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REMOTELY CONTROLLABLE CIRCUIT SYSTEM

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Fig. 1

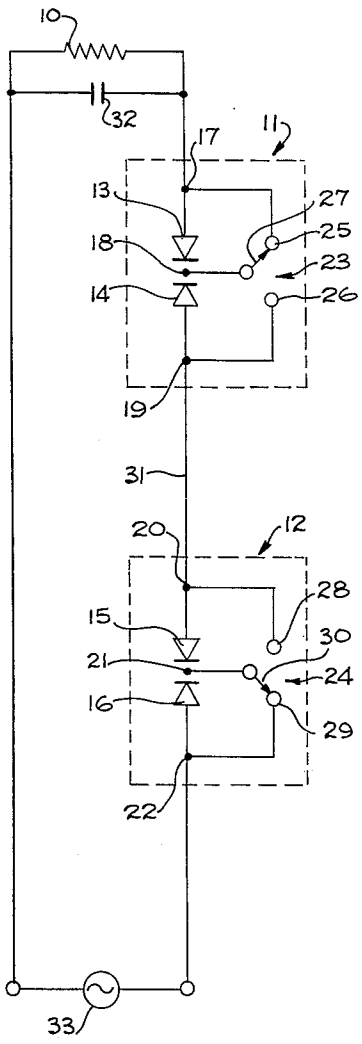
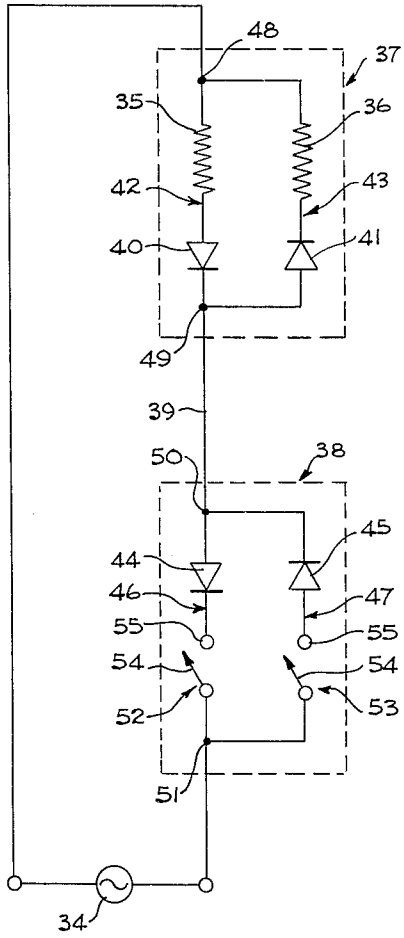


Fig. 2



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REMOTELY CONTROLLABLE CIRCUIT SYSTEM

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This invention relates generally to the remote control of circuit systems, especially those in which an impedance or impedances are to be energized electrically from remote points. More particularly the invention has to do with improvements in alternating current circuits, by means of which remote control of load energization is achieved or maintained while the number of conductors or transmission wires is reduced by one-half.

Generally speaking, it is characteristic of known circuits in which two conditions of load on and off energization from remote control locations must be satisfied, that at least two transmission lines are required to transmit the energizing current. Thus, to take a simple example, if it is desired to establish on-off control of an electric light bulb in a room from either of two switch locations, as typically found at opposite ends of the room, it has been thought necessary to run two conductors or wires between the switch locations in order to achieve the desired control of the lamp. To take another illustration, selective electrical energization of two impedances from a remote location is conventionally brought about by transmitting current from the control location through either or both of two transmission lines running from the control location to the remote loads.

It is a primary object of the present invention to enable the same results to be achieved as discussed above, but without requiring the use of two transmission lines, thereby achieving a very substantial saving since only one conductor or line is necessary to transmit current. Broadly speaking, this object is served through the provision of two groups of rectifiers each including a pair of rectifiers connected to pass current in opposite directions, these rectifier groups being connected in series by a single transmission line. In addition, the invention includes switch means cooperable with the rectifiers for establishing current flow through alternate of the rectifiers of each group, so that the direction of current flow between the groups and through the transmission lines is controllable.

