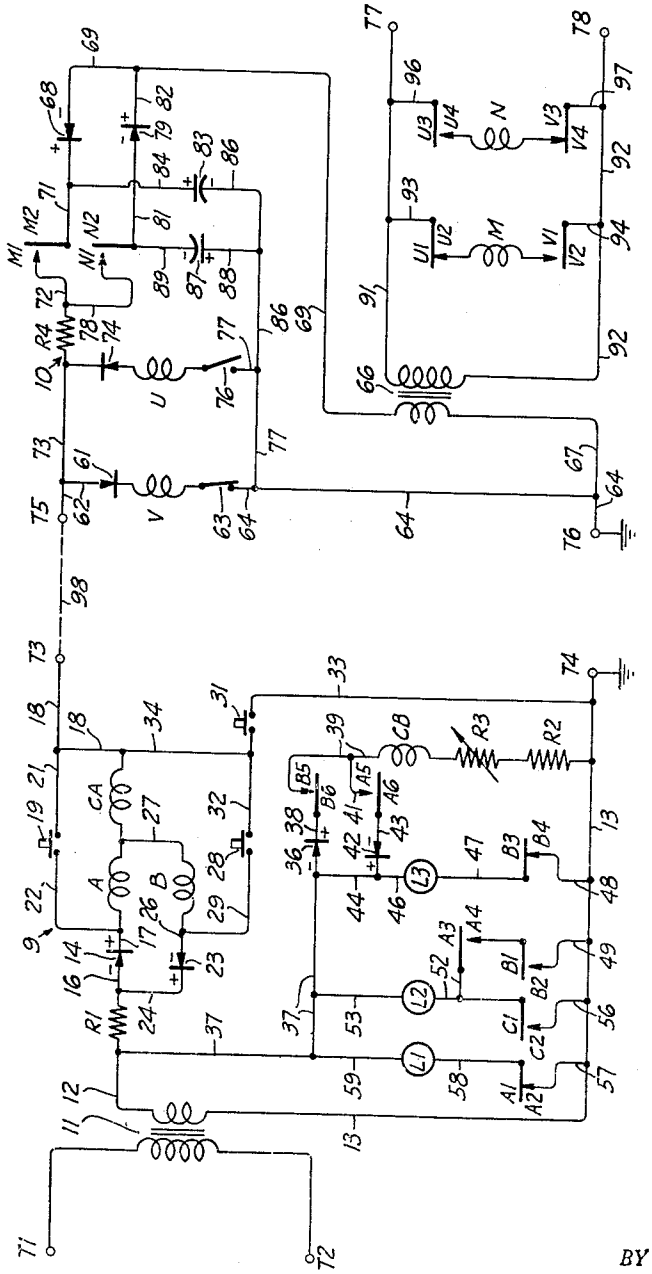
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FUNCTION CONTROL SYSTEM AND APPARATUS

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# FUNCTION CONTROL SYSTEM AND APPARATUS

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This invention relates generally to a function control system and apparatus and more particularly to a function control system and apparatus of a type which will provide supervisory control and continuous monitoring.

In many industrial applications it is desirable to monitor and control one or more functions. For example, it may be desirable to know at any one time the position of a gate, valve, door, motor or the like and then to change the position of the device. The equipment heretofore provided for such a purpose has been unduly complicated and expensive. Also much of such equipment failed to provide continuous monitoring.

In general, it is an object of the present invention to provide a function control system and apparatus which is particularly useful for the purposes referred to above.

Another object of the invention is to provide a function control system and apparatus of the above character in which control and continuous monitoring are provided.

Another object of the invention is to provide a function control system and apparatus of the above character in which several functions may be controlled over the same line.

A further object of the invention is to provide a function control system and apparatus of the above character which is simple and inexpensive to construct and easy to operate and maintain.

Additional objects and features of the invention will appear from the following description in which the preferred embodiment has been set forth in detail in conjunction with the accompanying drawing.

Referring to the drawing, the single figure is a circuit diagram with certain portions of the apparatus shown schematically incorporating my invention.

