crossing traffic lanes show green at the same time; namely, then, and only then, when it is not the case that, for any reason whatever the red lights of either traffic lane remain lit. In this case the red and green signal lights for one traffic lane would be lit simultaneously. Since in this case, however, the rule of operation of the red signal lights with reference to simultaneously illuminated green signal lights takes precedence, the protection of the crossing is assured.

What is claimed is:

1. A supervisory signalling system for detecting the failure of one of a plurality of compatible light groups wherein each group may include an unequal number of parallel connected lights, comprising:
   (a) a separate feed conductor for each light group,
   (b) a ferrite core transformer for each feed conductor having its primary winding connected in series in the feed conductor,
   (c) a diode-capacitor filter network for each transformer connected to the secondary winding of the transformer,
   (d) a transistor,
   (e) a diode gate for each filter network connected between the filter network and the base terminal of the transistor, and
   (f) a source of biasing voltage connected to each diode gate, whereby the interruption of current flow in any feed conductor unblocks its associated diode gate and the biasing voltage renders the transistor non-conductive.

2. A supervisory signalling system for detecting the failure of two incompatible light groups in first and second pluralities of light groups wherein the groups in the first plurality are compatible with each other and the groups in the second plurality are compatible with each other, but wherein the groups in the first plurality are incompatible with the groups in the second plurality and wherein each light group may include an unequal number of parallel connected lights, comprising:
   (a) a separate feed conductor for each light group,
   (b) a ferrite core transformer for each feed conductor having its primary winding connected in series in the feed conductor,
   (c) a diode-capacitor filter network for each transformer connected to the secondary winding of the transformer,
   (d) first and second transistors having their emitter-collector paths connected in parallel,
   (e) a first plurality of diode gates individually connected between the filter networks of the first plurality of light groups and the base of the first transistor,
   (f) a second plurality of diode gates individually connected between the filter networks of the second plurality of light groups and the base of the second transistor, and
   (g) a source of biasing voltage connected to each diode gate, whereby the interruption of current flow in the feed conductors of any two incompatible light groups unblocks a diode gate in each of the first and second plurality of diode gates and the biasing voltage renders both transistors non-conductive.

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