More specifically, in the instance where energization of an impedance is to be made controllable from either of two remote locations, the two groups of rectifiers at the remote location each include a pair of rectifiers connected in back-to-back series relation to pass current in opposite directions. As a result, this combination of the rectifiers and the switch means cooperable therewith permits establishment and interruption of current flow between the remote rectifier groups and through the load in response to switch operation passing current through alternate of the rectifiers of either pair. In this illustration, the switch means preferably comprises two switches respectively connected across the pairs of rectifiers in the two groups, each of the switches including two contacts and contactor means movable into alternate engagement with the contacts. The contactor and one of the contacts is electrically connected across one of the back-to-back rectifiers and the contactor and the other contact are electrically connected across the other of the back-to-back rectifiers.

As a second illustration of the invention, which will be described in greater detail in the specification, the two remote groups of rectifiers may each include a pair of rectifiers connected in parallel circuit branch relation to pass current in opposite directions through the circuit branches. In this example, switch means are

cooperable with the rectifiers of one group for establishing current flow through alternate of the rectifiers of each group, and a pair of impedances may be connected in series with the rectifier circuit branches of the other rectifier group, these impedances being selectively electrically energizable by operation of the remote switch means. Here again, the two groups of rectifiers are connected by only one transmission line. In this example, the two conditions of on-off load energization are embodied in the two impedances which are selectively energizable. On the other hand, in the previously discussed example, the two conditions of on-off load energization are embodied in control of energization of a single load from either of two remote stations.

These and other objects and advantages of the invention will be further understood from the following detailed description of the invention, in which:

FIG. 1 is a circuit diagram showing one form of the invention wherein on-off energization of a load is facilitated from either of two remote locations, only a single transmission line interconnecting the remote locations; and

FIG. 2 is a circuit diagram showing the embodiment of the invention wherein selective on-off energization of two loads at a first location is controllable from a remote and second location, only one transmission line interconnecting these two stations.

Referring first to FIG. 1, a single alternating current power load, such as an electric lamp is shown at **10**, it being desired that this lamp be switched on or off from two remote locations generally indicated at **11** and **12**. Each of the locations **11** and **12** is characterized as comprising a group of rectifiers, each including a pair of same **13** and **14**, and **15** and **16**, each pair being connected in back-to-back series relation to pass current in opposite directions. Thus, rectifier **13** passes current from terminal **17** to terminal **18**, whereas rectifier **14** passes current from terminal **19** to terminal **18**. Likewise, rectifier **15** passes current from terminal **20** to terminal **21**, while rectifier **16** passes current from terminal **22** to terminal **21**.

Cooperating with the rectifier groups are the switches generally designated at **23**, **24**, switch **23** including a pair of contacts **25**, **26** respectively connected with terminals **17** and **19**, and a movable contactor **27** alternately engageable with contacts **25** and **26** and permanently connected with terminal **18**. Likewise, switch **24** includes contacts **28** to **29** respectively connected with terminals **20** and **22** and movable contactor **30** alternately engageable with contacts **28** and **29** and permanently connected with terminal **21**.

It will be noted that only one transmission line **31** interconnects the two groups of rectifiers, line **31** being shown as being connected with terminals **19** and **20** so as to cause the groups of rectifiers to be electrically connected in series, and also in series with the load **10**. It will also be noted that engagement of the movable contactors **27**, **30** with the fixed contacts **25**, **26**, **28** or **29**, effects shorting of alternate of the rectifiers of each group, so that current will pass through the load **10** only when the non-shorted rectifiers in each group will pass current in the same direction. Alternatively, if the non-shorted rectifiers in each group will pass current only in opposite directions relative to transmission line **31**, then no current will pass through the load **10**. Under these conditions, either one of the switches **23** and **24** may be used to turn the load on or off regardless of the setting of the other switch.