The apparatus shown in the drawing consists of a control unit 9 and a remote unit 10. The control unit 9 is comprised of a transformer 11 which has its primary connected to terminals T1 and T2 which are connected to a conventional source of power such as 117 volts A.C. 60 cycle. One side of the secondary of transformer 11 is connected to one side of a resistance R1 by conductor 12 and the other side of the secondary of transformer 11 is connected to terminal T4 by conductor 13. The other side of the resistance R1 is connected to a rectifier 14 by conductor 16 and the other side of the rectifier 14 is connected to a relay coil A by conductor 17. The other side of coil A is connected to one side of a coil CA and the other side of coil CA is connected to terminal T3 by conductor 18. Conductor 18 is connected to one side of a push button 19 by conductor 21 and the other side of the push button 19 is connected to conductor 17 by conductor 22.

One end of a rectifier 23 is connected to conductor 16 by conductor 24 and the other side of the rectifier 23 is connected to a relay coil B by conductor 26. The other side of coil B is connected between coils A and CA by conductor 27. Conductor 26 is connected to one side of a push button 28 by conductor 29 and the other side of push button 28 is connected to one side of a push button 31 by conductor 32. The other side of push button 31 is connected to conductor 13 by conductor 33. Conductor 32 is connected to conductor 18 by conductor 34.

Conductor 12 is connected to one side of a rectifier 36 by conductor 37 and the other side of rectifier 36 is connected to movable contact B6 by conductor 38. Stationary contact B5 is connected to one side of coil CB by conductor 39 and the other side of coil CB is connected to one side of a resistance R3. The other side of the resistance R3 is connected to a resistance R2 and the other side of resistance R2 is connected to conductor 13. Conductor 39 is also connected to stationary contact B5 by conductor 41 and movable contact A6 is connected to one side of a rectifier 42 by conductor 43. The other side of rectifier 42 is connected to conductor 37 by conductor 44. Conductor 44 is connected to one side of lamp L3 by conductor 46 and the other side of lamp L3 is connected to contact B3 by conductor 47. Stationary contact B4 is connected to conductor 13 by conductor 48. Stationary contact B2 is connected to conductor 13 by conductor 49 and movable contact B1 is connected to stationary contact A4 by conductor 51. Movable contact A3 is connected to one side of lamp L2 by conductor 52 and the other side of lamp L2 is connected to conductor 37 by conductor 53. Conductor 52 is connected to movable contact C1 and stationary contact C2 is connected to conductor 13 by conductor 56. Stationary contact A2 is connected to conductor 13 by conductor 57 and movable contact A1 is connected to one side of lamp L1 by conductor 58. The other side of lamp L1 is connected to conductor 37 by conductor 59. This completes the description of the components of the control unit.

The remote unit which is shown on the right hand side of the drawing consists of a rectifier 61 one side of which is connected to input terminal T5 by conductor 62. The other side of the rectifier 61 is connected to one side of a relay coil V and the other side of the relay coil is connected to one side of a switch 63. The other side of switch 63 is connected to input terminal T6 by conductor 64.

Conductor 64 is connected to one side of a primary winding of a transformer 66 by conductor 67 and the other side of the primary winding is connected to one side of a rectifier 68 by conductor 69. The other side of rectifier 68 is connected to movable contact M2 by conductor 71 and stationary contact M1 is connected to one side of resistance R4 by conductor 72. The other side of resistance R4 is connected to conductor 62 by conductor 73. Conductor 73 is connected to one side of a rectifier 74 and the other side of the rectifier is connected to one side of a relay coil U. The other side of the relay coil U is connected to a switch 76 and the other side of switch 76 is connected to conductor 64 by conductor 77.

Conductor 72 is connected to stationary contact N1 by conductor 78 and movable contact N2 is connected to one side of a rectifier 79 by conductor 81. The other side of rectifier 79 is connected to conductor 69 by conductor 82. Conductor 71 is connected to one side of a condenser 83 by conductor 84 and the other side of condenser 83 is connected to conductor 77 by conductor 86. Conductor 86 is connected to one side of a condenser 87 by conductor 88 and the other side of condenser 87 is connected to condenser 81 by conductor 89.

