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C. E. STEWART ET AL

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SUPERVISORY CONTROL SYSTEM

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2 Sheets-Sheet 1

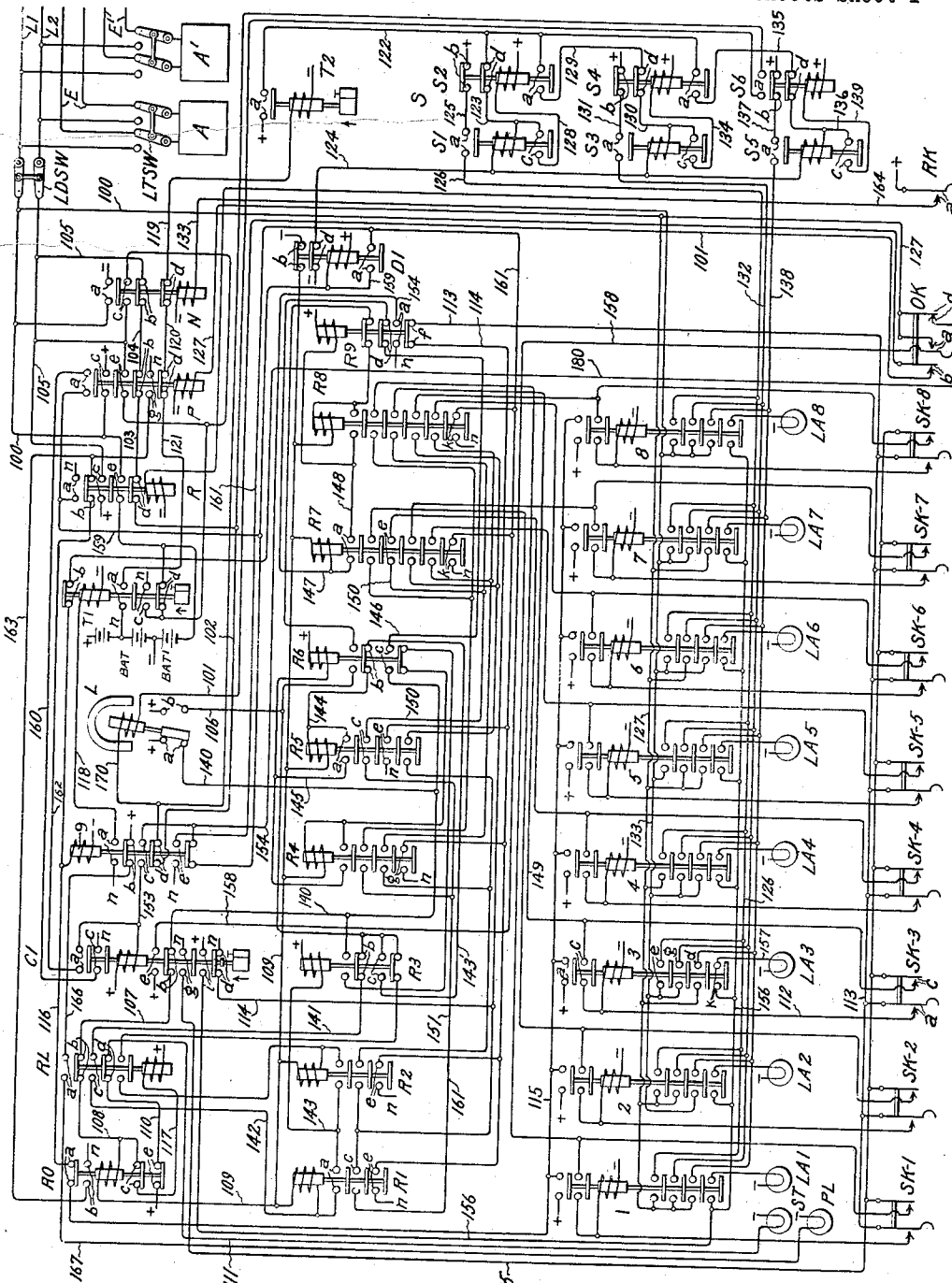


Fig. 1.

