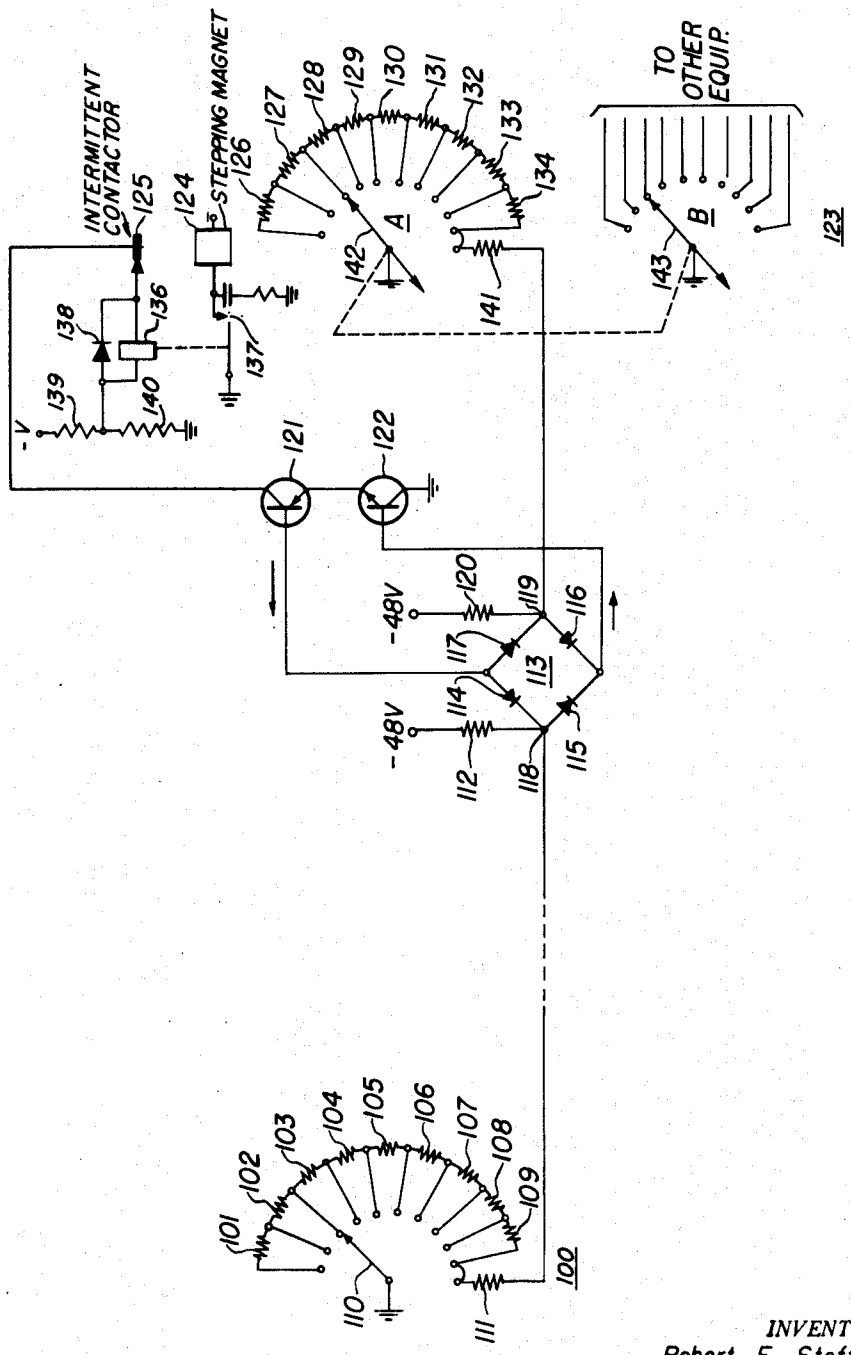
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REMOTE CONTROL ROTARY SWITCH

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REMOTE CONTROL ROTARY SWITCH

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This invention relates, in general, to remotely controlled rotary stepping switches, and in particular, the invention relates to an arrangement for controlling the operation of a remote rotary stepping switch.

There are numerous ways in which a distant rotary switch may be controlled. For example, it is always possible to pulse a connecting wire, thus presenting a known number of pulses to the distant rotary switch and stepping it a known number of steps. It is also possible to have the distant rotary switch search for a particular marked contact. In this case, however, it is necessary to have a multiplicity of wires between the distant rotary switch and the control device. It is advantageous to have a distant rotary switch find a particular "marked" contact, and have all of the "marking" accomplished over a single wire.

It is therefore the principal object of this invention to provide a new and improved arrangement for controlling the operation of a distant rotary stepping switch over a single control line.

It is a further object of this invention to provide a new and improved arrangement for controlling the operation of a distant rotary switch over a single control wire which is more sensitive to smaller signals thus providing faster, more positive operation of the switch.