One side of the secondary winding of transformer 66 is connected to terminal T7 by conductor 91 and the other side of the secondary winding is connected to terminal T8 by conductor 92. Conductor 91 is connected to movable contact U1 by conductor 93 and stationary contact U2 is connected to one side of relay coil M. The other side of relay coil M is connected to the stationary contact V1 and the movable contact V2 is connected to conductor 92 by conductor 94. Conductor 91 is connected to movable contact U3 by conductor 96 and stationary contact U4 is connected to one side of relay coil N. The other side of coil N is connected to stationary contact V3 and movable contact V4 is connected to con-

ductor 92 by conductor 97. This completes the description of the components of the remote unit.

Operation of my function control system and apparatus may now be briefly described as follows: Let it be assumed that terminals T1 and T2 and T7 and T8 have been connected to conventional power sources such as 117 volt A.C. 60 cycle. Let it also be assumed that the apparatus is being used to control a certain device, such as the opening and closing of a motor operated valve. If such is the case, switches 63 and 76 can be of the limit switch type which are adapted to be actuated by the valve's movement to its extreme closed and open positions, switch 63 being operated when the valve is moved to an extreme open position and switch 76 being operated when the valve is moved to an extreme closed position.

It is to be understood that the lettered contacts are operated by the relay coil bearing the particular letter. Thus, contacts A1, A2, A3, A4, A5 and A6 are operated by relay coil A. Relay C is provided with two coils, one denoted as coil CA and the other denoted as coil CB whose functions are hereinafter described. However, as hereinafter pointed out, it is not absolutely necessary that relay C have two coils.

Now assume that 60 cycle A.C. is applied to terminals T1 and T2 and through transformer 11 to provide suitable operating voltage. For example, the transformer 11 may be used for reducing the voltage from 117 volts A.C. to 48 volts. The 60 cycle A.C. is applied through the limiting resistor R1 to the two rectifiers 14 and 23. The rectifiers 14 and 23 are reversed so that voltage is applied to the negative terminal of the rectifier 14 and to the positive terminal of the rectifier 23. The rectifiers 14 and 23 therefore provide both the positive and negative half waves of each cycle.

Assuming that we are in the positive half wave of one cycle of the 60 cycle A.C., rectifier 14 will pass the positive half wave through the coil of relay A and coil CA of relay C to terminal T3.

The negative half wave of the same cycle is passed by rectifier 23 and passes through the coil of relay B and the coil CA of relay C to terminal T3.

The secondary of the tranformer 12 also supplies 60 cycle A.C. to the rectifiers 36 and 42. Rectifier 36 serves to supply the positive half wave of each each cycle to the coil CB of relay C when relay B has been operated to close contacts B5 and B6. The current flows through limiting resistors R2 and R3 to the other side of the secondary of the transformer 11.

Rectifier 42 serves to pass the negative half wave of each cycle to relay coil CB when contacts A5 and A6 are closed by operation of relay A. When relays A and B are both energized, it is apparent that the coil CB will be supplied with alternating current because both the positive and negative half waves of each cycle will be passing through coil CB.

Let it be assumed that the control unit 9 and the remote unit 10 are connected together by suitable electrical means such as line 98 for connecting terminals T3 and T5 and a ground return between terminal T4 and terminal T6.

Let it also be assumed that the motor-operated valve is in a closed position and that the limit switch 63 is closed. The operation of the limit switches 63 and 76 is such that the limit switch 63 is closed when the valve is in a closed position and remains closed until the valve is moved to an extreme open position whereas the limit switch 76 is open when the valve is in a closed position and closes as soon as the valve is moved from its extreme closed position. Switch 76 remains closed until the valve is moved to an extreme closed position. Switch 63 is opened as soon as the valve is moved from the extreme open position.

With the apparatus in the condition shown in the circuit diagram, a weak current consisting of positive pulses flows over the line 98. The circuit is completed from one side of the secondary of transformer 11 through conductor 12, resistance R1, rectifier 14, conductor 17, high resistance relay coils A and CA, conductor 18, terminal T3, conductor 98, terminal T5, conductor 62, rectifier 61, the coil of relay V, switch 63, conductor 64, terminal T6 via ground return to terminal T4, conductor 13 to the other side of the secondary winding of transformer 11.

