

Sept. 29, 1936.

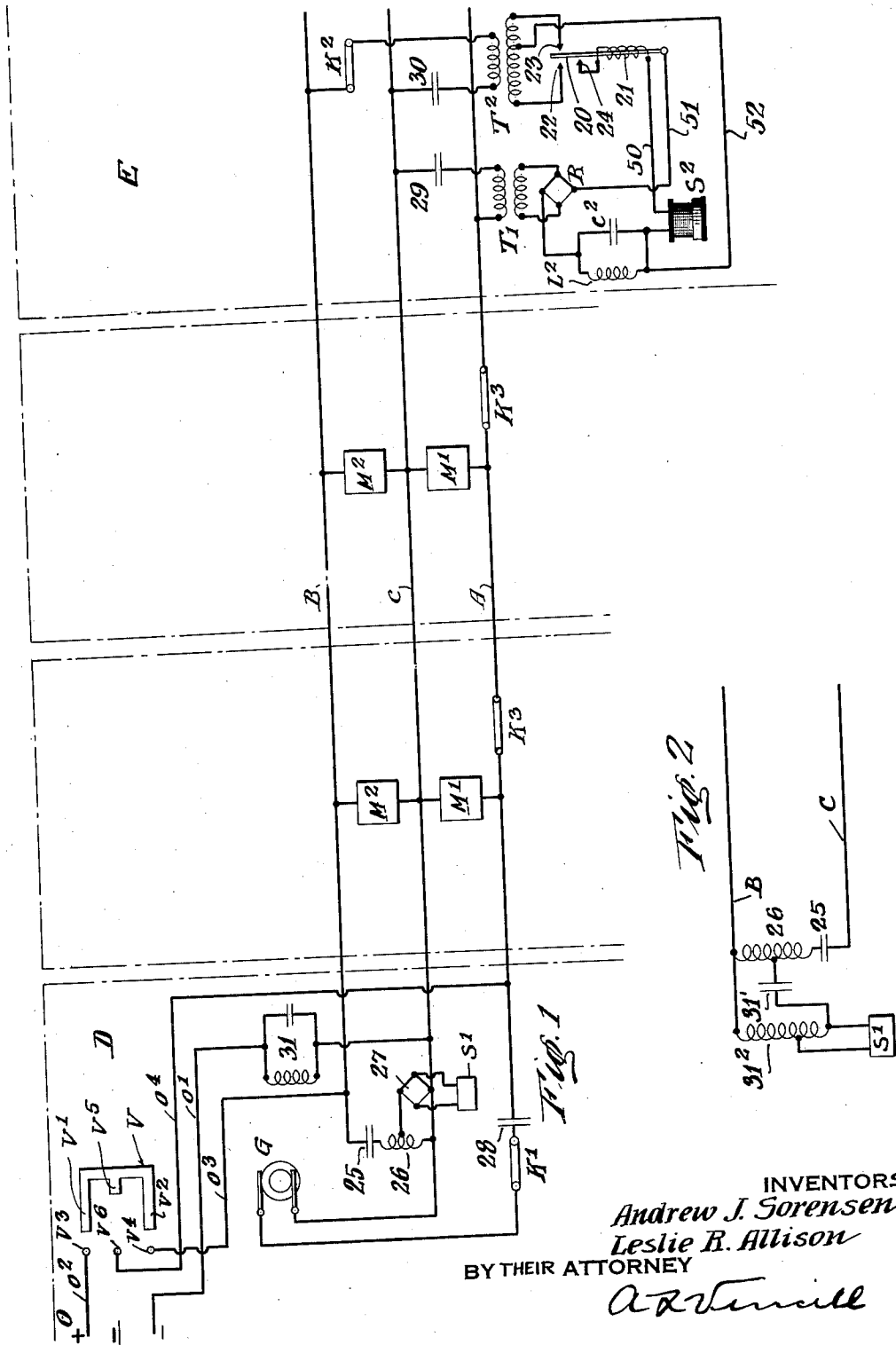
A. J. SORENSEN ET AL

2,055,563

CONTROL SYSTEM

Filed June 1, 1931

2 Sheets-Sheet 1



Sept. 29, 1936.