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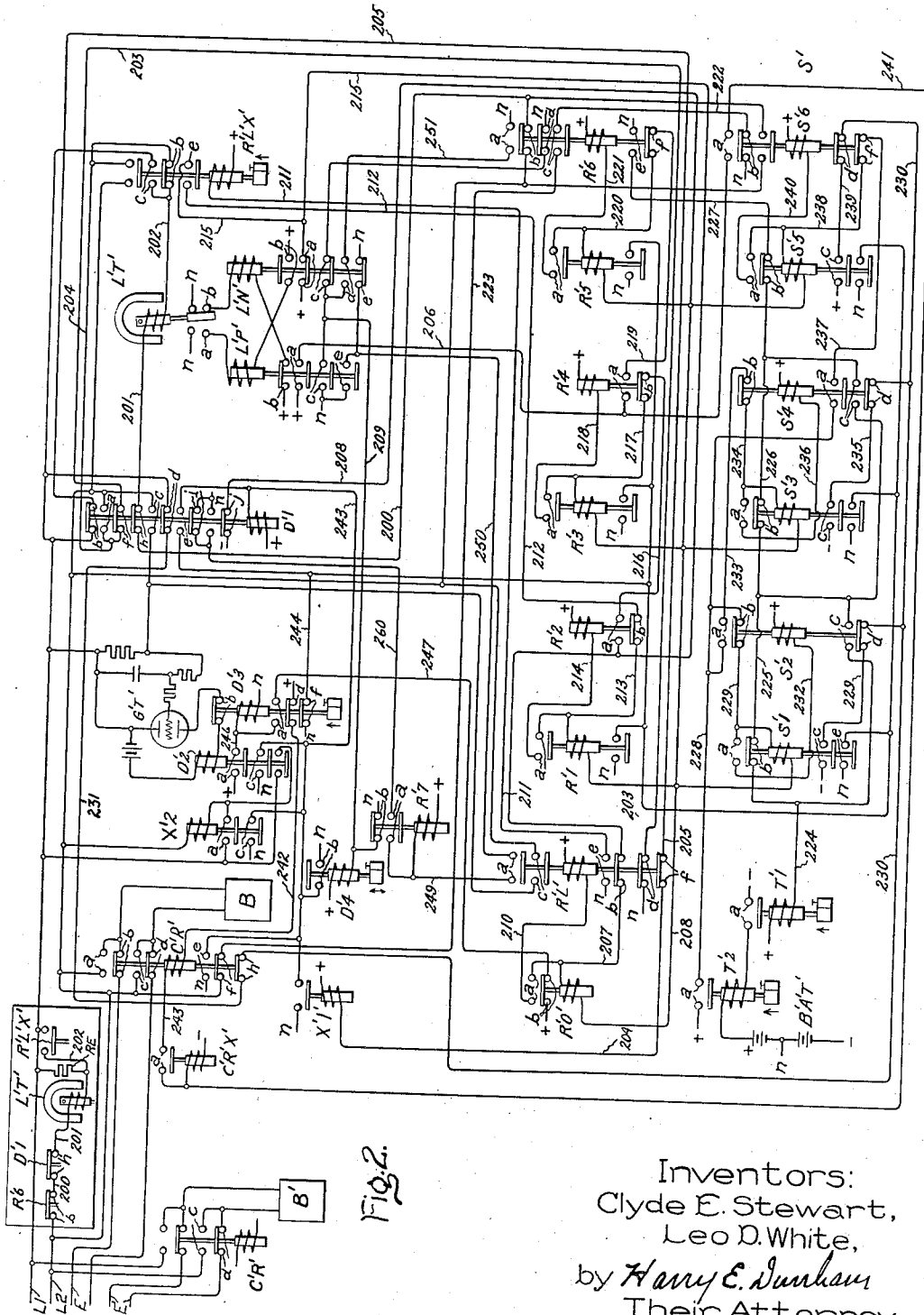
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2 Sheets-Sheet 2



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SUPERVISORY CONTROL SYSTEM

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9 Claims. (Cl. 177—353)

Our invention relates to supervisory control systems and particularly to such systems which are of the type that include equipment at a controlling station such as a dispatcher's office, equipment at a remote station where the apparatus to be supervised is located, and a set of conductors interconnecting the two station equipments of the system. In such a supervisory control system, the whole equipment is rendered inoperative if for any reason the individual conductors interconnecting the two station equipments of the system become short-circuited or open-circuited.

One object of our invention is to provide an arrangement whereby a dispatcher at the dispatcher's office can effect the transfer of the two station equipments of a supervisory control system from its normal set of conductors to a spare set of conductors whenever he so desires.

Another object of our invention is to provide an arrangement whereby a dispatcher can effect the transfer of the two station equipments of any one of a plurality of supervisory control systems from its respective set of conductors to a spare set of conductors which is common to all of the station equipments.

