

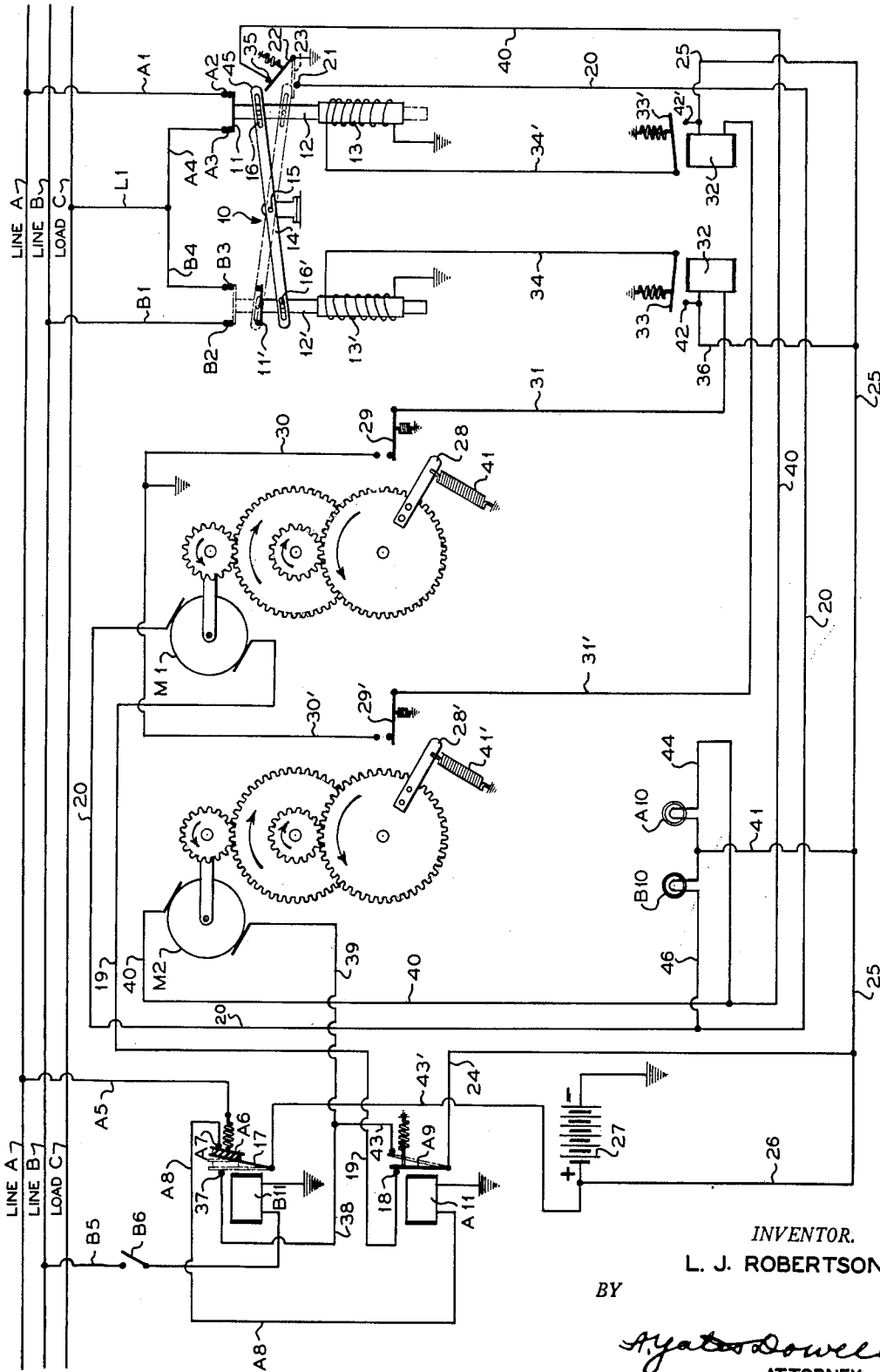
May 15, 1956

L. J. ROBERTSON

2,745,971

AUTOMATIC TRANSFER SWITCH CONTROL CIRCUIT

Filed Dec. 6, 1951



INVENTOR.