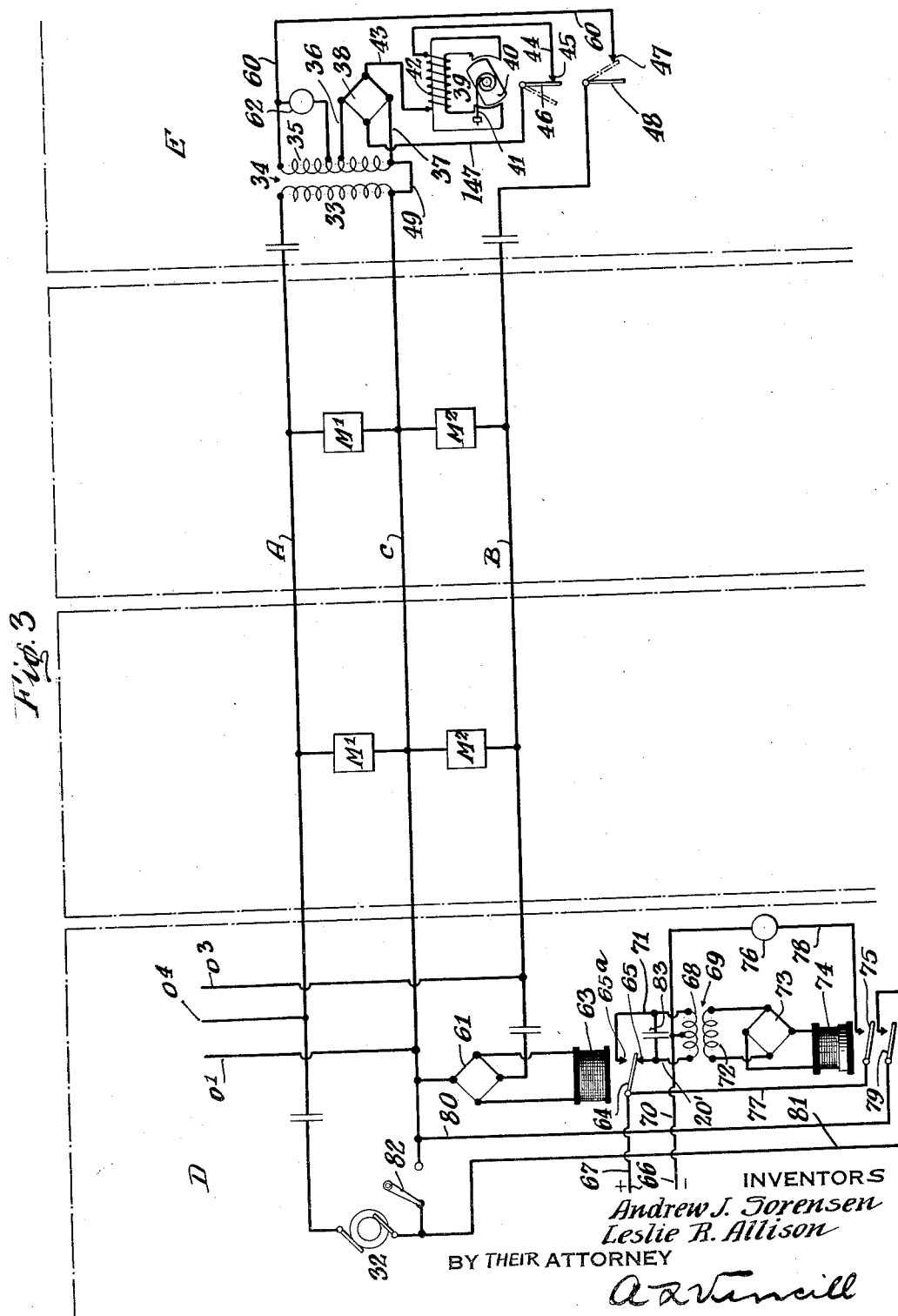
A. J. SORENSEN ET AL

2,055,563

CONTROL SYSTEM

Filed June 1, 1931

2 Sheets-Sheet 2



UNITED STATES PATENT OFFICE

2,055,563

CONTROL SYSTEM

Andrew J. Sorensen, Edgewood, and Leslie R. Allison, Forest Hills, Pa., assignors to The Union Switch & Signal Company, Swissvale, Pa., a corporation of Pennsylvania

Application June 1, 1931, Serial No. 541,400

22 Claims. (Cl. 177—311)

This invention relates to control systems, and, although it has been primarily designed for employment in connection with brake-control means on trains, its utility is by no means to be limited to such function as it is susceptible of use in other fields.

