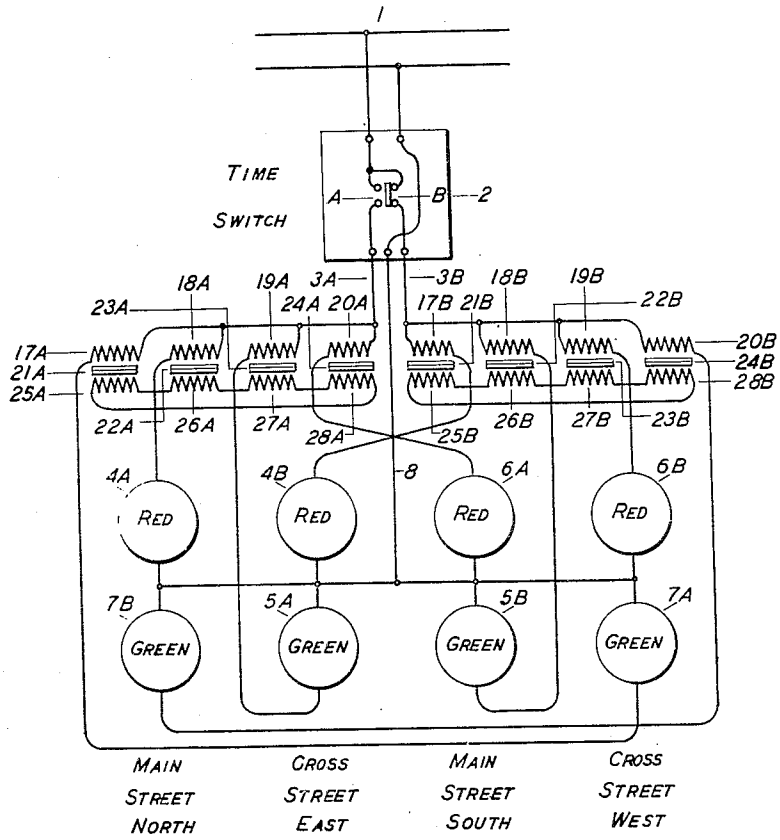
Nov. 30, 1937. A. S. FITZ GERALD 2,100,313

TRAFFIC CONTROL SYSTEM

Filed Dec. 21, 1933 3 Sheets-Sheet 1

FIG. 1.



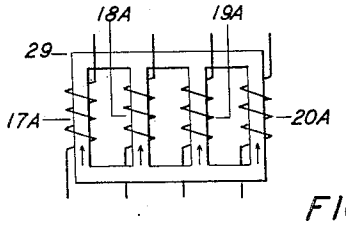


FIG 2

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TRAFFIC CONTROL SYSTEM

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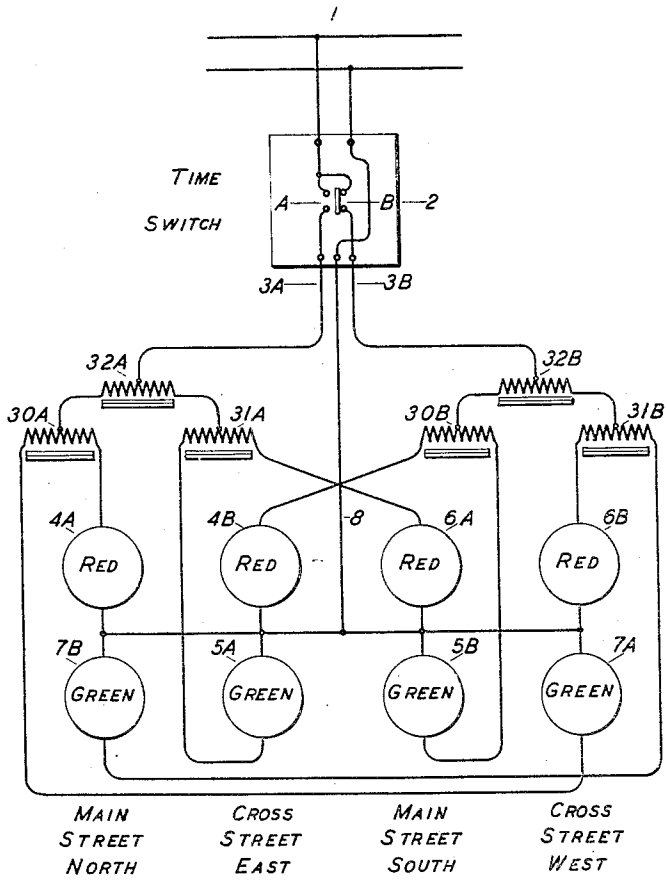