Thus, when the valve is in an extreme closed position, a weak current consisting of positive pulses will flow over line 98. The weak current is insufficient to cause operation of relay V but is sufficient to operate relay A which causes opening of its contacts A1 and A2 to de-energize lamp L1. Contacts A3 and A4 will also be closed but since contacts B1 and B2 are open lamp L2 will not be lit. Since relay B is not energized, lamp L3 will remain lit which serves to indicate that the motor-operated valve is in a closed position.

It should be explained that no negative pulses will pass over the line 98 because the switch 76 is open. Relay C is not operated by the weak positive pulses passing through coil CA of relay C because of the bucking flux set up in coil CB. As soon as relay A is operated, contacts A5 and A6 are closed which causes negative pulses to pass through coil CB. The flux created by coil CB is opposite to that created by coil CA and thus relay C remains unoperated. The resistance R3 is adjusted to equalize the currents in the coils CA and CB so that zero flux results. Thus, when weak positive pulses are flowing over the line 98 only relay A is operated and only lamp L3 is lit.

Now let it be assumed that it is desired to move the valve from its closed position to an open position. Push button 19 is pressed which serves to bypass the high resistance coils A and CA to apply strong positive pulses to the line 98. The strong positive pulses follow the same path as the weak positive pulses.

The strong positive pulses now applied over the line 98 are sufficient to cause operation of relay V which causes closing of its contacts V1 and V2 and opening of its contacts V3 and V4. Closing of contacts V1 and V2 permits A.C. to flow through the coil of relay M from terminals T7 and T8 to cause energization of relay M and closing of its contacts M1 and M2. Additional control contacts (not shown) are provided on relay M which may be used for starting operation of the motor to open the valve of the unit to be controlled by the control unit 10. Closing of contacts M1 and M2 applies a filtered steady state positive D.C. voltage to the coil of relay V and maintains relay V in an energized condition even though push button 19 is released. This steady state positive D.C. is supplied by rectifier 68 and condenser 83 through the limiting resistance R4 from the power supply across terminals T7 and T8.

Operation of relay M and closing of its contacts M1 and M2 also causes a filtered steady state D.C. to be applied to the line 98 which operates relays B and C in the control unit 9. The positive steady state D.C. from line 98 is applied to the right hand sides of the coil of relay B and to coil CA of relay C. Negative pulses are applied to the left hand side of the coil of relay B by the rectifier 23. Therefore a substantial voltage difference appears across the opposite ends of the coil B and current flows through the coil of relay B and through coil CA to cause operation of relay B. Relay C is also operated because the current flow in coil CA unbalances the zero flux relationship between coils CA and CB to provide a net flux difference which causes operation of relay C.

Operation of relays B and C causes lamps L1 and L2 to be lit which indicates that the valve or other function controlled by the remote unit 10 is being moved toward an open position. Lamp L1 is lit because contacts A1

and A2 remain closed because relay A is not operated.

It is to be understood that across the coil for relay A there is a small voltage difference because on the left hand side positive pulses are applied and on the right hand side steady state positive D.C. is applied. However, as long as the voltage on the right hand side of the coil for relay A is higher than that on the left hand side, no current can flow through the coil of relay A because of the orientation of the rectifier **14**.

Lamp L2 is lit because contacts C1 and C2 are closed by operation of relay C. The closing of contacts B1 and B2 by operation of relay B does not establish another circuit for lighting of lamp L2 because contacts A3 and A4 are still open. Lamp L3 is de-energized because contacts B3 and B4 are opened by operation of relay B.

After the valve or other function controlled by the remote unit **10** has been started from a closed position toward the open position by operation of the push button **19**, two conditions may occur. One is that the valve may move toward a completely open position and the other is that it can be stopped in an intermediate stage by operation of push button **31**. Let it first be assumed that it is desired to stop the valve in an intermediate position between closed and open positions. This can be accomplished by operation of the push button **31** at the proper time which short circuits the line **98** to ground. Assuming that the line resistance is relatively low, the push button **31** serves to reduce the voltage on the coil of relay V to substantially zero. The resistance R4 serves to limit the current flow. This will cause relay V to be de-energized causing opening of its contacts **1** and **2** and de-energization of relay M to open its contacts M1 and M2. The opening of contacts M1 and M2 removes the positive steady state D.C. from line **98**.