The main object and feature of the invention is the provision of means for testing or indicating the integrity of one or more circuits that control normally deenergized translating means without, however, energizing said translating means when testing the circuit or circuits.

In the accompanying drawings the invention is disclosed in several concrete and preferred forms, in which

Fig. 1 is a diagrammatic view of the circuits constituting one form of the invention;

Fig. 2 is a detail view of part of Fig. 1 showing a slight modification of one of the indicating means employed in the invention;

Fig. 3 is a diagrammatic view similar to Fig. 1 but showing a modified form of the invention.

In the exemplification shown in the drawings, there are two circuits which here have one path in common, said path being conveniently indicated by conductor C, reference characters A and B indicating line wires which in conjunction with common path C and other devices to be presently described constitute two line circuits. These line circuits may be conceived as extending from a control station D to a remote station E, and in the present instance said control station is one of a plurality of cars, such as the cab of the engine, and said remote station is another one of a plurality of cars, such as the caboose of a train. Any number of intervening cars may, of course, be present, and it will be seen that the line circuits extend from car to car. M' indicates a translating device, here a traffic-controlling device such as a brake-control magnet, connected across conductors A and C. M² indicates a similar translating device connected across conductors B and C. M' and M² are of the type of brake-control means that are normally deenergized, and which when energized apply the brakes. Any suitable means may be provided to energize M' and M². In the present instance is shown a source of direct current O having one lead o' connected to path C and the other lead o² connected through wires o³ and o⁴ to either one or both of line conductors B and A. The arrangement is here such that when the engineer's brake valve V is in the position shown in the drawings, that is in release, running or holding position, the contacts are

open and no current is supplied to the line wires, but that when valve V is moved to bring contacts v', v² and v⁵ into engagement with contacts v³, v⁴ and v⁶, current is supplied to paths M' and M² to thereby energize them and give a service application of the brakes. When valve V is moved into an intermediate or lap position in which contacts v' and v² are in engagement with contacts v³ and v⁴ but in which contacts v⁵ and v⁶ are out of engagement, M² only is energized whereby the brake application already made is maintained.

It will be understood that with such construction it is desirable to provide means for testing the integrity of the line conductors so that the engineer may be assured at all times that the brakes will function if operated. Also, on long freight trains, it is desirable that the crew in the caboose be kept informed as to the dependability of the brakes.

Accordingly, the following means, or their equivalent, are provided to test the integrity of the line circuit:

Suitable means are provided to supply to the line conductors current of a character different from that of source O. As here shown, G indicates a generator located at the control station to supply an alternating current of a suitable frequency, say one hundred and fifty cycles, to circuit A—C. Suitable means, located at the other station, are responsive to the influence of said current to thereby produce a return indication current flow of a character different from that supplied by G and also by O, said return indication flow being sent over circuit B—C back to the control station. In the form of the invention here shown, the devices located at the remote station are as follows: T' is a transformer, the primary of which is bridged across conductors A and C, and T² indicates another transformer, the secondary of which is connected across conductors B and C and the primary of which receives energy from the secondary of T' in a manner presently to be described. A tuned alternator or reed vibrator consisting essentially of tuned vibratory reed 20 and coil 21 is provided, this device being of a well-known construction and being actuated by current having a unidirectional flow. The natural period of vibration of reed 20 is here established at a frequency of thirty cycles or at some other frequency that will make the return indication current of a distinctly different character from the one-hundred-fifty cycle current supplied by G. Reed 20 when vibrating will alternately engage

contacts 22 and 23 of the primary of transformer T², and the secondary of said transformer will therefore impress conductors B and C with a thirty cycle alternating current. The alternating current received by the secondary of transformer T' is passed through rectifier R, the alternating component in the output of the latter being here suppressed by reactor L² and condenser C², and unidirectional current will now pass from the upper terminal of R by way of L², signal S² and wire 50 to coil 21, contact 24, reed 20, and wire 51 back to lower terminal of R. This will cause reed 20 to vibrate and will energize primary of T² by current from upper terminal of R, by way of L², wire 52, primary of T², contact 22 or 23, reed 20 and wire 51 back to lower terminal of R. Signal or indicating device S² is here a direct current slow-release relay. Any suitable means may be located at the control station to respond to the influence of the return indication current, but not to the current supplied by G or O, and these means may be here as follows: S' is a signal or indicating device here consisting of a direct current relay connected across conductors B and C through the instrumentality of condenser 25, reactor 26 and rectifier 27, the condenser and reactor being tuned to the frequency of thirty cycles.