L. J. ROBERTSON

BY

A. Yates Dowell
ATTORNEY

1

2,745,971

AUTOMATIC TRANSFER SWITCH CONTROL CIRCUIT

Lloyd James Robertson, Albuquerque, N. Mex.

Application December 6, 1951, Serial No. 260,239

9 Claims. (Cl. 307-64)

The present invention relates to an automatic control for connecting a load to a main supply of electric current when main and auxiliary supply sources are provided and for connecting the load to the auxiliary source in the event the main source fails.

Although it has been proposed to shift a load from one supply line to another in the event of failure of one line, these proposed arrangements have been deficient in a number of features. Prior control systems have been unnecessarily complicated and in many cases have unnecessarily shifted the load from one supply line to the other when the break was momentary. Further, the prior control systems did not include indicating means to show which line was furnishing the power. Also the switch operating means of the prior art required continuous energization of the actuating mechanism, and the switch arrangements of some prior systems could connect both lines to the load at the same time.

It is therefore an object of the present invention to avoid the defects of the prior art and produce a new and useful control circuit.

Another object of the present invention is to provide a control for connecting only one of two separate sources of electricity to a load.

A further object of the present invention is the provision of a control for two supply lines for a single load with the supply of current from one line normally connected to the load but in the event of failure of power in the one supply line the current will be automatically supplied by the other supply line. Also upon the return of power to the said one line, the load will be automatically reconnected thereto.

Another object of the present invention is the provision of a time delay between the interruption of the supply of current from one line and the connection of the load to the other line so that unnecessary changes from one supply line to the other are avoided.

Further and other objects will appear as the description proceeds and upon reference to the drawing showing a wiring diagram of an embodiment of the present invention with the connections arranged for the supply of power from the "main" supply.

Only one wire is shown for each supply line A and B and the load C since it is well understood that the other wire in the usual two wire systems is normally grounded, and the showing of the other normally grounded wire in the diagram would result in unnecessary complications without attendant advantages.

The supply lines A and B represent the usual "main" and "auxiliary" supply lines such as are used for supplying a rural district from two separate sources. The load is represented by a third line C which is connected to one of the supply lines by the solenoid actuated main switch 10.

A main switch 10 serves to connect supply lines A or B to the load C. This switch includes a contact A2 connected by lead A1 to main supply line A. Contact A3 is connected by lead A4 to lead L1 to the load C.

2

Similarly auxiliary supply line B is connected by lead B1 to contact B2. Contact B3 spaced from B2 is connected by lead B4 to lead L1 which in turn is connected to load C. Switch 10 includes bridging contact 11 and 11' mounted on solenoid armatures 12, 12' respectively which are actuated by solenoids 13, 13' respectively. Armatures 12, 12' are connected by lever 14 which is pivoted intermediate its ends at 15 and is connected at its ends to armatures 12, 12' by suitable means such as pin and slot connections 16 and 16' respectively. Contacts 11, 11' provide electrical connection between contacts A1, A2 and B2, B3 respectively and only one supply line may be connected to the load and at one time.

Line A is also connected by means of lead A5 to an insulated contact A6 on an armature 17 of a relay B-11. Contact A6 is urged by the usual spring into engagement with contact A7 connected by means of lead A8 to relay A-11. The circuit is completed to a ground from relay A-11. This energization of relay A-11 causes armature A9 thereof to assume the full line position against the tension of the spring and into contact with the contact 18. Armature A9 is connected by lead 24 to conductor 25 thence by lead 26 to the positive terminal of battery 27. Contact 18 through lead 19 is connected to motor timer M1; from motor timer M1 a lead 20 is connected to contact 21 of single pole double through switch 22. A spring normally urges the moveable element 23 of switch 22 into engagement with contact 35 and the moveable element 23 is moved into engagement contact with 21 by an extension 45 of lever 14 which engages the moveable element 23. In the event that main switch 10 is in full line position the circuit from contact 21 would not be completed and no change would occur since the supply of current to the load is already coming from main supply line A.