Another object of our invention is to provide an arrangement whereby a dispatcher can effect the selective transfer of the remote station equipment of any one of a plurality of supervisory control systems from its respective set of conductors to a spare set of conductors which is common to all of the station equipments.

Our invention will be better understood from the following description when taken in connection with the two accompanying drawings comprising Figs. 1 and 2 which, when joined together, diagrammatically illustrate a selective control system embodying our invention, and its scope will be pointed out in the appended claims.

In the accompanying drawings, we have shown our invention in connection with two supervisory control systems, each of which includes equipment at a dispatcher's office, equipment at a remote station, and an individual set of conductors interconnecting the two equipments of the system. These supervisory control equipments may be of any suitable type, examples of which are well-known in the art. They may, for example, be of the type shown in copending application, Serial No. 689,087, filed September 12, 1933, by James H. Oliver, and assigned to the same assignee as this application.

Since the circuit details of these supervisory control systems form no part of our present in-

vention, we have represented the dispatcher's office equipment of one of these systems by a rectangle A which is connected by the two line conductors E to a remote station equipment represented by a rectangle B. Similarly, the dispatcher's office equipment of the other system is represented by a rectangle A' which is connected by two line conductors E' to its associated remote station equipment represented by a rectangle B'.

For the purpose of this description, it will be assumed that the dispatcher's office equipments A and A' are located at the same office, but that the remote station equipments B and B' are located at different points. Interconnecting this single dispatcher's office and the two remote stations is a common set of conductors consisting of the two conductors L1 and L2. Associated with these two conductors L1 and L2 at the dispatcher's office is suitable control means diagrammatically shown in detail in Fig. 1 whereby the dispatcher may transfer the dispatcher's office equipment of either supervisory control system to the spare set of conductors L1 and L2 and may cause the proper select code and an operating impulse to be transmitted over the line conductors L1 and L2 to effect the transfer of a desired remote station equipment of either of the two supervisory control systems to the spare set of conductors. Associated with the spare set of conductors L1 and L2 at each of the remote stations is suitable control means which is selectively controlled by the select codes transmitted over the spare conductors from the dispatcher's office so that only the desired remote station equipment is transferred to the spare set of conductors in response to the transmission of the operating impulse from the dispatcher's office. Since the control apparatus is the same in each of the remote stations, except for certain connections hereinafter described, only the control apparatus associated with the remote station equipment B is shown in detail in Fig. 2.

At the dispatcher's office we provide for each remote station equipment to be connected to the spare set of conductors L1 and L2 a select key which is operated when the dispatcher desires to effect the transfer of the corresponding remote station equipment. Also for each remote station equipment, we provide an indicating lamp which is lighted when the corresponding equipment has been selected for transfer to the spare set of conductors. Although we have shown in the drawings only two supervisory systems having remote station equipments arranged to be connected to the line conductors L1 and L2, the dis-

patcher's office equipment shown in Fig. 1 is designed so that it may be used to effect the transfer of any one of eight different remote station equipments to a single spare set of conductors.

We have shown in Fig. 1, eight select keys SK1 to SK8, inclusive, one for each of the eight transfers which may be effected. Also we have shown eight lamps La1 to La8 which are respectively associated with the select keys SK1 to SK8, inclusive. We also provide the code relays 1 to 8, inclusive, which are respectively associated with the select keys SK1 to SK8, inclusive. Each of these code relays is energized when the associated select key is operated and sets up a select code which is individual thereto. Also associated with the select keys SK1 to SK8, inclusive, is a sender S, comprising a group of six relays S1 to S6, inclusive, that are sequentially energized, when any one of the select keys is operated, to effect the transmission of the select code which has been set up by the energized code relay associated with the operated select key. When each of the relays S1, S3, and S5 is energized, a circuit is completed for either a relay P or a relay N, depending upon the code set up by the energized code relay. The relay P, when energized, is arranged to cause a positive impulse to be transmitted over the conductors L1 and L2, and the relay N, when energized, is arranged to cause a negative impulse to be transmitted over the conductors L1 and L2. In this manner, the operation of any one of the select keys effects the transmission over the conductors L1 and L2 of a select code comprising a series of three positive and negative impulses, permuted individual to the operated select key to effect the selection of the desired remote station equipment to be connected to the conductors L1 and L2.