Suitable blocking or filtering means, such as are well known in the art, may be inserted in the various leads to segregate the current of source O from the other sources. For instance, in addition to condenser 25, there may be interposed condensers 28, 29 and 30 to prevent direct current from flowing through alternator G and the transformers, and a reactor-condenser unit 31, or a reactor alone, may be inserted between C and source O. So also magnets M' and M² can be protected from the alternating currents by having a high impedance. If it be desired to provide a more effective filter in connection with signal S', there can be used, in addition to the elements described, a second condenser 31' and a reactance 31² as shown in Fig. 2.

Assuming keys K' and K² to be in their closed position, it will be evident that the one-hundred-fifty cycle current from G will be supplied over wires A and C and will energize primary of transformer T'. This, in turn, will, through the instrumentalities described, energize signal S² and supply a thirty cycle current to secondary of transformer T² and to wires B and C. The indication given by S² will indicate, to the crew in the caboose, the integrity of wires A and C. The return indication current will then cause signal S' at the control station to be displayed, thus indicating to the engineer that wires A, B and C are in working order. It will be evident that, should either of wires A or B become impaired, signal S' will not be displayed. If wire C should be broken, there might be a tendency for the current from G to flow from A to B through magnets M' and M², but if that should happen such current would be too small to cause S' to display a false indication because signal S' and its associated elements are not responsive to current from G but only to current from T².

It will further be seen that by opening and closing the circuits by means of keys K' and K² (or intermediate keys K³ in the cars) messages can be sent in both directions in accordance with a prearranged code as the opening or closing of keys K' and K³ will give indications both at S' and S², and the opening and closing of key K² will give indications at S'.

In the modification shown in Fig. 3 there is shown the same three conductors A, B, and C and the same exemplification of means to supply energy to magnets M' and M² as is described in connection with Fig. 1, and it is therefore unnecessary to repeat the description. The current source at the control station is here indicated by alternating current generator 32, delivering say a sixty-cycle current, connected between wires A and C whereby primary winding 33 of transformer 34 of the remote station is energized. Connected to secondary 35 of said transformer, by means of wires 36 and 37, is a rectifier 38. 39 indicates a driven code transmitter of the oscillating type having an oscillatory armature 40 normally urged in one direction by spring 41 and moved in the other direction when winding 42 is energized. Winding 42 is connected in the output circuit of rectifier 38 by means of wire 43, winding 42, wire 44, contact 45, movable contact 46, and wire 147. 20 When winding 42 is energized the circuit is broken at contacts 45 and 46 thereby in turn deenergizing winding 42 and thereby again closing contacts 45 and 46 and so on. In addition to controlling its own energizing circuit, code transmitter 39 controls, by means of contacts 47 and 48, the circuit including wires B and C, and the mass of armature 40 and the force exerted by spring 41 are so adjusted that said armature oscillates at some resonant frequency differing relatively widely from the sixty cycle frequency, say a frequency of three cycles per second. By these means the current received by secondary 35 from primary 33 is modulated or modified or is given a characteristic different from that of the sixty-cycle current to thereby render it suitable as a return indication current having a distinct characteristic. It will be seen that in the present instance there is no separate circuit at the remote station between the line circuit composed of wires A and C and that composed of wires B and C, because, as shown, wire C is connected by means of wire 49 to secondary 35, and from the latter leads a wire 60 to contact 47, contact 48 being connected to wire B, and wires B and C being bridged at the control station by rectifier 61. It will now be apparent that as long as secondary 35 is being energized by primary 33, the code transmitter will be actuated to send a return indication current over the following path: from secondary 35, wire 60, contacts 47 and 48, wire B, rectifier 61, wire C, and wire 49 back to secondary 35. 62 indicates a lamp, a relay or other indicating means connected in shunt between secondary 35 and wire 60, whereby as long as secondary 35 is energized by primary 33 that fact will be indicated to the crew in the caboose. 63 indicates a repeater relay at the control station or engine, said relay being energized by current flow in rectifier 61 and deenergized when no current flows, and thus relay 63 is energized and deenergized in step with the opening and closing movement of contact 48, which, as we have seen, has here a frequency of three cycles per second. 64 is an armature controlled by relay 63 and this armature is picked up and released in step with the above described energization and deenergization of relay 63. Energization and deenergization of relay 63 therefore causes armature 64 to alternately engage contacts 65 and 65^a, and when armature 64 engages 65 current flows from a local source 66 at the control station over wire 67, armature 64, contact 65, wire 20', through one-half of primary winding 68 of transformer 69, wire 70 and back to source 66. Conversely when arma-