As soon as the push button **31** is released, weak current pulses to both polarities pass over line **98** and cause operation of relays A and B. The positive pulses are supplied by the rectifier **14** through the coil of relay A and coil CA, line **98**, rectifier **61**, the coil of relay V, switch **63**, conductor **64** via the ground return between terminals T4 and T6, conductor **13** to the secondary winding of transformer **11**, conductor **12**, resistor R1 to the other side of the rectifier **14**. This current flow causes operation of relay A but does not cause operation of relay V because relay V is margined so that it will only be operated by a strong current.

The current path for the negative pulses supplied by rectifier **23** and flowing through the coil of relay B is similar in that the current also passes through coil CA and over the line **98** after which it passes through the rectifier **74**, the coil of relay U, the switch **76**, conductor **77** to the conductor **64**. This current flow causes operation of relay B but does not cause operation of relay U because relay U is also margined like relay V to operate only on a strong current.

Relay C is not operated by the current flowing through the coil CA because both the positive and negative pulses are flowing through the coil which are the same as an A.C. signal. Relay C will not respond to an A.C. signal. Relay C is also not operated because any flux created in the coil CA is balanced out by the flux created in the coil CB. Operation of relays A and B causes closing of contacts A5 and A6 and B5 and B6 which causes voltage of both polarities to be applied to the coil CB in the same way that voltage of both polarities is applied to the coil CA.

Operation of relays A and B cause lamp L1 to be de-energized and thus lamp L2 only remains lit. Operation of relay A opens contacts A1 and A2 which opens the circuit for lamp L1. Operation of relays A and B causes closing of contacts A3 and A4 and B1 and B2 which completes a circuit for L2. Thus, deenergization of relay C and opening of its contacts C1 and C2 does not de-energize lamp L2. Lamp L3 remains unlit because contacts B3 and B4 are open. Thus, when only lamp L2 is lit, it indicates that the function controlled by the remote unit **10** is in a transitory position between two extreme positions such as the fully open and closed positions of a valve.

Now let it be assumed that it is desired to move the valve to a fully open position. Push button **19** is then depressed to create the sequence of operation hereinbefore described. Upon movement of the valve to a fully open position, switch **63** is opened which causes de-energization of relay V. De-energization of relay V opens its contacts V1 and V2 to cause de-energization of relay M and opening of its contacts M1 and M2. Opening of contacts M1 and M2 removes the positive steady state D.C. from the line **98**.

With switch **63** open, we have only a path over line **98** for negative pulses from the control unit **9** and therefore relay B is operated. As previously explained, the curent path for energizing relay B is completed through the switch **76**. Switch **76** as also explained previously is closed as soon as the valve is moved from the extreme closed position. Relay U is not energized because the weak current is insufficient to cause energization of relay U.

Since relay A is not energized, contacts A1 and A2 are closed which completes the circuit for lighting of lamp L1. Lamps L2 and L3 are not lit. Contacts A3 and A4 and C1 and C2 are open which prevents the lighting of lamp L2 and contacts B3 and B4 are open which prevents the lighting of lamp L3.

Now let it be assumed that it is desired to move the valve from a fully open position toward a closed position. Push button **28** is then operated which shunts out the high resistance coil of relay B and coil CA and causes strong negative current pulses to be applied directly to the line **98** from the rectifier **23**. These strong negative pulses will pass through rectifier **74** and through the coil of relay U, switch **76**, conductor **77**, conductor **64** via the ground return between terminals T4 and T6, conductor **13** to the secondary winding of transformer **11** through resistance R1 to the other side of the rectifier **23**. The strong negative pulses cause operation of relay U which causes contacts U3 and U4 to cause energization of relay N from the power source connected across terminals T7 and T8.