In the above example, in the event that main switch 10 was in the dotted line position, the circuit from contact 21 would be completed through moveable element 23 and ground. This would cause motor timer M2 to begin operating thereby rotating the gears in the gear train and causing arm 28 to engage a normally open switch 29, closing the same and establishing a connection from ground through lead 36, switch 29, lead 31, to relay 32 and from relay 32 to lead 36 thence to conductor 25 and lead 26 to the battery. This resulting energization of relay 32 causes armature 33 to establish contact with contact 42 for supplying current from the battery through lead 26, conductor 25, lead 36, contact 42, armature 33, lead 34 to solenoid 13' and from thence to ground. This energizes solenoid 13' causing armature 12' to move from the dotted line position to the full line position carrying bridge contact 11' away from contacts B2 and B3 bridging the connection from line B to load C. Due to the lever connection 14 between armatures 12' and 12, armature 12 carrying bridge contact 11 is moved from the dotted line position to the full line position establishing electrical connection between contacts A2 and A3 resulting in main supply line A furnishing electricity to load C. When lever 14 is moved from the dotted line to the full line position armature 23 of switch 22, moves from the dotted line to the full line position because of the spring bias thereof breaking the circuit through lead 26 to motor timer M1. Upon deenergization of motor timer M1 a spring 41 moves arm 28 away from switch 29 breaking the circuit and deenergizing relay 32. From the above description the normal operation of the circuit for supplying current from main supply A to the load C is disclosed.

In the event that supply line A fails, current will no longer be supplied to relay A-11 thereby releasing armature A9 for movement to the dotted line position which it would assume, due to the conventional spring. Cur-

3

rent is supplied from the battery through lead 26, conductor 25 and lead 24 to armature A9 of relay A-11 and thence through lead 43 to lead 39 to motor timer M2. From motor timer M2 the circuit is completed through lead 40 to contact 35 of switch 22 and thence to grounded moveable element 23 since the prior condition had the switch 10 in the full line position. The actuation of motor timer M2 causes the gear train to operate and move arm 28' into engagement with normally open switch 29'. A circuit is established from ground through lead 30' switch 29', lead 31' to relay 32' and from relay 32' through conductor 25 and lead 26 to the battery 27. The resulting energization of relay 32' causes armature 33' thereof to complete a circuit from the battery 27 through lead 26 conductor 25 contact 42' armature 33' lead 34' to solenoid 13 for energizing solenoid 13 causing armature 12 to move from the full line position to the dotted line position causing bridge contact 11 to break the circuit from A2 to A3 interrupting the connection from main line A to load C. Due to the lever 14 connecting armature 12 and 12', the bridge contact 11' is moved to complete a circuit from contact B2 to contact B3 resulting in supplying electricity from auxiliary line B to load C.

From the above description it is believed to be clear that electric current is normally supplied from main line A to the load, but in the event of failure of main supply line A, power will be supplied from auxiliary line B until the supply of power is restored to line A. As soon as power is restored to line A the relay A-11 will be energized to cause the load C to be connected to the main line.