At each of the remote stations, each impulse of a transmitted select code energizes a polarized relay L' so that it effects the energization of an associated relay L'P', if the impulse is a positive one and the energization of an associated relay L'N' if the impulse is a negative one. The sequence in which the relays L'P' and L'N' are operated by the three impulses of a select code determines which remote station equipment is selected for transfer to the spare set of conductors L1 and L2. Associated with each pair of relays L'P' and L'N' is a group of six relays R'1 to R'6, inclusive, which are so connected that all six of the relays of a group are energized only in response to the predetermined select code which is individual thereto. In the particular arrangement shown in Fig. 2, the only select code which will effect the energization of all the relays R'1 to R'6, inclusive, is the code in which the first impulse is a negative impulse, the second impulse is a negative impulse and the last impulse is a positive impulse. Each of the other seven select codes of three positive and negative impulses which are arranged to be transmitted by the sender S, shown in Fig. 1, in response to the operation of the select keys SK1 to SK8, inclusive, cannot effect the energization of more than four of the relays R'1 to R'6 as they are shown connected in Fig. 2. Similarly, in each of the other remote stations the corresponding relays R'1 to R'6 are connected in such a manner that they will all be energized only in response to a particular select code which does not effect the energization of all of the corresponding relays in any other station. For example, in one of the other stations all of the relays R'1 to R'6, inclusive, may be connected so that they are all energized only in response

to a select code in which each of the three impulses is a positive impulse, while in another of the stations all of the relays R'1 to R'6, inclusive, may be connected in such a manner that they are all energized only in response to a select code in which each of the impulses is a negative impulse, while in another station the relays R'1 to R'6, inclusive, may be connected in such a manner that they are all energized only in response to a select code in which the first two impulses are positive impulses and the last impulse is a negative impulse, etc.

At the termination of the last impulse of a transmitted select code, a sender S', which consists of a group of six relays S'1 to S'6, inclusive, operates in the remote station which has been selected to effect the transmission over the conductors L1 and L2 of a check code which is individual to the selected remote station equipment. Preferably, each sender S' is arranged to transmit a check code which is the same as the corresponding select code.

At the dispatcher's office the check code selectively energizes a group of nine relays, R1 to R9, inclusive. If the check code received at the dispatcher's office agrees with the select code which was sent out from the dispatcher's office, the relays R1 to R9 are energized in the proper combination to complete an energizing circuit for a time relay C1. The energization of this relay C1 completes an energizing circuit for the lamp associated with the operated select key, thereby informing the dispatcher that the proper remote station equipment has been selected for transfer to the spare set of conductors L1 and L2. The energization of the time relay C1 also prepares the necessary circuits at the dispatcher's office so that when the dispatcher subsequently operates a common operate key OK a positive operating impulse is transmitted over the conductors L1 and L2 to effect the transfer of the selected remote station equipment from its normal set of conductors to the spare conductors L1 and L2.

At the selected station, the positive operating impulse effects the energization of the relay L'P', which in turn effects the energization of an associated transfer relay C'R' to transfer the selected remote station equipment from its normal set of conductors to the spare set of conductors L1 and L2. The dispatcher then operates a disconnecting switch LDSW associated with the line conductors L1 and L2 at the dispatcher's office so as to disconnect these conductors from the control apparatus shown in Fig. 1 and then operates a switch LTSW associated with the dispatcher's office equipment corresponding to the transferred remote station equipment so that this dispatcher's office equipment is disconnected from its normal set of conductors and is connected to the spare set of conductors L1, L2. The dispatcher then resets to normal in a manner well-known in the art the supervisory equipment now connected to the spare set of conductors so that it is ready for use with the spare conductors. The amber lamp associated with the transferred equipment remains lighted to indicate to the dispatcher that the spare set of conductors are in use with that particular equipment.

When it is desired to reconnect the two equipments that are connected to the spare set of conductors L1 and L2 to their normal set of conductors, the switch LTSW associated with the dispatcher's office equipment is restored to its normal position, the switch LDSW is closed, and then the operated select key is restored to its nor-

mal position. A release key RK at the dispatcher's office is then depressed for several seconds. The operation of this release key causes a relatively high negative potential to be applied across the conductors L1 and L2. This high potential at each of the remote stations effects the operation of a glow tube G'P', which in turn effects the energization of an associated reset relay D'2, which, when energized, causes the associated remote station control apparatus to be reset to normal.

A detailed description of the operation of the embodiment of our invention shown in the two accompanying drawings will now be given.