Operation of relay N closes its contacts N1 and N2 and also causes the operation of additional contacts (not shown) which can be used for starting a motor or like device to move the valve from an open position toward a closed position. Closing of contacts N1 and N2 cause a negative steady state D.C. to be applied to the line **98** from the rectifier **79** in a manner similar to that in which positive steady state D.C. was applied to the line **98** when contacts M1 and M2 were closed.

The application of negative steady state D.C. to the line **98** causes operation of relays A and C in a manner similar to that in which relays C and B were operated when positive steady state D.C. was applied to the line **98**. Relay B is not operated for the same reason that relay A was not operated when positive steady state D.C. was applied to the line **98** by the remote unit **10**.

With the valve moving toward the closing position and relays A and C operated, lamps L2 and L3 will be lit. Lamp L1 will not be lit because relay A is energized and has opened its contacts A1 and A2. Lamp L2 is lit because contacts C1 and C2 are closed by operating relay C. Lamp L3 is lit because relay B is not energized and its contacts B3 and B4 are closed.

Relay C is operated by either positive steady state D.C. or negative steady state D.C. supplied by the remote unit **10**.

While the valve is being moved toward a closed position, it may be stopped in any desired position by operation of push button **31**. Then if it is desired to continue closing of the valve, push button **28** is pressed.

Operation of the valve continues until it has moved to a fully closed position at which time limit switch **76** is opened to de-energize relay U to open contacts U3 and U4. Opening of contacts U3 and U4 de-energizes relay N and opens contacts N1 and N2 removing the negative steady state D.C. from the line **98**.

At this time, only weak positive pulses will flow over the line **98** because switch **76** is open. The flow of weak positive pulses will cause operation of relay A. Relay A is operated but relay V is not operated because the current is insufficient to operate that relay. Relay C is not operated because the flux created by the current flowing through coil CA is balanced or bucked out by the current flowing through coil CB when contacts B5 and B6 of relay B are closed. Only lamp L3 is lit when the valve is in the fully closed position because relays B and C are not operated. Since relay B is not operated, contacts B3 and B4 are closed to light lamp L3. Since relay A is operated, contacts A1 and A2 are open to prevent lighting of lamp L1.

If it is now desired to move the valve toward an open position, it is only necessary to operate the push button **19** to cause a sequence of operation as hereinbefore described. As soon as the valve moves from the fully closed position, switch **76** is closed. Thus switch **76** is only open during the time when the valve is in the fully closed position. Switch **63** is only open when the valve is in a fully open position.

From the foregoing, it is apparent that it is possible to control the operation of a remotely located device by relatively simple apparatus and at the same time to provide continuous monitoring to give the condition of the remotely located function. The apparatus can be further simplified by elimination of the second coil, coil CB for relay C and the associated circuitry consisting of rectifiers **36** and **42**, contacts B5, B6, A5 and A6, and resistances R2 and R3. Relay C is then margined so that it will not operate on an A.C. signal or on weak positive pulses. The operation of the circuitry is identical to that hereinbefore described except that no bucking voltages are created by a coil CB. The reliability of operation of relay C in such a simplified circuitry is entirely satisfactory.

The system and apparatus herein provided is fail safe in one respect in that if the remote unit has been instructed to cause the motor operated valve to move to an open or closed position, the remote unit will cause this operation to be accomplished even though a line failure between the control unit and the remote unit should occur during the operation. This is true because the steady state D.C. provided by the remote unit serves to maintain energization of one of the relays V or U and either of these relays is maintained in an energized condition until one of the limit switches **63** or **76** is opened by movement of the valve to either a closed or an open position.

When a line failure occurs, an immediate indication is given by the lamps L1, L2 and L3 that a failure has occurred. No weak or trickle current will be flowing over the line **98** and hence neither relays A nor B will be operated. Under this condition, both lamps L1 and L3 will be lit because contacts A1 and A2 and B3 and B4 remain closed. When this occurs, an abnormal condition is present.

By utilizing a number of relatively simple and inexpensive components, I have provided means for distinguishing weak and strong currents, and means for distinguishing between steady state D.C. and pulsating D.C. A.C. can also be distinguished from D.C. By utilizing such means for distinguishing between different types of electrical energy, various operations can be performed at a remotely located point by the use of a single line while at the same time providing continuous monitoring of what is occurring at the remotely located point. It is readily apparent that such a control system and apparatus is particularly adaptable to the opening and closing of doors, gates, valves and the like, the starting and stopping motors and so forth. It also can be used for motive control and other semi-related functions in which it is desired to change from one condition to another.