FIG 3

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TRAFFIC CONTROL SYSTEM

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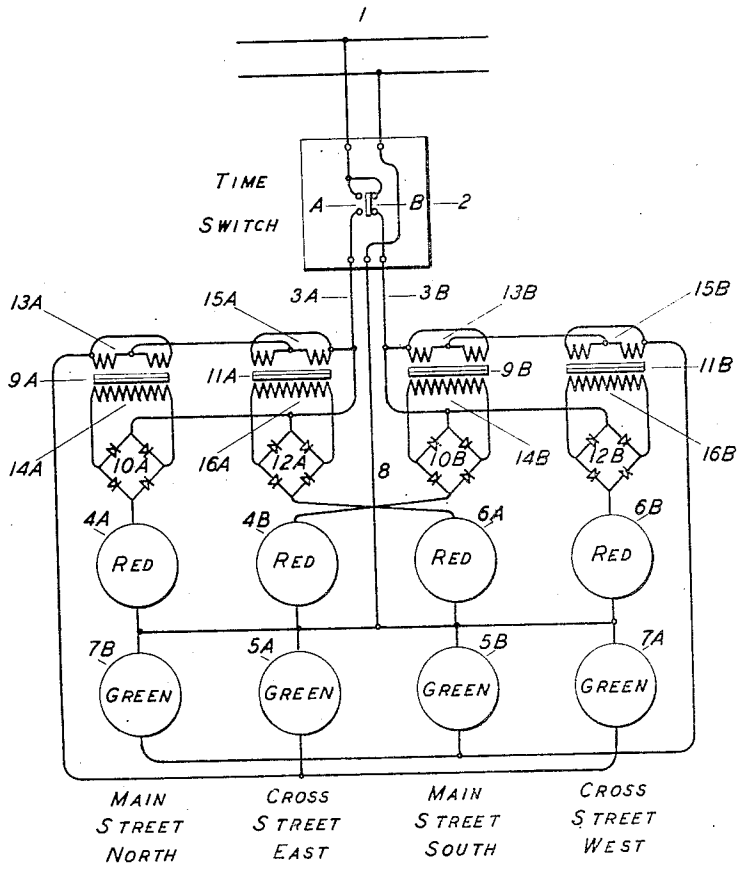


FIG 4

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2,100,313

TRAFFIC CONTROL SYSTEM

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Application December 21, 1933, Serial No. 703,342
In Great Britain December 23, 1932

7 Claims. (Cl. 177—337)

This invention relates to electric signalling systems, and more particularly to circuits for the control of traffic signal lights such as are used at highway intersections.

Traffic control systems, of the type commonly installed at the intersection of two highways, usually consist of at least two lighting circuits, controlled by means of a time switch, each circuit comprising two red lights and two green lights. For example, one circuit may include the two red lights on a main highway running north and south and the two green lights on a cross street running east and west. A second circuit may include two red lights on the cross street and two green lights on the main highway. These two circuits are, according to the usual practice, energized alternately by a time switch so that the traffic on one street is stopped, by exhibiting red lights thereto, while traffic on the other highway is permitted to proceed, by the showing of green lights.