In the event that it is desired to have supply line B become the main source of power and supply line A become the auxiliary source, the manual switch B6 is closed carrying the current from line B through lead B5 switch B6 to relay B-11 thence to ground. The resulting energization of relay B-11 causes armature 17 to move to the dotted line position thereby making a circuit from battery 27, through lead 43', armature 17, contact 37, and leads 38 and 39, to motor timer M2, and therefrom through lead 40, to contact 35, of switch 22, to armature 23, and to ground thereby causing operation of the motor timer and the gear train to move arm 28' into engagement with switch 29', for closing the same. The closing of switch 29' establishes a circuit from ground through lead 30', switch 29', lead 31', to relay 32', and from relay 32', to conductor 25 and lead 26 to the battery 27, thereby energizing solenoid 32. Armature 33' of relay 32' moves into engagement with contact 43' and completes a circuit from the battery 27, through lead 26, conductor 25, contact 42', armature 33', lead 34', to solenoid 13 and thence to ground thereby causing armature 12, to move from the full line position, to the dotted line position. This causes the extension 45 of lever 14 to engage moveable element 23 to break the contact between contact 35 and grounded armature 23, thereby deenergizing the motor timer M2 and permitting spring 41' to turn the timer to the position shown. The lever 14 also causes armature 12' to move bridge contact 11' into circuit closing engagement with contacts B2 and B3, establishing an electrical connection between line B and the load C.

It is believed to be clear that when switch B6 is closed the power is supplied from line B under normal circumstances, but in the event of failure of power in line B, relay B-11 will be deenergized allowing armature 17 to assume its full line position resulting in the arrangement described in the first condition, a description of the circuit is not repeated as the operation should be clear.

An additional feature of this control includes indicating lamps A-10 and B-10 connected to the battery by common lead 41, conductor 25 and lead 26. Lamp A-10 is connected by lead 44 to lead 40 to contact 35 and grounded moveable element 23 thereby completing a cir-

4

cuit resulting in the illumination of lamp A-10 which indicates that the power is supplied by line A. Lamp B-10 is similarly connected by lead 46 to lead 20. When main switch 10 is in dotted line position as would be the case when line B was supplying the power, contact 21 of switch 22 makes contact with moveable element 23 and completes the circuit from lead 20 to ground illuminating lamp B-10. The indicating lamps would be positioned at any suitable location which could be spaced a substantial distance from the main switch 10 making it a simple matter for the sub-station attendant to be informed of the line supplying the electric power.

It appears that the advantages of the present control system are obvious and that the consumer has the choice of determining which line will normally supply the power requirements. In the event of differences in rates on different lines it may be desirable to change the main supply from one line to the other and vice-versa. Also due to the different demand conditions on the different supply lines it is advantageous for the consumer to have the control of which power lines supplies the load.

The motor timers M1 and M2 do not operate instantaneously and therefore allows a small delay between the actuation thereof and the closing of the switches 29 and 29'. This is a substantial advantage because it does not change the supply lines when momentary failures occur as when the line is struck by lightning. However, if the delay is of sufficient duration the load is connected to the supply line having available power. If both lines of power fail, the load will be connected to line B as both relays B-11 and A-11 will be deenergized.

It is contemplated that the extent of time delay may be controlled by the type of springs 41, 41' used for returning the motor timers to their full line deenergized positions; also the gear ratio on the motor timers could be varied and other suitable means such as brakes, dash-pots or the like could be used for controlling the time delay. Relays A-11 and B-11 may be connected to the secondary of transformers to avoid having the full line voltage in the control circuits thereof.

It will be obvious to those skilled in the art that various changes may be made in the invention, without departing from the spirit or scope thereof, and therefore the invention is not limited by that which is shown in the drawing and described in the specification but only as indicated in the appended claims.

What is claimed is:

1. A control system for the selective connection of a load to a main or an auxiliary power line comprising a main switch including a contact connected to the main line, a second contact connected to the auxiliary line, third and fourth contacts connected to the load, a first solenoid, a first armature movable thereby, a bridging contact on said armature movable to close the circuit between said first and third contacts, a second solenoid, a second armature movable thereby, a second bridging contact on said second armature movable to close the circuit between said second contact and said fourth contact, interconnecting lever means between said first and second bridging contacts for causing said bridging contacts to be in operative position one at a time, said lever having an extension at one end thereof, a single throw double pole spring biased limit switch located in the path of the extension of said lever means, said limit switch being closed in the spring biased direction when said first bridging contact is in circuit closing relation and said limit switch being closed in the opposite direction upon contact by the extension of said lever means when said second bridging contact is in circuit closing relation between said auxiliary line and said load, a first relay in said system normally connected to said main line, a second relay connectable to said auxiliary line through a manually operated switch, the armature of said second relay having a spring biased insulated contact connected to said main line to complete a circuit to said first relay,