Normally, when the spare conductors L1 and L2 are not in use, the switch LDSW at the dispatcher's office is in the position shown so that a circuit is completed from the line conductor L1 through the upper contacts of the switch LDSW, conductor 100, contacts b of operate key OK, conductor 101, winding of polarized relay L, conductor 170, contacts d of relay 9, conductor 102, contacts d of relay R, conductor 103, contacts b of relay P, conductor 104, contacts b of relay N, conductor 105, lower contacts of switch LDSW to the line conductor L2. At each of the remote stations, except the most remote station there is connected across the conductors L1 and L2 a circuit including in series the contacts b of relay R'6, conductor 200, contacts h of relay D'1, conductor 201, winding of polarized relay L'T', conductor 202, and resistor RE. At the most remote station, which we will assume is the station where the substation equipment B is located, the neutral of the station battery B'A'T' is connected to the conductor L2 through contacts d of relay R'L', conductor 203, contacts f of relay D'1, conductor 204, contacts b of relay R'L'X', conductor 202, winding of relay L'T', conductors 201, contacts h of relay D'1, conductor 200, and contacts b of relay R'6. The positive terminal of the station battery B'A'T' at the most remote station is connected to the conductor L1 through winding of a relay X'1, contacts f of relay R'L', conductor 205, and contacts b of relay D'1. Therefore, the polarized line relays L'T' in all of the remote stations except the most remote station are normally connected in parallel with each other and with the polarized relay L at the dispatcher's office and these parallel connected relays are connected in series with the relay X'1 and the polarized relay L'T' in the most remote station. The current in this normal check circuit is not of sufficient magnitude to operate the relay X'1. However, the current is in such a direction that each of the parallel connected line relays L'P' closes its contacts a, the relay L closes its contacts a and the series connected line relay L'T' in the most remote station closes its contacts b. At the most remote station, an energizing circuit is normally completed for the associated relay L'N' through contacts b of the relay L'T' and the contacts b of the relay L'P'. The contacts a of relay L'N' complete an energizing circuit for its associated relay R'O' from the positive terminal of the associated station battery B'A'T', contacts a of relay L'N', conductor 215, contacts b of relay R'L', conductor 207, winding of relay R'O', conductor 208, contacts f of relay D'1 to the negative terminal of battery B'A'T'.

At the other remote stations, the relay L'T' completes at its contacts a an energizing circuit for the associated relay L'P' through contacts b of the associated relay L'N'. In each of these other remote stations, the energizing circuit of

relay R'O' includes the contacts a of relay L'P' instead of the contacts a of relay L'N' so that all of the relays R'O' are normally energized.

Also at each of the remote stations, an energizing circuit is completed for the relay D'4 thereat from the positive terminal of the station battery B'A'T', winding of relay D'4, conductor 209, contacts b of relay R'7, to the neutral of the station battery B'A'T'.

At the dispatcher's office, the contacts a of the relay L completes an energizing circuit for the relay RO from the positive terminal of the battery BAT, contacts a of relay L, conductor 140, contacts b of relay C1, conductor 107, contacts b of relay RL, conductor 108, winding of relay RO, conductor 109, contacts b of relay D1 to the negative terminal of battery BAT. The contacts e of the energized relay RO completes a circuit for the start lamp ST from the positive terminal of battery BAT through contacts e of relay RO, conductor 110, contacts d of relay RL, conductor 111, start lamp ST to the negative terminal of battery BAT. The lighted lamp ST informs the dispatcher that the spare conductors L1 and L2 are in normal condition and are not being used.

When it is desired to transfer a remote station equipment to the spare conductors L1 and L2, the dispatcher operates the corresponding select key. Therefore, when he desires to effect the transfer of the remote station equipment B shown in Fig. 2, he operates the select key SK3, which is the select key individual to this equipment. The closing of the contacts a of the select key SK3 completes a circuit for the associated code relay 3 from the negative terminal of the battery BAT through the winding of relay 3, conductor 112, contacts a of select key SK3, conductor 113, contacts f of relay R9, conductor 114, contacts d of relay C1 to the neutral of battery BAT. The closing of the contacts a of relay 3 completes an energizing circuit for relay 9 from the positive terminal of battery BAT through contacts a of relay 3, conductor 115, contacts a of relay RO, conductor 116, winding of relay 9, to the negative terminal of battery BAT. A circuit is also completed for relay P from conductor 116 through contacts b of relay T1, conductor 180, contact d of operate key OK, conductor 127, winding of relay P to the negative terminal of battery BAT. The opening of the contacts d of the relay 9 when it becomes energized interrupts the heretofore described normal circuit through the polarized relay L in the dispatcher's office so that this relay opens its contacts a. The opening of these contacts removes the short-circuit from around the winding of relay RL so that this relay is energized in series with the relay RO through the conductor 117 and the contacts c of relay RO.