The problem to which this invention relates is concerned with the elimination of a dangerous condition which may exist when one or more of the traffic control lamps fails to light due to a defect or failure in the system.

A situation which, at the present time, is a common occurrence in any big city, and which is liable to give rise to traffic accidents, which, of course, it is the main objective of a traffic control system to prevent, is the failure of one of the lights to be illuminated at the proper time, due to the burning out of the light, or to failure of a time switch contact.

Many traffic light installations, especially at intersections where traffic is heavy only at special hours of the day, as, for example, morning and evening business rush hours, are only put in service during certain hours. During other times of the day when the traffic is light it is common practice to switch off the traffic lights, either because they are not needed, or for reasons of economy.

At such times, drivers of vehicles, on observing that the lights are not illuminated are expected to exercise such caution, on approaching an intersection, as would be proper at any cross roads where no traffic lights exist.

If, however, one of the red lights fails to be illuminated a condition of danger results. Suppose, for example, that on a main highway running north and south, at the intersection of a cross street, running east and west, the red light which faces north, i. e. that which is exhibited to southbound traffic, burns out. Under this condition the following occurrence may result. Suppose, for example, a southbound vehicle approaches the intersection at an instant when the time switch is energizing the circuit which exhibits a red light north and south and a green light east and west, and that at the same time another vehicle, westbound on the cross street, approaches. The driver of the former vehicle sees no light because, by hypothesis, the red light facing north has burned out. He may assume that the traffic light system is not in service at that time of day and may drive according to the proper rule of the road at an intersection at which no traffic signals are present. He observes the second car approaching from his left, and, according to the rule, he may conclude that he has the right of way and may proceed and enter the intersection. The driver of the second car, on the other hand, who, if there were no traffic lights would not have the right of way, sees a green light, and feels justified thereby in proceeding at full speed.

The danger residing in such a condition is manifest and this condition is one which it is common experience frequently exists.

It is therefore an object of the present invention to eliminate the above cited element of danger in traffic control systems by preventing the illumination of green lights at any time when a red light, which should be simultaneously illuminated, fails to be energized due to a defective condition in the system.

While the provision of electro-magnetic contact-opening devices for accomplishing the above purpose may readily be arranged, one of the more common causes of failure in traffic light systems is defective contacts. Traffic signal control apparatus is employed under severe operating conditions in that the equipment is installed out of doors and is exposed to various weather conditions and in addition, in many instances, it is in continuous service. Unless such apparatus receives skilled and regular maintenance it is evident that, apart from burning out of lights, contact trouble will probably occur occasionally. As a means of avoiding this difficulty, it would clearly not be logical to install additional apparatus embodying contacts.

A further object of the present invention, therefore, is to provide a means of preventing exhibition of a green light, on failure of a red light to function, by means of entirely stationary apparatus having no contacts.

These and other novel features which I believe to be characteristic of my invention will be set

forth with particularity in the appended claims. My invention itself, however, both as to its organization and method of operation, together with further objects and advantages thereof, may best be understood with reference to the following description taken in connection with the accompanying drawings, in which:

Figure 1 is an electrical circuit diagram of an embodiment of my invention and:

Figures 2, 3, and 4 are electrical circuit diagrams of modifications of my invention.

In Figure 1 I show a source of alternating current power 1 and a time switch 2 adapted to energize, alternately, two lamp circuits through contacts A and B respectively. The circuit controlled by the contact A includes the conductor 3A and signal lamps 4A, 5A, 6A and 7A, respectively. The circuit controlled by contact B includes the conductor 3B and signal lamps 4B, 5B, 6B, and 7B. All of the signal lamps are connected to one terminal of the source 1 through a common conductor 8.

The lamps 4A and 6A may be taken to represent the red lights facing north and south, respectively, on a main highway and the lamps 5A and 7A may represent the green lights facing east and west, respectively, on an intersecting cross street. Similarly the lights 4B and 6B may represent the red lights controlling the cross street and 5B and 7B the green lights controlling the main street.