5

an independent source of electrical energy, first and second motor timers, said energy source, a first contact of said first relay, said first motor timer and the contact of the normally closed contact of the spring biased single pole double throw limit switch being in a circuit whereby the first motor timer is actuated when all of these contacts are closed; a normally open switch actuatable by said first motor timer after a predetermined delay, a third relay actuatable by said normally open switch, a contact of said third relay being closed when the latter is actuated for operating said second solenoid, a second contact of said first relay being closed when said first relay is deenergized and being connected to a contact of said second relay which is closed when said second relay is energized and said contacts being connected together and to said second motor timer, said second motor timer being connected to the contact of said limit switch which is normally spring biased closed, whereby said second motor timer may be actuated, a second normally open switch actuatable by said second motor timer after a predetermined delay, a fourth relay connected to said second normally open switch, a contact of said fourth relay being connected to said second solenoid for actuating the second solenoid and establishing a connection between said auxiliary line and said load when the power of said main line fails or said manual switch is operated, and electrically operated indicating means connected to said independent source of electrical energy and to said single pole double throw limit switch for indicating the position of said main switch.

2. A control system for the selective connection of a load to a main or an auxiliary power line comprising a main switch including a contact connected to the main line, a second contact connected to the auxiliary line, third and fourth contacts connected to the load, a first solenoid, a first armature movable thereby, a bridging contact on said armature movable to close the circuit between said first and third contacts, a second solenoid, a second armature movable thereby, a second bridging contact on said second armature movable to close the circuit between said second contact and said fourth contact, interconnecting lever means between said first and second bridging contacts for causing said bridging contacts to be in operative position one at a time, said lever having an extension at one end thereof, a single throw double pole spring biased limit switch located in the path of the extension of said lever means, said limit switch being closed in the spring biased direction when said first bridging contact is in circuit closing relation and said limit switch being closed in the opposite direction upon contact by the extension of said lever means when said second bridging contact is in circuit closing relation between said auxiliary line and said load, a first relay in said system normally connected to said main line, a second relay connectable to said auxiliary line through a manually operated switch, the armature of said second relay having a spring biased insulated contact connected to said main line to complete a circuit to said first relay, an independent source of electrical energy, first and second motor timers; said energy source, a first contact of said first relay, said first motor timer and the contact of the normally closed contact of the spring biased single pole double throw limit switch being in a circuit whereby the first motor timer is actuated when all of these contacts are closed; a normally open switch actuatable by said first motor timer after a predetermined delay, a third relay actuatable by said normally open switch, a contact of said third relay being closed when the latter is actuated for operating said second solenoid, a second contact of said first relay being closed when said first relay is deenergized and being connected to a contact of said relay which is closed when said second relay is energized and said contacts being connected together and to said second motor timer, said second motor timer being connected to the contact of said limit switch which is

6

normally spring biased closed, whereby said second motor timer may be actuated, a second normally open switch actuatable by said second motor timer after a predetermined delay, a fourth relay connected to said second normally open switch, a contact of said fourth relay being connected to said second solenoid for actuating the second solenoid and establishing connection between said auxiliary line and said load when the power of said main line fails or said manual switch is operated.

3. A control system for selectively connecting a main line or an auxiliary line to a load comprising a main switch operable to connect said main line and auxiliary line one at a time to the load, a first solenoid for moving said main switch to connect said load to said main line, a second solenoid for actuating said main switch for connecting said auxiliary line to said load, a first relay energized by said main line, a single pole double throw limit switch actuatable by said main switch for making a contact when said main switch is in either position, a first motor timer connected in series with one contact of said limit switch, said first motor timer being actuated when said first relay is in the energized position, a first normally open switch operated by said motor timer for energizing said first solenoid connecting said main line to the load, a second motor timer in series with the other contact of said limit switch, said second motor timer being actuated when said first relay is in deenergized position, a second normally open switch operated by said motor timer for energizing said second solenoid connecting said auxiliary line to the load.