The closing of contacts c of relay P connects the positive terminal of the main battery BAT to conductor L1 and the closing of contacts e of relay P connects the negative terminal of an auxiliary battery BAT-1 to conductor L2 through contacts d of relay T1. Since the positive terminal of battery BAT-1 is connected to the negative terminal of the main battery BAT, a higher positive voltage is applied across the conductors L1 and L2 at the dispatcher's office than is applied across them by the battery B'A'T' in the most remote station. Therefore, the current reverses through the polarized line relay L'T' in the remote station so that it opens its contacts b and effects the de-energization of the associated relay L'N' and thereby removes a short-circuit from around the associated relay R'L', which

becomes energized in series with the associated relay R'O' in a circuit which includes the contacts *a* of relay R'O' and the conductor 210. The relay R'L', by opening its contacts *d* and *f*, also disconnects the conductors L1 and L2 from its normal source of potential B'A'T'. The contacts *e* of the relay R'L' complete through conductor 211 an energizing circuit for the associated relay R'L'X', which, by opening its contacts *b* and closing its contacts *c*, transfers the connection of the winding of the associated polarized relay L'T' from a series connection with the conductor L2 to a shunt connection across the conductors L1 and L2.

Since at the intermediate stations the line relays L'T' are connected across the conductors L1 and L2, the boosted positive potential across these conductors does not effect any change in the position thereof.

At the dispatcher's office, the contact *a* of the relay 9 completes through conductor 118 an energizing circuit for the slow-to-operate relay T1. The opening of contacts *b* of relay T1 interrupts the heretofore described circuit for relay P so as to remove the boosted positive impulse from the conductors L1 and L2 and thereby effect the energization of the relay R'L' and P'L'X' in each of the intermediate stations.

By closing its contacts *a*, relay T1 completes an energizing circuit for the slow-to-operate relay T2 from the negative terminal of battery BAT through the winding of relay T2, conductor 119, contacts *d* of relay N, conductor 120, contacts *d* of relay P, conductor 121, contacts *a* of relay T1 to the neutral of battery BAT. The closing of the contacts *a* of relay T2 completes an energizing circuit for the relay S1 of the code sender S from the positive terminal of battery BAT through contacts *a* of relay T2, conductor 122, contacts *d* of relay S2, conductor 123, winding of relay S1, conductor 124, contacts *d* of relay D1 to the negative terminal of battery BAT. By closing its contacts *a*, relay S1 completes an energizing circuit for relay N from the positive terminal of battery BAT through contacts *b* of relay S2, conductor 125, contacts *a* of relay S1, conductor 126, contacts *e* of relay 3, conductor 133, winding of relay N to the negative terminal of battery BAT. The closing of the contacts *a* of relay N connects conductor L1 to the negative terminal of battery BAT, and the contacts *c* of relay N connects the conductor L2 to the neutral of battery BAT through contacts *c* of relay T1 so that a negative impulse is transmitted over the spare set of conductors to each of the line relays L'T' in the remote stations. The opening of the contact *d* of relay N interrupts the heretofore described circuit for relay T2 so that this relay becomes de-energized and by opening its contacts *a* removes a short circuit from the winding of relay S2, which is now energized in series with relay S1 through the conductor 128 and contacts *c* of relay S1.

By opening its contacts *b*, relay S2 interrupts the heretofore described circuit for relay N, thus removing the first impulse of the select code, from the conductors L1 and L2. When the relay N closes its contacts *d*, the heretofore described energizing circuit for relay T2 is again completed and a circuit is now completed for the relay S3 of the code sender S from the positive terminal of battery BAT through contacts *a* of relay T2, conductor 122, contacts *a* of relay S2, conductor 129, contacts *d* of relay S4, conductor 130, winding of relay S3, conductor 124, contacts *d* of relay D1 to the negative terminal of battery BAT.

By closing its contacts *a*, relay S3 completes an energizing circuit for relay N from the positive terminal of battery BAT through contacts *b* of relay S4, conductor 131, contacts *a* of relay S3, conductor 132, contacts *g* of relay 3, conductor 133, winding of relay N to the negative terminal of battery BAT. The closing of contacts *a* of relay N connects the conductor L1 to the negative terminal of battery BAT and the closing of contacts *c* of relay N connects the conductor L2 to the neutral of battery BAT through contacts *c* of relay T1 so that a negative impulse is transmitted over the spare set of conductors L1 and L2 to each of the line relays L'T' in the remote stations. The opening of the contacts *d* of relay N interrupts the heretofore described circuit for relay T2, which in turn opens its contacts *a* and removes the short-circuit from around the winding of relay S4, which is now energized in series with the winding of relay S3 through conductor 134 and contacts *c* of relay S3.