The invention as it is embodied in this disclosure makes use of a balanced resistance bridge. The resistors associated with a manual selector switch are located at one end of a single control wire and form one variable leg of the resistance bridge. The resistors connected to the bank contacts on one level of the distant rotary switch and two fixed resistors form another variable leg and two fixed legs, respectively, of the resistance bridge and are located at the other end of the control line. To set the wiper of the rotary switch to a particular bank contact (the wipers on the other levels of the rotary switch are stepped accordingly and may be used to perform whatever functions may be desired) the wiper of the manual selector switch is positioned to the corresponding contact on the manual selector switch. This causes an unbalancing of the resistance bridge. To detect the unbalance of the resistance bridge a full-wave diode rectifier bridge is connected across the output diagonal of the resistance bridge to rectify the resulting signal flow and to impress this signal on a transistor amplifier. The full-wave rectifier bridge assures a unidirectional signal flow of the bi-directional signals to provide for the proper operation of the transistor amplifier. A relay connected in a mutually interrupting circuit of the rotary switch stepping magnet is directly powered by the amplified signal to operate the rotary switch causing it to be stepped until the balanced condition of the resistance bridge is again restored, which will occur when the wiper of the distant rotary switch steps to the bank contact corresponding to the setting of the manual switch.

The invention, both as to its organization and method of operation, together with other objects not specifically mentioned, will best be understood by reference to the following specification taken in connection with the accompanying drawing.

This drawing shows a schematic circuit diagram of the arrangement according to the invention for remotely controlling a rotary switch.

Referring now to the drawing, the control portion of this invention consists basically of a balanced resistance bridge circuit. Two legs of this balanced bridge circuit are composed of the resistors **101–109** associated with the controlling wafer switch **100** and a fixed resistor **112**. The other two legs of this resistance bridge are composed of the resistors **126–134** associated with the controlled rotary switch **123** and a second fixed resistor **120**. If the resistors set in the rotary switch **123** are the same as the resistors set in the wafer switch **100** then the resistance bridge is balanced and there is no voltage between points **118** and **119**. If the setting of the wiper **110** of the wafer switch **100** is changed the resistance of wafer switch **100** is changed, and there is a resulting voltage difference between points **118** and **119** due to the unbalancing of the resistance bridge.

A detector comprising diode bridge **113** including diodes **114–117** and a transistor amplifier including two complementary transistors, i.e., two transistors of opposite conductivity type, for example, the PNP type transistor **121** and the NPN type transistor **122**, is employed to detect this voltage difference between the points **118** and **119**. The diode bridge **113** causes the current flowing due to the voltage difference between points **118** and **119** to flow in the direction shown by the arrows. It may be noted that whether the potential of point **118** is higher or lower than that of point **119** (caused by larger or smaller resistance due to wafer switch **100**), the current flow is only in the direction shown. This current is amplified by means of transistors **121** and **122** to operate relay **136**. It may be noted that relay **136** is directly powered by the rectified and amplified signal resulting from the unbalanced condition of the resistance bridge thus eliminating the need for any test relay, or similar memory device. Any marginal detection requirements or contact adjustments are, in addition, therefore eliminated resulting in a faster, more positive operation and control of the rotary stepping switch **123**. Furthermore, it may also be observed that if operating time is of the essence, relay **136** may, in addition, be eliminated and the rectified and suitably amplified signal employed to directly power the stepping magnet **124** of rotary switch **123**. In this case the interrupter contact **125** would be in series with the stepping magnet **124** itself.

Relay **136** in operating closes make contact **137** to extend ground to stepping magnet **124** to cause it to operate to step wiper **142** of rotary switch **123**. As wiper **142** of rotary switch **123** steps over its bank contacts the current resulting from the unbalanced resistance bridge either increases or decreases, till eventually the correct contact is reached. When this occurs the resistance bridge is balanced, and all relay current is stopped.

Assume now for the purpose of illustration that wiper **142** of the rotary switch **123** and the wiper **110** of the wafer switch **100** are both sitting on the first bank contact of the respective switches and that it is desired to step wiper **142** of the rotary switch **123** to the fifth bank contact. Wiper **110** of the wafer switch **100** is moved to its fifth bank contact reducing the resistance of this variable leg of the resistance bridge. Current will now flow from ground through wiper **110**, the fifth bank contact of wafer switch **100**, through resistances **109–109**, through resistor **111**, resistor **112**, to negative battery potential. This current flow results in a lower potential at point **118** then is present at point **119** causing a current flow through the diode bridge **113**. The current flows in the direction of the arrows to the base of transistor **122**, emitter of transistor **121**, and the base of transistor **121**, to the diode bridge **113**. Transistors **121** and **122** are rendered conductive to cause current flow from ground, through the collector and emitter of tran-