ture 64 engages contact 65^a current will flow from source 66 by way of wire 67, armature 64, contact 65^a, wire 71, through the other half of primary winding 68, wire 70 and back to source 66. Direct current flowing alternately first through one-half and then through the other half of the primary of transformer 69 induces an alternating current in secondary 72, and this alternating current is rectified by rectifier 73 to thereby energize direct-current relay 74 which is of the slow-release type so that, as long as armature 64 vibrates at the given frequency, said relay 74 will hold up the armatures controlled by it. One of said armatures 75 is interposed in a circuit controlling indication device or lamp 76, which circuit can be traced as follows: from source 66 over wire 67, wire 77, armature 75, wire 78, lamp 76 and wire 79 back to source 66. The other armature 79 of said relay 74 controls the connection between wires A and C at the power input end. When 79 is in closed position a circuit may be traced as follows: from generator 32 to wire A, primary 33, wire C, wire 80, armature 79, and wire 81 back to generator 32. It will be noted that this circuit shunts starting switch 82 in wire C so that said switch need not remain closed after the system starts operating. Condenser 83 associated with primary 68 is for the purpose of minimizing sparking at contacts 65 and 65^a.

The operation of the system is as follows: The operator closes switch 82 thereby supplying current from generator 32 to wires A and C and primary 33. Secondary 35 being thereby energized, lamp 62 is lighted, the oscillating code transmitter is actuated, and a modulated return indication current of a character different from that supplied by generator 32 is sent over wires B and C and the connections thereof as previously described. The return indication current causes relay 74 to be energized thereby lighting lamp 76 and also closing the shunt between A and C around starting switch 82. Said starting switch may now be opened and the system will continue to function so long as the integrity of the circuits is maintained. If wire A or C breaks or the integrity of the circuits is disturbed in such a way that primary 33 of transformer 34 receives no current from 32, then lamp 62 will be extinguished, the code transmitter will cease operating and no return indication current will be sent back to the control station. Therefore relay 74 will become deenergized, lamp 76 will be extinguished and the power supply from generator 32 to wires A and C will be cut off. So likewise, a lack of integrity in circuit B—C will deenergize relay 74, extinguish lamp 76 and disconnect the supply of power from 32 to circuit A—C. This, in turn, will deenergize transformer 34, lamp 62 will become extinguished and the code transmitter will cease operation. In certain circumstances a break in wire C may produce a tendency of the current from generator 32 to pass across from wire A through magnets M' and M² to wire B and thence through rectifier 84, wire 83, contact 79, and wire 81 to generator 32. But as this current will not have been modulated by the code transmitter, relay 74 will not remain energized and hence lamp 76 will become extinguished and the power supply from 32 will be cut off with the results previously described.

We claim:

1. A control system including: a circuit extending between two locations, two indicating devices associated therewith each responsive to the influence of current flow therein of a char-

acter different from that to which the other indicating device is responsive and one at each end of the circuit, means at one location to continuously supply current of a certain character to said circuit to thereby energize the indicating device at the other location, and means including said first means to produce a current, which is simultaneously supplied to the circuit at said other location, to the influence of which the other indicating device is responsive.

2. A control system including: two circuits composed of two line conductors and a common path extending between two locations, two indicating means one at each end of the two circuits to indicate the integrity thereof and each responsive to the influence of current of a character different from that to the influence of which the other is responsive, means to continuously supply current to one of said circuits to energize one indicating means, and means including said first means to produce a current, which is simultaneously supplied to the other circuit, to which the other indicating means is responsive.

3. A control system including: two circuits each extending between two stations, means located at one station to continuously supply current of a given character to one of said circuits, means located at the other station energized by current flow in said first-mentioned circuit and to thereby simultaneously produce a current flow of a different character in the other circuit, and indication means located at said one station responsive to the influence of current flow of the character supplied to the second circuit by the means located at said other station.

4. A control system including: two circuits each extending between two stations, means located at one station to continuously supply current of a given character to one of said circuits, means located at the other station energized by current flow in said first-mentioned circuit and to thereby simultaneously produce a current flow of a different character in the other circuit, indication means located at said other station responsive to the influence of current flow of the character supplied to the first circuit by the means located at said one station, and indication means located at said one station responsive to the influence of current flow of the character supplied to the second circuit by the means located at said other station.