It will be apparent from the diagram that when the time switch closes the left hand contact A, energizing the circuit 3A and illuminating the lamps 4A, 5A, 6A, and 7A, traffic on the main street will be given the stop signal and traffic on the cross street will receive the go signal. When the time switch closes the right hand contact B, energizing the circuit 3B and illuminating the lamps 4B, 5B, 6B, and 7B, cross street traffic will be halted and the main street traffic will be given the signal to proceed.

In accordance with my invention as shown in Figure 1 I provide a transformer connected in each lamp circuit. The transformers have primary windings 17A, 18A, 19A, 20A, 17B, 18B, 19B, 20B, cores 21A, 22A, 23A, 24A, 21B, 22B, 23B, 24B, and secondary windings 25A, 26A, 27A, 28A, 25B, 26B, 27B, and 28B.

Each of the primary windings is connected in series with one of the lamp circuits and, as shown in the drawings, all of the secondary windings associated with the lamp circuits intended to be simultaneously energized, are connected in series to form a closed circulating current circuit. That is to say, when all of the primary windings are carrying equal currents the connections of the secondary windings should be such that the induced voltages are additive in polarity.

In accordance with this arrangement it will be readily understood by those skilled in the art that so long as all of the lamp currents are equal, current will circulate in the secondary windings and there will be no substantial magnetization of the transformer cores. Accordingly the transformers, under normal conditions, operate under the same conditions as current transformers. They do not, therefore, represent any appreciable impedance and all of the lamps are energized substantially at the voltage of the source 1.

If, however, any one of the four lamps in either group fails to light, the secondary of the transformer which has its primary winding connected in series with the open-circuited lamp now acts as a choke coil and affects flow of circulating current in the closed circuits such that the secondary ampere-turns of the remaining three transformers no longer corresponds to the primary ampere-turns. Thus each of the three remaining transformers no longer represent negligible impedance. The transformers may be provided with magnetic circuits and windings having such turns that when one lamp fails the remaining three transformers, under the conditions cited, present sufficient choke coil effect to prevent the remaining three lamps from being effectively illuminated.

If desired the identical effect outlined above may be brought about by a slightly different structure as indicated in Figure 2. Instead of employing four separate magnetic cores 21A, 22A, 23A, 24A, etc., each of the primary windings 17A, 18A, 19A, 20A, etc., may be situated on a single magnetic core 29 of four-legged shape, as indicated in the drawings. No secondary windings are required. It will be obvious to those skilled in the art that this arrangement is an equivalent of that shown in Figure 1.

In either of the arrangements shown in Figures 1 and 2 it will be noted that, when all four lamp currents are present and equal, no effective magnetization of the magnetic circuit results. When one circuit fails, magnetization of the magnetic circuit takes place presenting a choke coil effect which dims the remaining lamps.

An alternative arrangement for accomplishing the same result is shown in Figure 3 in which the source 1, time switch 2, and lamps 4A, 5A, 6A, 7A, 4B, 5B, 6B, and 7B, are indicated by like numerals as in Figure 1.

In the arrangement shown in Figure 3 I employ six choke coils or reactors provided with mid-point taps, 30A, 31A, 32A, 30B, 31B, and 32B. On referring to the drawings it will be noted that red lamp 4A and green lamp 7A are energized respectively, through half sections of the reactor 30A, the direction of the two lamp currents in the winding of the reactor being such that the magnetic effects are equal and in opposition. Thus when both lamps are burning no magnetization of the reactor 30A takes place and its impedance is substantially zero.

In like manner green lamp 5A and red lamp 6A are energized through reactor 31A, the remaining lamps being energized in precisely the same way through reactors 30B and 31B.

As further shown in the figure the two parallel circuits which include the reactor 30A, lamps 4A and 7A, and the reactor 31A, lamps 5A and 6A, are energized through the reactor 32A according to a similar principle.