I claim:

1. In a system for the control of a device at a remote location, a control unit, a remote unit at the remote location adapted to control the operation of said device, electrical circuit means connecting the control unit and the remote unit, said control unit comprising a power supply, relay means connected to said power supply, means connected to the power supply and to the relay means for bypassing said relay means to produce a signal of one type when said relay means is bypassed and a signal of another type when said relay means is not bypassed, means connecting the relay means and the bypassing means to the electrical circuit means for transmission of the signals over the electrical circuit means to the remote unit, said remote unit comprising relay means connected to the electrical circuit means and movable between operated and unoperated positions in accordance with said signal, said relay means at the remote unit being adapted to control the operation of said device, and means at the control unit operated by said relay means at the control unit for indicating when a signal of one type is being transmitted over said electrical circuit means and when a signal of the other type is being transmitted over said electrical circuit means.

2. A system as in claim 1 wherein the device is capable of assuming two extreme positions and positions between the two extreme positions and wherein the relay means at the remote unit comprises a pair of relays and wherein said remote unit also includes a switch in series with each of said relays, one of the switches being in a closed position and the other of said switches being in an open position when said device is in one extreme position, said one switch being in an open position and said other switch being in a closed position when said device is in the other extreme position, both of said switches being closed when said device is in a position between the two extreme positions.

3. A system as in claim 1 wherein said relay means adapted for controlling the operation of said device at the remote unit includes means for generating a signal of a third type and applying it to said relay means at the remote unit to maintain the same in an operated condition after the same has been operated by one of said signals, and wherein said control unit includes additional relay-operated indicating means operated by said signal of the third type.

4. A system as in claim 3 wherein said signal of the first type is strong pulsating D.-C., said signal of the second type is weak pulsating D.-C. and wherein said signal of the third type is steady state D.-C.

5. In a system for the control of a device at a remote location, the device being capable of assuming two states, a control unit, a remote unit at the remote location and adapted to control the operation of said device and electrical circuit means connecting the control unit and the remote unit, said control unit comprising a first power supply of pulsating positive D.-C., a second power supply of pulsating negative D.-C., first and second relay means connected to said first and second power supplies, first means for bypassing said first relay means, second means for bypassing said second relay means, means connecting the first and second relay means and the first and second bypassing means to the electrical circuit means whereby said control unit serves to apply weak positive and negative pulsating D.-C. to the electrical circuit means when neither of the bypassing means is actuated and serves to apply strong pulsating positive D.-C. when said first bypassing means is actuated and strong pulsating negative D.-C. when said second bypassing means is actuated, said first and second relay means being energized by

either weak or strong pulsating D.-C., and indicating means actuated by said first and second relay means at the control unit, said remote unit comprising first and second relay means, said first and second relay means at the remote unit being operated by a strong current and remaining inoperative under a weak current, and means controlled by said first and second relay means at the remote unit for controlling the operation of said device.

6. A system as in claim 5 wherein said remote unit includes a switch in series with each of said first and second relay means, said switches being adapted to be moved between open and closed positions by the device, one of the switches being closed and the other of said switches being open in one state of the said device, said one switch being in an open position and said other switch being in a closed position in the other state of said device.

7. A system as in claim 5 wherein said control unit includes a third relay means in series with said first and second relay means, and wherein said means at the remote unit controlled by the first and second relay means includes means for generating a steady state D.-C. and applying the same to said first and second relay means at the remote unit and to said electrical circuit means when either of said first or second relays at the remote unit is operated, said third relay means at the control unit being operated by said steady state D.-C., and indicating means at the control unit for indicating when said third relay means is operated.