5. A control system including: a train of cars, two circuits each extending from car to car, means located in one car to continuously supply current of a given character to one of said circuits, means, located in another car responsive to the influence of current flow in said first-mentioned circuit supplied by the means in the first car, to simultaneously produce a current flow in the other circuit of a character different from that supplied by the means in the first car, and indication means located in the first-mentioned car responsive to the influence of the character of current supplied to the second circuit by the means located in the second car.

6. A control system including: a train of cars, two circuits each extending from car to car, means located in one car to continuously supply current of a given character to one of said circuits, means, located in another car responsive to the influence of current flow in said first-mentioned circuit supplied by the means in the first car, to simultaneously produce a current flow in the other circuit of a character different from

that supplied by the means in the first car, indication means located in the other car responsive to the influence of the character of current flow in the first circuit supplied by the means in the first car, and indication means located in the first car responsive to the influence of the character of current supplied to the second circuit by the means located in the second car.

7. A control system including: two circuits each extending between two stations, means located at one station to continuously supply current of a given character to one of said circuits, means located at the other station responsive to the influence of said current to thereby simultaneously produce in the other circuit a return indication current flow of a character different from that received over the first circuit from the first-mentioned station, and an indicating device located at said first-mentioned station responsive to current having the character of the return indication flow supplied to the second circuit but not effectively responsive to current of the character supplied to the first circuit.

8. A control system including: two circuits each extending between two stations and composed of two line conductors and a common path, means located at one station to continuously supply current of a given character to one of said circuits, means located at the other station responsive to the influence of said current to thereby simultaneously produce in the other circuit a return indication current flow of a character different from that received over the first circuit from the first-mentioned station, and an indicating device located at said first-mentioned station responsive to current flow having the character of the return indication flow supplied to the second circuit but not effectively responsive to current of the character supplied to the first circuit.

9. A control system including: line circuit means extending between two stations, means located at one station to supply an alternating current to the line circuit means, a rectifier located at the other station to receive and rectify the alternating current received from the first station, and means located at said other station to convert the direct current of the rectifier into an alternating current of a character different from that supplied by the means at the first station and received by the rectifier at the second station and to supply it to the line circuit means to thereby provide a return indication current to the first station.

10. A control system including: line circuit means extending between two stations, means located at one station to supply an alternating current to the line circuit means, a rectifier located at the other station to receive and rectify the alternating current received from the first station, and a tuned alternator located at said other station to convert the direct current of the rectifier into an alternating current of a character different from that supplied by the means at the first station and received by the rectifier at the second station and to supply it to the line circuit means to thereby provide a return indication current to the first station.

11. A control system including: line circuit means extending between two stations, means located at one station to supply an alternating current to the line circuit means, a rectifier located at the other station to receive and rectify the alternating current received from the first station, means located at said other station to

convert the direct current of the rectifier into an alternating current of a character different from that supplied by the means at the first station and received by the rectifier at the second station and to supply it to the line circuit means to thereby provide a return indication current to the first station, and a rectifier located at the first station to receive and rectify the return indication current received from the other station.

12. A control system including: line circuit means extending between two stations, means located at one station to supply an alternating current to the line circuit means, a rectifier located at the other station to receive and rectify the alternating current received from the first station, means located at said other station to convert the direct current of the rectifier into an alternating current of a character different from that supplied by the means at the first station and received by the rectifier at the second station and to supply it to the line circuit means to thereby provide a return indication current to the first station, and indication means at the second station responsive to the influence of current flow in the output circuit of the rectifier.

13. A control system including: line circuit means extending between two stations, means located at one station to supply an alternating current to the line circuit means, a rectifier located at the other station to receive and rectify the alternating current received from the first station, means located at said other station to convert the direct current of the rectifier into an alternating current of a character different from that supplied by the means at the first station and received by the rectifier at the second station and to supply it to the line circuit means to thereby provide a return indication current to the first station, a rectifier located at the first station to receive and rectify the return indication current received from the other station, indication means at the second station responsive to the influence of current flow in the output circuit of the rectifier located at that station, and indication means at the first station responsive to the influence of current flow in the output circuit of the rectifier located at the first station.