By opening its contacts *b*, relay S4 interrupts the heretofore described circuit for relay N, thus removing the second impulse of the select code from the conductors L1 and L2. When the relay N closes its contacts *d*, the heretofore described circuit for relay T2 is again completed, and this relay T2 in turn completes an energizing circuit for the relay S5 of the sender S from the positive terminal of battery BAT through contacts *a* of relay T2, conductor 122, contacts *a* of relay S4, conductor 135, contacts *d* of relay S6, conductor 136, winding of relay S5, conductor 124, contacts *d* of relay D1, to the negative terminal of battery BAT. By closing its contacts *a*, relay S5 completes an energizing circuit for relay P from the positive terminal of battery BAT through the contacts *b* of relay S6, conductor 137, contacts *a* of relay S5, conductor 138, contacts *d* of relay 3, conductor 127, winding of relay P to the negative terminal of battery BAT. The closing of the contacts *c* and *e* of relay P causes a positive impulse to be transmitted over the spare conductors L1 and L2. The opening of the contacts *d* of relay P effects the de-energization of the relay T2, which in turn, by opening its contacts *a*, removes a short-circuit from around the winding of relay S5 so that this relay becomes energized in series with the winding of relay S5 through a circuit which includes the contacts *c* of relay S5 and conductor 139.

By opening its contacts *b*, relay S6 interrupts the heretofore described circuit of relay P, thus removing the third impulse of the select code from the conductors L1 and L2. By closing its contacts *a*, relay S6 completes a shunt circuit around the contacts *d* of relay 9 so that the operating winding of polarized relay L is reconnected across the line conductors L1 and L2.

In the remote station where the equipment B is located, the first impulse of the select code, which is a negative impulse, causes the relay L'T' to close its contacts *b* and thereby complete the energizing circuit for relay L'N'. This relay L'P', by closing its contacts *a*, completes an energizing circuit for the relay R'1 from the positive terminal of battery B'A'T' through contacts *a* of relay L'N', conductor 215, contacts *e* of relay R'L'X', conductor 212, contacts *b* of relay R'2, conductor 213, winding of relay R'1, conductor 208, contacts *j* of relay D'1 to the negative terminal of battery B'A'T'. Upon the removal of the first impulse of the select code, the relay L'T' effects the deenergization of the relay L'N', which in turn, by opening its con-

tacts *a*, removes a short-circuit from around the winding of relay R'2 so that a circuit is completed for this winding in series with the winding of relay R'1 through contacts *a* of relay R'1 and conductor 214.

The second impulse of the transmitted select code, which is a negative impulse, causes the relay L'T' to close its contacts *b* so that the energizing circuit for the relay L'N' is completed. By closing its contacts *a*, relay L'N' completes an energizing circuit for the relay R'3 from the positive terminal of the battery B'A'T' through contacts *a* of relay L'N', conductor 215, contacts *a* of relay R'2, conductor 216, contacts *b* of relay R'4, conductor 217, winding of relay R'3, conductor 208, contacts *j* of relay D'1 to the negative terminal of battery B'A'T'. Upon the removal of the second impulse of the select code from the conductors L1 and L2, the relay L'T' effects the deenergization of relay L'N', which in turn, by opening its contacts *a*, removes a short-circuit from around the winding of the relay R'4 so that an energizing circuit is completed for this winding in series with the winding of relay R'3 through the contacts *a* of relay R'3 and conductor 218.

The third impulse of the transmitted select code, which is a positive impulse, causes the relays L'T' and L'P' to become energized so that an energizing circuit is completed for the relay R'5 from the positive terminal of battery B'A'T' through contacts *a* of relay L'P', conductor 206, contacts *a* of relay R'4, conductor 219, contacts *f* of relay R'6, conductor 220, winding of relay R'5, conductor 208, contacts *j* of relay D'1, to the negative terminal of battery B'A'T'. Upon the removal of the last impulse of the select code from the conductors L1 and L2, the relays L'T' and L'P' become de-energized and the opening of the contacts *a* of relay L'P' removes a short-circuit from around the winding of relay R'6 so that an energizing circuit for this winding in series with the winding of relay R'5 is completed through the conductor 221 and the contacts *a* of relay R'5.