The position of the contactors **27** and **30** in FIG. 1 corresponds to the condition that no current passes through the load **10**. This is true, because the non-shorted rectifiers **14** and **15** will pass current only in

opposite directions, i.e. the directions of the arrows formed by the rectifier symbols. On the other hand, if either of the contactors 27 or 30 is moved to engage the contact 26 or the contact 28 as the case may be, then current will flow through the load 10. This is true, because when contactor 27 is moved to engage contact 26, the non-shorted rectifiers 13 and 15 will then pass current in the same direction, and the shorted rectifiers 14 and 16 will have current passed around them through the contactors 27 and 30.

Characteristic of this system is that power to the load is reduced by the action of the rectifiers. This condition can be overcome by installing a capacitor 32 in shunt with the load 10, or by utilizing a load 10 with a lower voltage rating, or by using a higher voltage source as indicated at 33.

Now referring to FIG. 2, the A.C. power source is shown at 34 for supplying the two impedances 35 and 36 shown typically in the form of resistive loads located at a first station 37. Selective on-off energization of the loads 35 and 36 is realized from a second or control station 38 typically located remotely from station 37, and it is a characteristic of this system that only one transmission line 39 interconnects the two stations.

Station 37 includes a group of rectifiers 40 and 41 connected in parallel circuit branch relation, the branches being generally designated at 42 and 43, the connection being such that the rectifiers pass current in opposite directions through the branches, with respect to transmission line 39. Likewise, station 38 includes a group of rectifiers 44 and 45 connected in parallel circuit branch relation to pass current in opposite directions through the circuit branches generally designated at 46 and 47, with respect to the transmission line 39. Thus, rectifier 40 passes current only in the direction from terminal 48 to terminal 49, both terminals being common to the branches 42 and 43, while rectifier 41 passes current only from terminal 49 to terminal 48. Likewise, rectifier 44 passes current only from terminal 50 to terminal 51, while rectifier 45 passes current only from terminal 51 to terminal 50.

The branches 46 and 47 include the switches 52 and 53, these being typically single pole, single throw switches. Each of these includes a movable contactor 54 and a fixed contact 55, as shown.

In operation, when switch 52 is closed, current will flow through the circuit including load 35, rectifier 40, line 39, rectifier 44, and switch 52. By analogy, when switch 52 is opened, and switch 53 is closed, current will flow only through the switch 53, rectifier 45, transmission line 39, rectifier 41 and load 36. Thus, either of the loads may be selectively operated at any given time, without interaction between the loads or the switching functions. Also, both loads may be simultaneously operated by closure of both switches, and without interaction between the loads, since load 35 is energized only by half cycle current flowing through transmission line 39 in the direction from station 37 to station 38, while load 36 is energized only by half cycle current flowing through transmission line 39 from station 38 to station 37. These directions are further identified by the arrow-shaped rectifier symbols.

I claim:

1. A switching system for use in an alternating current circuit, comprising two groups of rectifiers each including a pair of rectifiers connected in back to back series relation to pass current in opposite directions, said rectifier groups being connected in series, and means cooperable with the rectifiers of each group for bypassing current flow around alternate of the rectifiers of each group, whereby current will flow between said groups only when the non-bypassed rectifiers of said groups pass current in the same direction.

2. A switching system for use in an alternating current circuit, comprising two groups of rectifiers each including a pair of rectifiers connected in back to back series relation to pass current in opposite directions, a single conductor interconnecting said groups in series, and two switch means respectively cooperable with the rectifiers of said groups for bypassing current flow around alternate of the rectifiers of each group, whereby current will flow between said groups only when the non-bypassed rectifiers of said groups pass current in the same direction.

3. The invention as defined in claim 2, including an impedance connected in series with said rectifier groups.

4. The invention as defined in claim 3, including a capacitor connected in shunt across said impedance, said impedance being resistive.

5. The invention as defined in claim 2, in which each switch means comprises two contacts and contactor means movable into alternate engagement therewith, said contactor and one of said contacts being electrically connectible across one of said back to back rectifiers and said contactor and the other contact being electrically connectible across the other of said back-to-back rectifiers.

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