If, for example, red light 4A should burn out there would be no current in the right hand section of reactor 30A. The left hand section therefore functions as a choke coil, preventing green lamp 7A from being energized. Both lamps 5A and 6A, being intact, reactor 31A is unmagnetized and presents no choke coil action. The reactor 32A has unequal currents in the two half sections. The right hand section carries a current equivalent to that taken by two lamps, whereas the left hand section carries only the current of one lamp. Accordingly the exciting ampere-turns of the two half sections are no longer equal and magnetization of the core of 32A, in accordance with the difference between the two currents, takes place. The resulting choke coil effect, by suitable design of the reactors may

readily be made such that neither green lamps 5A nor 7A may be energized sufficiently to provide effective illumination.

As shown in Figure 3 the above described arrangement is duplicated in respect of the circuit energized from the contact B on the time switch 2.

In accordance with my invention as shown in Figure 4 I energize the green lights in series with saturating reactors and cause the saturating reactors to be saturated with rectified current derived from the red lamp circuits. So long as the red lamp circuits are intact the saturating reactors are completely saturated and represent a negligible impedance in the green lamp circuit. But if one or both of the red lamps should burn out, or should fail to be illuminated due to contact trouble, one or both of the saturating reactors will be unsaturated, and will represent an effective impedance in series with the green lamps. This impedance may be of such a value that it prevents the green light from being sufficiently energized to give visible illumination.

I connect in series with each of the red lamps 4A, 4B, 6A, and 6B, respectively, rectifiers 10A, 10B, 12A, and 12B. Rectified current from these rectifiers is caused to flow in the saturating windings 14A, 14B, 16A, and 16B of four saturating reactors which have cores 9A, 9B, 11A, 11B, and impedance windings 13A, 13B, 15A, 15B.

Green lights 5A and 7A, which are energized when the time switch closes the contact A are, as shown in the figure, connected in parallel and are energized in series with the two impedance windings 13A and 15A. Likewise the two green lights 5B and 7B which are energized when the time switch closes the contact B are, in parallel, energized in series with the impedance windings 13B and 15B.

In accordance with the above arrangements it will be seen that so long as both of the saturating reactors are saturated, the corresponding pair of green lamps will be energized at substantially the voltage of the source 1, both of the saturating reactors presenting negligible series impedance. But if either of the red lamps burns out or fails to light one of the reactors will become unsaturated and will prevent either of the green lights from being effectively illuminated. If both of the red lights should fail the same effect, to increased extent, will take place.

It will further be seen, on referring to the diagram, that the circuit which is energized when the time switch closes contact B, is connected in a precisely similar manner and functions in the same way.

Although I have chosen a particular embodiment of my invention for the purpose of explanation, many modifications thereof will be apparent to those skilled in the art to which it pertains. My invention, therefore, is not to be limited except insofar as is necessitated by the prior art and the spirit of the appended claims.

What I claim as new and desire to secure by Letters Patent of the United States is:

1. In a traffic signalling system for a highway intersection, electric stop and go signals, a circuit for said stop signal, a second circuit for said go signal, means for intermittently and simultaneously energizing said circuits to an extent sufficient to render the said signals operative, and an impedance device connected in said circuits, said device having minimum impedance when both said circuits are energized, but presenting a substantially greater impedance to one of said circuits when the other circuit is deenergized, whereby, when said stop signal fails to function, said go signal is rendered inoperative.

2. In a traffic signalling system for a highway intersection, electric stop and go signals, a circuit for said stop signal, a second circuit for said go signal, means for intermittently and simultaneously energizing said circuits to an extent sufficient to render the said signals operative, and a variably conductive device connected in said circuits, said device having maximum conductivity when both said circuits are energized, but offering reduced conductivity to one of said circuits when the other circuit is de-energized, whereby when said stop signal fails to function, said go signal is rendered inoperative.