4. A control for selectively connecting a load to a main or an auxiliary power line comprising a main switch connectable to said load and one at a time to said main and auxiliary power lines, a first solenoid for actuating said main switch to connect said main line to the load, a second solenoid for actuating said main switch to connect said auxiliary line to said load, a first relay connected to said main line, a first motor timer actuatable by said first relay for momentarily energizing said first solenoid for connecting said main line to said load, a second motor timer actuatable by said first relay when said main power line is deenergized for momentarily energizing said second solenoid for connecting said auxiliary line to said load.

5. A control system for selectively connecting a main or auxiliary electric power line to a load comprising a main switch operative to connect said main and auxiliary lines one at a time to said load, electric means for actuating said switch, means responsive to the energization of said main line for causing said electric means to operate said switch to connect the main line to the load and upon deenergization of the main line causing said switch to connect said auxiliary line to the load, and timing means actuated by the deenergization of said main lines for delaying the operation of said electric means whereby a momentary interruption of the energization of said main line will not cause said electric means to operate, and indicating means controlled by the positions of said main switch to show which electric power line is connected to the load.

6. A control system for selectively connecting a main or auxiliary electric power line to a load comprising a main switch operative to connect said main and auxiliary lines one at a time to said load, electric means for actuating said switch, means responsive to the energization of said main line for causing said electric means to operate said switch to connect the main line to the load and upon deenergization of the main line causing said switch to connect said auxiliary line to the load, and timing means actuated by the deenergization of said main line for delaying the operation of said electric means whereby a momentary interruption of the energization of said main line will not cause said electric means to operate.

7. A control system for a main and auxiliary supply line for supplying electric current to a load comprising a

7

main switch arranged when in one position for connecting the main supply to the load and when in the other position connecting the auxiliary supply to the load, means responsive to the energization of main supply for moving said main switch to the said one position and means responsive to deenergization to said main supply for moving said switch to the other position, and manually controlled means for actuating said switch for normally connecting the load to the auxiliary supply when the auxiliary supply is energized and connecting the load to the main supply when the auxiliary supply is deenergized.

8. A control system for connecting a load to a main or auxiliary source of power comprising switch means for selectively connecting one at a time said main or auxiliary source of power to said load, means responsive to the energization of said main source of power for connecting said load to said main source of power, and means responsive to the deenergization of said main source of power for disconnecting said load from said main source of power and connecting said load to said auxiliary source of power, manually controlled means for normally actuating said connecting means for connecting said load to said auxiliary source of power when said auxiliary source of power is energized, said manually controlled means operating said connecting means for connecting said load to said main source of power when said auxiliary source of power is deenergized, timing means for delaying the

8

disconnection of said load from said main and auxiliary sources of power whereby a momentary interruption in the energization of the load connected source of power will not operate said connecting means.

9. A control system for connecting a load to a main or auxiliary source of power comprising switch means for selectively connecting one at a time said main or auxiliary source of power to said load, means responsive to the energization of said main source of power for connecting said load to said main source of power, and means responsive to the deenergization of said main source of power for disconnecting said load from said main source of power and connecting said load to said auxiliary source of power, manually controlled means for normally actuating said connecting means for connecting said load to said auxiliary source of power when said auxiliary source of power is energized, said manually controlled means operating said connecting means for connecting said load to said main source of power when said auxiliary source of power is deenergized.

References Cited in the file of this patent

UNITED STATES PATENTS

25	1,528,045	Butcher	Mar. 3, 1925
	1,869,330	Anderson	July 26, 1932
	2,018,495	Hoffman	Oct. 22, 1935
	2,486,305	Mahnke	Oct. 25, 1949