

[54] ISOLATION CIRCUIT FOR ARC
REDUCTION IN A DC CIRCUIT

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317/DIG. 6, 11 R; 179/18 G

[56] References Cited

UNITED STATES PATENTS

3,430,063 2/1969 Webb 307/136

3,539,775 11/1970 Casson 219/501

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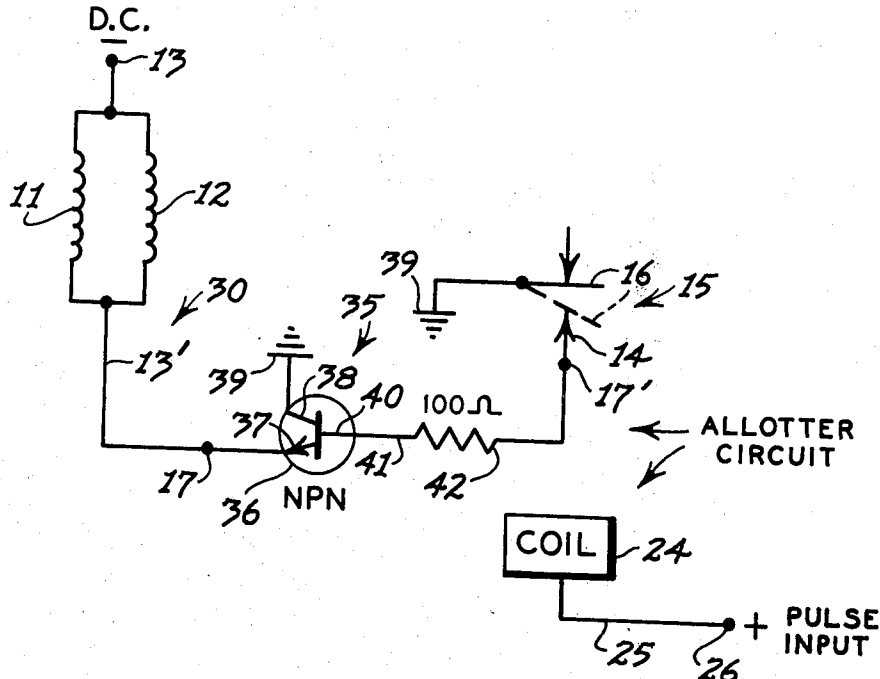
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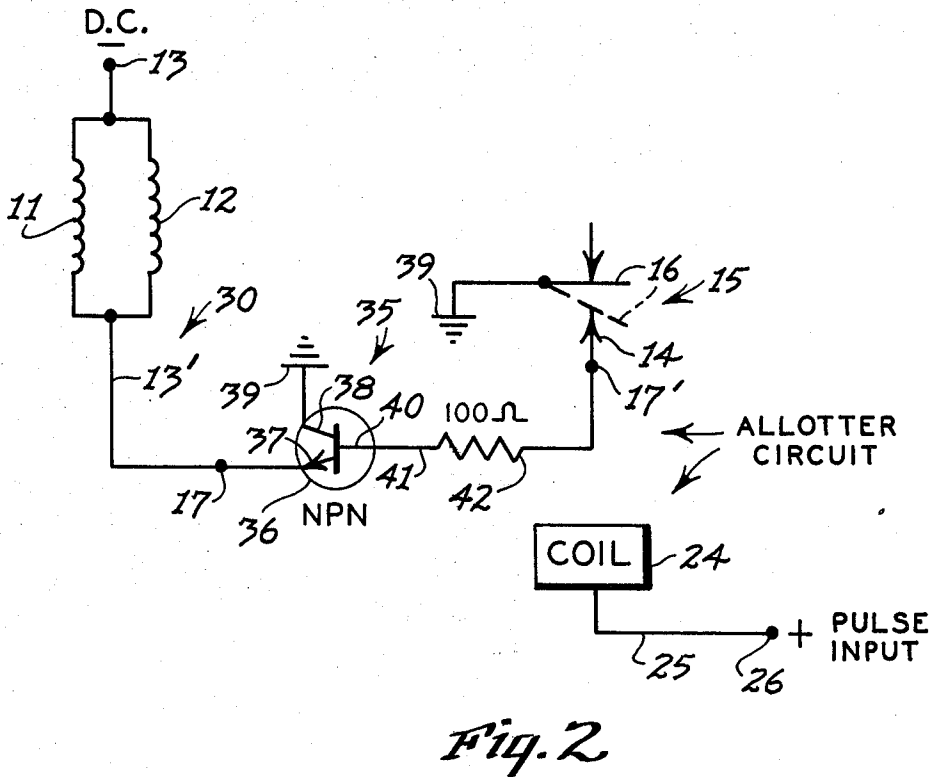
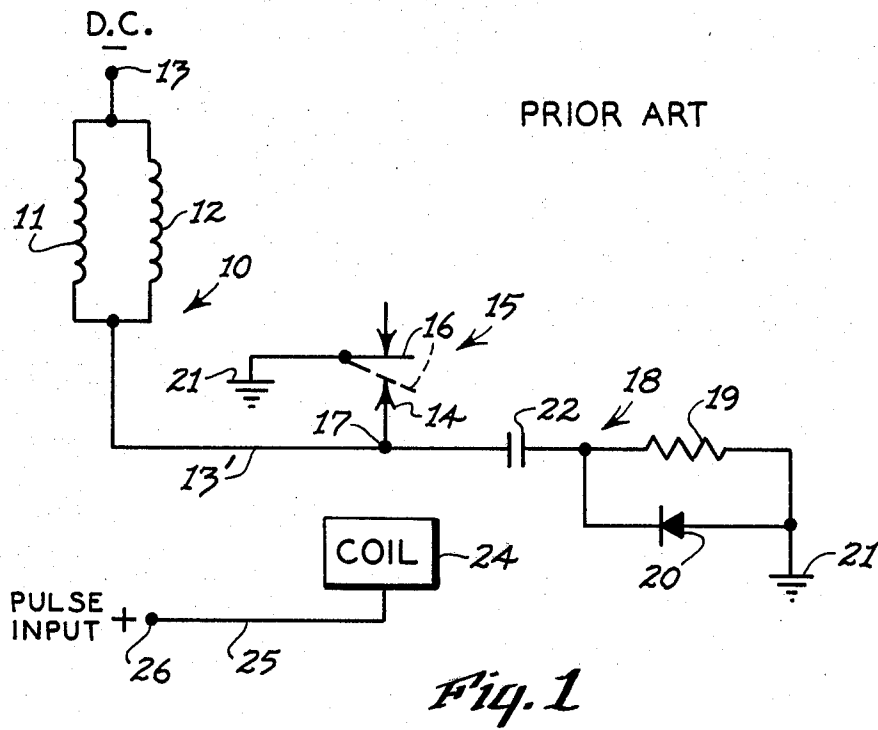
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ABSTRACT