3. In a traffic signal system for a highway intersection, an alternating supply circuit, a time switch, a red signal light, means connecting said red signal light whereby said red light is intermittently energized from said circuit through said time switch to an extent sufficient to render said red light luminous, a green signal light, means connecting said green signal light whereby said green signal light is simultaneously intermittently energized in like manner, an impedance device comprising a magnetic core, a first winding on said magnetic core and a second winding on said magnetic core, means to connect said first winding in series with said green light, and means for energizing said second winding in accordance with the current drawn from said supply circuit by said red light, so as to cause the effective impedance of said first winding to be increased when no current flows in said red light, whereby, when said red light fails to function, the energization of said green light is reduced to an extent such as to render it non-luminous.

4. In a traffic signal system for a highway intersection, an alternating supply circuit, a time switch, a red signal light, means connecting said red signal light whereby said red light is intermittently energized from said circuit through said time switch to an extent sufficient to render said red light luminous, a green signal light, means connecting said green signal light whereby said green signal light is simultaneously intermittently energized in like manner, an impedance device comprising a magnetic core, a first winding on said magnetic core and a second winding on said magnetic core, means to connect said first winding in series with said green light and means for applying to said second winding excitation derived from the current drawn from said supply circuit by said red light, so as to cause the effective impedance of said first winding to be increased when no current flows in said red light, whereby, when said red light fails to function, the energization of said green light is reduced to an extent such as to render it non-luminous.

5. In a traffic signal system for a highway intersection, an alternating supply circuit, a time switch, a plurality of red signal lights, means for at times energizing said red signal lights from said supply circuit to an extent sufficient to render said red lights luminous, a plurality of green signal lights, means for simultaneously energizing said green signal lights from said supply circuit to a like extent, a magnetic core having a plurality of members, a plurality of windings, each of said windings being situated on one of said members, means for connecting each of said windings in series with one of said lights, said magnetic core being so proportioned and the turns on said windings and direction of currents

through said windings being so arranged that, when current flows in all of said lights, no effective magnetization of said magnetic core results, and when no current flows in one of said lights effective magnetization of said core is set up whereby the current in the remaining lights is reduced to an extent sufficient to render said remaining lights non-luminous.

6. In a traffic signal system for a highway intersection, an alternating supply circuit, a time switch, a plurality of red signal lights, means for at times energizing said red signal lights from said supply circuit, a plurality of green signal lights, means for simultaneously energizing said green signal lights from said supply circuit, a plurality of transformers having each a primary winding and a secondary winding, means for connecting each of said lights to each of said primary windings, means for connecting all of said secondary windings in series to form a closed circuit, the number of turns and the polarity of the connection of said windings being such that when current flows in all of said lights current circulates in said closed circuit to an extent sufficient to render all said lights luminous so as to cause no effective magnetization of the cores of said transformers, and when no current flows in one of said lights effective magnetization of the core of at least one of said transformers is set up whereby the current in the remaining lights is reduced to an extent sufficient to render said remaining lights non-luminous.

7. In a traffic signal system for a highway intersection, an alternating supply circuit, a first, second, third, and fourth signal light, means for at times energizing said lights from said supply circuit, a first, second, and third reactor, said reactors being provided with mid-point taps, a common conductor for connecting all of said lights to one terminal of said supply circuit, means for connecting said first and second lights to the extremities of the winding of said first reactor, means for connecting said third and fourth lights to the extremities of the winding of said second reactor, means for connecting the mid-point taps of said first and second reactor to the extremities of the winding of said third reactor, and means for connecting the mid-point tap of said third reactor to the other terminal of said supply circuit, the turns of said windings and the polarity of the connection of said windings being such that when sufficient current flows in all of said lights to render said lights luminous no effective magnetization of the magnetic cores of said reactors results, and when no current flows in one of said lights effective magnetization of at least one of said cores is set up whereby the current in the remaining lights is reduced to an extent sufficient to render said remaining lights non-luminous.

ALAN S. FITZ GERALD.