14. A control system including: two line circuit means extending between two stations, means located at one station to supply an alternating current to one line circuit means, two transformers located at the second station, the primary of one of which is connected to said one line circuit means and the secondary of the other of which is connected to the other line circuit means, a rectifier the input circuit of which is connected to the secondary of the first transformer, and an interrupter connected to the output circuit of the rectifier and to the primary of the second transformer.

15. A control system including: two line circuit means extending between two stations, means located at one station to supply an alternating current to one line circuit means, two transformers located at the second station, the primary of one of which is connected to said one line circuit means and the secondary of the other of which is connected to the other line circuit means, a rectifier the input circuit of which is connected to the secondary of the first transformer, a tuned alternator connected to the output circuit of the rectifier, and means including a contact operated by said tuned alternator for

connecting the output circuit of the rectifier to the primary of the second transformer.

16. A control system including: two line circuit means extending between two stations, means located at one station to supply an alternating current to one line circuit means, two transformers located at the second station, the primary of one of which is connected to said one line circuit means and the secondary of the other of which is connected to the other line circuit means, a rectifier the input circuit of which is connected to the secondary of the first transformer, an interrupter connected to the output circuit of the rectifier and to the primary of the second transformer, and an indicating device also connected to the output circuit of the rectifier.

17. A control system including: two line circuit means extending between two stations, means located at one station to supply an alternating current to one line circuit means, two transformers located at the second station, the primary of one of which is connected to said one line circuit means and the secondary of the other of which is connected to the other line circuit means, a rectifier the input circuit of which is connected to the secondary of the first transformer, a tuned alternator connected to the output circuit of the rectifier, means including a contact operated by said tuned alternator for connecting the output circuit of the rectifier to the primary of the second transformer, and a slow-release indicating device connected to the output circuit of the rectifier and to an element of the tuned alternator.

18. A control system including: line circuit means extending between two stations, means located at one station to supply an alternating current to the line circuit means, means located at said other station connected with said circuit means to modify the alternating current received from the first station comprising: a transformer, the primary of which is connected to the line circuit, a rectifier the input circuit of which is connected to the secondary of the transformer, and a code transmitter connected to the output circuit of the rectifier; and a circuit connected to the secondary of the transformer and including an indicating device and a contact controlled by the code transmitter.

19. A control system including: two line conductors and a common path, means located at one station to supply an alternating current to one of the line conductors and the common path, a transformer located at the other station the primary of which is connected between said first line conductor and the common path and the secondary of which is connected to the other line conductor, and the common path, a rectifier the input circuit of which is connected to the secondary of the transformer, a code transmitter connected to the output circuit of the rectifier, and a circuit breaker, in the connection between

the secondary and the second line circuit, controlled by the code transmitter.

20. A control system including: two line conductors and a common path, means located at one station to supply an alternating current to one of the line conductors and the common path, a transformer located at the other station the primary of which is connected between said first line conductor and the common path and the secondary of which is connected to the other line conductor and the common path, a rectifier the input circuit of which is connected to the secondary of the transformer, a code transmitter connected to the output circuit of the rectifier, a circuit breaker, in the connection between the secondary and the second line circuit, controlled by the code transmitter, and a rectifier at the first station the input circuit of which is connected between the second line wire and the common path.

21. A control system including: two line conductors and a common path, means located at one station to supply an alternating current to one of the line conductors and the common path, a transformer located at the other station the primary of which is connected between said first line conductor and the common path and the secondary of which is connected to the other line conductor and the common path, a rectifier the input circuit of which is connected to the secondary of the transformer, a code transmitter connected to the output circuit of the rectifier, a circuit breaker, in the connection between the secondary and the second line circuit, controlled by the code transmitter, a rectifier at the first station the input circuit of which is connected between the second line wire and the common path, and a repeater relay connected to the output circuit of the rectifier at the first station.

22. A control system including: two line conductors and a common path, means located at one station to supply an alternating current to one of the line conductors and the common path, a transformer located at the other station the primary of which is connected between said first line conductor and the common path and the secondary of which is connected to the other line conductor and the common path, a rectifier the input circuit of which is connected to the secondary of the transformer, a code transmitter connected to the output circuit of the rectifier, a circuit breaker, in the connection between the secondary and the second line circuit, controlled by the code transmitter, a rectifier at the first station the input circuit of which is connected between the second line wire and the common path, a repeater relay connected to the output circuit of the rectifier at the first station, a circuit to be opened and closed by the repeater relay, and a slow release relay controlled by said circuit.

ANDREW J. SORENSEN.
LESLIE R. ALLISON.