sistor 122, the emitter and collector of transistor 121, interrupter contact 125 of stepping magnet 124, through relay 136, to the voltage divider comprising resistors 139 and 140, causing relay 136 to operate. Relay 136 in operating closes make contact 137 to extend ground through battery of stepping magnet 124 causing it to operate to step wiper 142 of the rotary switch 123 to its second bank contact. Stepping magnet 124 in operating at interrupter contact 125 removes ground from relay 136 causing it to restore, which in turn removes ground at make contact 137 causing stepping magnet 124 to restore. The bridge circuit will still be unbalanced due to the larger resistance of rotary switch 123 and current will continue to flow through diode bridge 113 and transistors 122 and 121. When stepping 124 restores ground is again extended over the path previously described to again operate relay 136 which again, in turn, causes stepping magnet 124 to operate to step wiper 142 to the third bank contact. The stepping of wiper 142 of the rotary switch 123 and the current flow through the diode bridge 113 and transistors 122 and 121 will continue until wiper 142 steps to the fifth bank contact of rotary switch 123 at which time equal resistances will be included in each of the variable legs of the resistance bridge and the resistance bridge will be in a balanced condition. Current will no longer flow through the diode bridge 113 and transistors 122 and 121 since resistance bridge is balanced and the potential at points 118 and 119 will again be equal. Transistors 121 and 122 will be rendered non-conductive thus relay 136 will not operate.

It may also be noted that provisions are made for making adjustments for a changing line resistance. The resistance 111 is actually a part of the line, and if the line resistance increases then this resistor may be reduced in value. If the resistance of the line increases to the extent that varying this resistor 111 has no effect, the resistor 141 which is at the opposite end of the line on rotary switch 123 may be increased to compensate for this. It may also be noted that the ground return path between the wipers 110 and 142, respectively, and the bridge power source could also obviously be in the form of a metallic wire if so desired.

In adidtion, it may be noted that resistors 139 and 140 forming a voltage divider may be eliminated by employing a transistor capable of withstanding the operating voltage employed in the circuit arrangement. The diode 138 bridging the winding of relay 136 is employed to protect the transistors from the inductive surge resulting when relay 136 restores after operation. Rotary switch 123 is shown comprising two levels of bank contacts, levels A and B with ganged wipers 142 and 143, respectively. As many levels of bank contacts as may be desired may be used on the rotary switch 123 and the levels other than level A may be employed to perform any operation desired.

What is claimed is:

1. An arrangement for controlling the setting of a rotary stepping switch at a first end of a control line from a controlling switch at the other end of said line; said arrangement including at said first end, a stepping magnet for actuating said rotary switch, an interrupter circuit for said magnet, a transistor amplifier for powering said interrupter circuit and rectifier means the output of which is connected to the input of said transistor amplifier; said arrangement further including a rectifier bridge comprising two parallel-connected voltage dividing networks each forming two arms of said bridge, a voltage source connected across said parallel-connected networks, one of said voltage dividing networks including a number of resistances at said first end of said line for varying the resistance ratio of the two arms of said network under the control of said rotary switch, the other voltage dividing network including a number of resistances at said other end of said line for selectively varying the resistance ratio of the two arms of said other network under the control of said controlling switch, and the input of said rectifier means being connected between the junction of said two arms of said one network and the junction of said two arms of said other network, whereby a difference between said two resistance ratios effected by a setting of said controlling switch causes said stepping magnet to actuate said rotary switch and balance said bridge by selectively varying said second mentioned ratio.

2. An arrangement as claimed in claim 1, wherein said rectifier means comprises a full-wave diode bridge connected across said junctions of the resistance bridge for causing the bi-directional signal resulting from the unbalancing of said resistance bridge to be impressed as a uni-directional signal on said transistor amplifier.

3. An arrangement as claimed in claim 2, wherein said transistor amplifier comprises a pair of complementary transistors connected in series.

4. An arrangement for controlling the setting of a rotary stepping switch at one location from a controlling switch at another location over a control line extending between said two locations; said arrangement including at said one location a stepping magnet for said rotary switch, an interrupter circuit for said magnet, a transistor amplifier for powering said interrupter circuit, and rectifier means the output of which is connected to the input of said transistor amplifier; said arrangement further including a source of direct current at said one location and a resistance bridge having two pairs of arms both pairs being connected across said source and each pair comprising a fixed resistance in its one arm and a variable resistance in its other arm, both said fixed resistances being provided at said one location, the fixed resistance of said first pair being connected to the end of said line at said one location, the variable resistance of said first pair including a plurality of resistors at said other location selectively connectable to the other end of said line by said controlling switch and the variable resistance of said second pair including a plurality of resistors at said one location selected by said rotary switch, whereby an unbalance of said resistance bridge due to a setting of said controlling switch automatically causes said stepping magnet to rebalance said bridge by selecting a number of said last-mentioned plurality of resistors.

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