8. In a system for the control of a device at a remote location, the device being capable of assuming two states, a control unit, a remote unit at the remote location and adapted to control the movement of said device between said two states and electrical circuit means connecting the control unit and the remote unit, said remote unit comprising first and second relay means, rectifier means connected to the electrical circuit means and connected in series with each of said relay means to permit flow of current through said first relay means in one direction and through said second relay means in an opposite direction, a switch connected in series with each of said relay means, said switches being adapted to be moved between open and closed positions by said device, one of said switches being in a closed position and the other of said switches being in an open position in one state of said device, said one switch moving to a closed position and said other switch moving to an open position upon said device assuming said other state, said first and second relay means being operated by a strong current and remaining inoperative under a weak current, and means operated by said first and second relay means for controlling the operation of said device, said means operated by said first and second relay means including an A.C. power supply rectifier means connected to said A.C. power supply for applying steady state D.-C. of one polarity to said electrical means and to the rectifier means connected in series with said first and second relay means when one of said first and second relay means is operated to maintain said one operated relay means in an operated condition, and steady state D.-C. of opposite polarity to the electrical circuit means and to the rectifier means connected in series with said first and second relays when the other of said relays is operated to maintain the other of said relays in an operated condition, said control unit comprising a power supply of pulsating positive D.-C. and a power supply of pulsating negative D.-C., first relay means connected to said positive power supply and second relay means connected to said negative power supply, third relay means connected in series with said first and second relay means, means connecting said third relay means to the electrical circuit means, means connected to the positive power supply and to the electrical circuit means for bypassing said first and third relay means to apply a strong positive pulsating D.-C. to said electrical circuit means when said first and third relay means are bypassed and to apply weak positive pulsating D.-C. to said electrical circuit means when said first and third relay means is not bypassed, means connected to the negative power supply and to the electrical circuit means for bypassing said second and third relay means to apply a strong pulsating negative D.-C. to the electrical circuit means when said second and third relay means are bypassed and to apply a weak pulsating negative D.-C. to said electrical circuit means when said second and third relay means is not bypassed, said first and second relay means at the control unit being operated by weak pulsating D.-C. and said third relay means being operated only by steady state D.-C. and circuity at the control unit including three indicating elements operated by said first, second and third relay means.

9. A system as in claim 8 wherein said device is of a type which is movable between open and closed positions and wherein said indicating element at the control unit indicate the positions of the device, the device being at an open position when the first element is energized, the device moving toward a closed position when the second and third indicating elements are energized, the device being stopped between open and closed positions when the second indicating element is energized, the device being in a closed position when the third indicating element is energized, and the device moving toward an open position when the first and second indicating elements are energized.

10. In a system for the control of a device at a remote location, a control unit, a remote unit at the remote location adapted to control the operation of said device, and electrical circuit means connecting the control unit and the remote unit, said control unit comprising a power supply, relay means connected to said power supply, means connected to the power supply and to the electrical circuit means for bypassing said relay means whereby a signal of one type flows over said electrical circuit means when said relay means is bypassed and a signal of another type flows over said electrical circuit means when said relay means is not bypassed, said remote unit comprising relay means movable between operated and unoperated conditions in accordance with said signal, and means at the control unit operated by said relay means at the control unit for indicating when a signal of said one type is flowing over said electrical circuit means.

11. In a system for the control of a device at a remote location, the device being capable of assuming two states, a control unit, a remote unit connected to the device, electrical circuit means connecting the control unit to the remote unit, alternating current supplies at the control and the remote units, a pair of switches operated by the device, one of the switchese being normally closed in one state of said device and remaining closed while the device is in said one state and until the device assumes the other state, the other switch being normally open in said one state of said device and assuming a closed position as soon as said device moves from said one state, means at the control unit for generating weak and strong positive pulsating D.-C. and weak and strong negative pulsating D.-C. and transmitting the same over the electrical circuit means to the remote unit, means at the control unit indicating the type of pulse being transmitted over the electrical circuit means, means at the remote unit for determining whether weak or strong positive pulses or weak or strong negative pulses are being received by the remote unit, means at the remote unit controlled by said last-named means for causing said device to assume a state in accordance with the type of pulse received, means at the remote unit for generating a steady state positive D.-C. of either negative or positive polarity and applying it to the electrical circuit means, and means at the control unit responsive to the D.-C. from the remote unit.

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