An isolation circuit for a direct-current circuit including a load, power supply and switch for opening and closing the D.C. circuit. The isolation circuit comprises a triode-type switch device, such as a transistor in which the collector and emitter are connected in series with the power supply and the load, while the base is connected through a resistive gating circuit to the switch.

4 Claims, 2 Drawing Figures





ISOLATION CIRCUIT FOR ARC REDUCTION IN A DC CIRCUIT

BACKGROUND OF THE INVENTION

This invention relates to an isolation circuit, and more particularly to a triode-type switch device for reducing or suppressing the arc across the contacts of a switch in a D.C. circuit.

Arc suppressors of varying types are known in the art.

One type of arc suppressor employed with relay switches in telephone line finder and alloter circuits is disclosed in FIG. 1 of the drawings in this application. Such an arc suppressor includes a resistor and diode in parallel coupled to the load line through a capacitor.

Arc suppressors in the form of solid-state switches are also known, such as those disclosed in the Webb U.S. Pat. No. 3,430,063 issued Feb. 25, 1969 and the Casson U.S. Pat. No. 3,539,775 issued Nov. 10, 1970. These solid-state switches are connected in parallel with the switch whose contacts are to be protected from arcing.

Although the above described arc suppressors do suppress the arc and slow down the erosion of the contacts, nevertheless they do not eliminate the arc, because the arc suppressing devices do not isolate the load from the switch contacts.

SUMMARY OF THE INVENTION

It is therefore an object of this invention to provide a triode-type switching device incorporated in a D.C. circuit having a load and a switch for opening and closing the circuit, which switching device will isolate the load from the switch contacts, and therefore substantially eliminate arcing of the contacts when the switch is opened and closed.

Another object of this invention is to provide a triode switch device connected between the load and the switch contacts in such a way as to isolate the load from the switch contacts without disturbing the function of the switch for opening and closing the D.C. circuit.

The isolation circuit or load isolator made in accordance with this invention preferably includes a transistor connected in a D.C. circuit including a power supply, a load and a make-break switch, in which the emitter and collector of the transistor are connected in series with the load and the power supply. The make-break switch is connected to one side of the power supply and also through a resistor to the base of the transistor for biasing the transistor into conduction when the make-break switch is closed.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a schematic electrical circuit diagram of a prior art arc suppressor device connected into a D.C. telephone line finder and alloter circuit; and

FIG. 2 is a schematic electrical circuit diagram of the isolation circuit made in accordance with this invention and incorporated in the D.C. relay switch of a telephone line finder and alloter circuit.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

Referring now to the drawings in more detail, FIG. 1 discloses very schematically, a fragment of a Stromberg-Carlson electro-magnet telephone line finder circuit 10 including a load in the form of line finder coils

11 and 12 for controlling a stepping switch, not shown. The line finder coils 11 and 12 are connected in parallel, and one end of the coils 11 and 12 is connected to an input terminal 13 to which a negative potential is applied. The other ends of the coils 11 and 12 are connected through line 13' to one contact 14 of a relay switch 15 whose movable contact 16 is connected to ground 21.

Connected in parallel with the relay switch 15 and to the line 13' at junction 17 is an arc suppressor circuit 18. The arc suppressor circuit 18 includes a resistor 19 and a diode 20 connected in parallel. One end of the resistor 19 and diode 20 are connected to ground at 21, while the other ends of the resistor 19 and diode 20 are coupled through capacitor 22 to the junction 17.

The relay switch 15 is actuated by a relay coil 24 when energized through line 25 from the input pulse from a line relay circuit at terminal 26.

Although the arc suppressor circuit 18 does suppress some of the arcing across the contacts 14 and 16, nevertheless, all arcing is not eliminated, because the load 11-12 is not isolated from the contacts 14 and 16 by the arc suppressor circuit 18. The arc suppressor circuit 18 is merely coupled in parallel with the relay switch 15.

In FIG. 2, the same parts of the Stromberg-Carlson line finder and alloter circuits disclosed in FIG. 1 will be identified by the same reference numerals.

In the line finder circuit 30 of FIG. 2, one end of the same line finder coils 11 and 12 are connected to input terminal 13 for receiving the negative potential from a source of power or voltage, not shown, while the opposite ends of the coils 11 and 12 are connected through line 13' to the same junction 17. However, the contact 14 of relay switch 15 is connected to a separate junction 17'. The movable contact 16 of relay switch 15 is also connected to ground 39.

The relay switch 15 is actuated by relay coil 24 when energized through line 25 by an input pulse from the line relay circuit at input terminal 26.

However, replacing the arc suppressor circuit 18 of FIG. 1, or any other conventional type of arc suppressor device, is the load isolator or isolation circuit 35 coupled between the junction 17 and 17'.

This isolation circuit 35 comprises an electronic triode switch device, preferably in the form of a transistor 36. The emitter 37 is connected to the junction 17; the collector 38 is connected to ground 39; while the base 40 is connected through lead 41, including resistor 42, to the junction 17'.

Although the isolation circuit 35 is disclosed as connected between a load and a relay switch in a Stromberg-Carlson telephone line finder circuit 30, nevertheless it will be understood that the isolation circuit 35 can be incorporated in any D.C. circuit having a load, a D.C. voltage supply and a make-break type switch 15.

For the particular line finder circuit 30 incorporating line finder coils 11 and 12, the transistor 36 is an NPN transistor and the resistor is disclosed as having a value of 100 ohms. It will be understood that under certain conditions, such as the value of the load and the polarity of the voltage, a PNP transistor might be used, and resistors of other appropriate values might also be incorporated in the circuit 35.

In the operation of the isolation circuit 35, when the movable contact 16 is moved to its dashed line, closed position in FIG. 2, by the energization of the coil 24, a

voltage is impressed across the resistor 42 in order to energize the base 40 to bias the transistor 36 into conduction. When the transistor 36 conducts, the emitter 37 and collector 38 act as a switch to close the circuit loop including the D.C. voltage supply impressed at 13, the line finder coils 11 and 12, line 13', emitter 37, collector 38 and ground 39. In this manner, the higher load or voltage across the coils 11 and 12 will be isolated from the contacts 14 and 16 of the relay switch 15. Accordingly since such a small voltage is supplied across the resistor 42, sufficient to bias the transistor 36 into conduction, little, if any, arcing will occur between the making contacts 14 and 16.

Of even more significance, when the relay coil 24 is de-energized to open or break the connection between the relay contacts 16 and 14, the voltage is removed from the base 40 to turn off the transistor 36, and thereby open the loop circuit through the load coils 11 and 12.

Most arcing damage to switch contacts is created when the contacts break, because of the back E.M.F. generated by the collapsing electrical load, that is the back E.M.F. induced in the line finder coils 11 and 12, which back E.M.F. normally would tend to oppose the opening of the contacts 14 and 16. Such arcing will not occur in the circuit 30 because the back E.M.F. is dissipated through its own closed loop 13', 37 and 38 to ground 39, thereby by-passing the contacts 14 and 16. In this manner, the isolation circuit 35 absorbs the shock of the energy of the current of the load collapsing across the transistor 36, which would normally collapse across the switch contacts 14 and 16.

Moreover, because of the isolation circuit 35 there is no time lag in the operation of the main circuit 13', which is normally created by the making and breaking of the contacts 14 and 16, such as in the circuit 10 of FIG. 1.

Accordingly, by employing an isolation circuit 35, such as that disclosed in FIG. 2, in the circuit 30, or a comparable circuit, the destructive arcing, and thereby erosion and pitting of the contacts 14 and 16 of the relay switch 15, is eliminated, or substantially eliminated.

What is claimed is:

1. In a direct-current circuit including a D.C. voltage supply having first and second poles, an inductive load having one side connected to said first pole, and make-break switch means having first and second electrical contacts and means for closing said contacts and for opening said contacts; means for isolating said load from said switch contacts comprising:

- a. triode switch means having first and second power electrodes and a gate electrode,
- b. means connecting said first power electrode to the other side of said inductive load,
- c. means connecting said second power electrode to said second pole,
- d. resistive gating means of predetermined value connected in electrical series with said second pole, said first and second contacts and said gate electrode,
- e. said resistive gating means impressing a sufficient voltage upon said gate electrode, when said contacts are closed, to bias said triode switch means in conduction with a minimum of current passing through the closed contacts;
- f. said resistive gating means turning off said triode switch means, when said contacts are open, to shunt the back E.M.F. currents generated in the collapsing inductive load only through said power electrodes to isolate said load from said make-break switch contacts.

2. The invention according to claim 1 in which said resistive gating means comprises a resistor of predetermined value connected in series between said gate electrode and said first electrical contact, and means connecting said second electrical contact to said second pole.

3. The invention according to claim 1 in which said triode switch means is a solid-state triode switch means.

4. The invention according to claim 3 in which said solid-state triode switch means is a transistor, said first electrode comprising the emitter, said second electrode comprising the collector, and said gate electrode comprising the base.

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