Therefore, in the remote station where the equipment B is located, all of the relays R'1 to R'6 are energized by the select code, which is transmitted in response to the operation of the select key SK3, but in each of the other remote stations this select code does not effect the energization of all of the corresponding relays R'1 to R'6, inclusive.

By opening its contacts *b*, relay R'6 opens the shunt circuit of the relay L'T' across the conductors L1 and L2 so that this relay does not respond to the check code which is transmitted over the conductors L1 and L2 as a result of the energization of the relay R'6. The closing of the contacts *c* of the relay R'6 connects the neutral terminal of battery B'A'T' to the conductor L2 through the contacts *b* of relay S'6, conductor 222, contacts *c* of relay R'6, conductor 223, and contacts *f* of relay C'R'. The closing of the contacts *e* of relay R'6 completes an energizing circuit for a slow-to-operate relay T'1 from the positive terminal of battery B'A'T' through winding of relay T'1, conductor 224, contacts *b* of relay S'1, conductor 225, contacts *b* of relay S'3, conductor 226, contacts *b* of relay S'5, conductor 227, contacts *e* of relay R'6, to the neutral of battery B'A'T'. By closing its contacts *a*, relay T'1 completes an energizing circuit for the slow-to-operate relay T'2, which in turn, by closing its contacts *a*, completes an

energizing circuit for the relay S'1 of the sender S' from the positive terminal of battery B'A'T' through contacts *a* of relay T'2, conductor 228, contacts *b* of relay S'2, conductor 229, winding of relay S'1, conductor 208, contacts *j* of relay D'1, to the negative terminal of battery B'A'T'. By closing its contacts *c*, relay S'1 connects the negative terminal of battery B'A'T' to the conductor L1 through conductor 229, contacts *d* of relay S'2, conductor 230, contacts *h* of relay C'R', conductor 231, and contacts *d* of relay D'1. Therefore, a negative impulse is transmitted over the conductors L1 and L2.

The opening of the contacts *b* of relay S'1 interrupts the heretofore described circuit for relay T'1, which in turn, by opening its contacts *a*, effects the de-energization of the relay T'2, so that it opens its contacts *a* and removes a short-circuit from around the winding of relay S'2 to cause this winding to be energized in series with the winding of relay S'1, in a circuit which includes the contacts *a* of relay S'1 and conductor 232. The opening of the contacts *d* of relay S'2 disconnects the negative terminal of battery B'A'T' from the conductor L1 so as to terminate the first impulse of the check code.

The closing of the contacts *c* of relay S'2 completes an energizing circuit for the slow-to-operate relay T'1 from the positive terminal of battery B'A'T' through the winding of relay T'1, conductor 224, contacts *c* of relay S'2, conductor 225, contacts *b* of relay S'3, conductor 226, contacts *b* of relay S'5, conductor 227, contacts *e* of relay R'6 to the neutral of battery B'A'T'. The energization of relay T'1 effects in turn the energization of slow-to-operate relay T'2, which in turn, by closing its contacts *a*, completes an energizing circuit for relay S'3 from the positive terminal of battery B'A'T' through contacts *a* of relay T'2, conductor 228, contacts *a* of relay S'2, conductor 233, contacts *b* of relay S'4, conductor 234, winding of relay S'3, conductor 208, contacts *j* of relay D'1 to the negative terminal of battery B'A'T'.

The closing of the contacts *c* of relay S'3 connects the negative terminal of battery B'A'T' to the conductor L1 through conductor 235, contacts *d* of relay S'4, conductor 230, contacts *h* of relay C'R', conductor 231, and contacts *d* of relay D'1. The energization of relay S'3 therefore causes a negative impulse to be transmitted over the conductors L1 and L2. The opening of the contacts *b* of relay S'3 interrupts the heretofore described circuit for the relay T'1, which in turn, by opening its contacts *a*, de-energizes the relay T'2. The opening of the contacts *a* of relay T'2 removes a short-circuit from around the winding of relay S'4 so that this winding is energized in series with the winding of relay S'3 in a circuit which includes the contacts *a* of relay S'3 and conductor 236.

The opening of the contacts *d* of relay S'4 disconnects the negative terminal of battery B'A'T' from conductor L1 so as to terminate the second impulse of the check code. The closing of the contacts *c* of relay S'4 completes an energizing circuit for the slow-to-operate relay T'1 from the positive terminal of battery B'A'T' through winding of relay T'1, conductor 224, contacts *c* of relay S'4, conductor 225, contacts *c* of relay S'4, relay S'2, conductor 225, contacts *c* of relay S'4, conductor 226, contacts *b* of relay S'5, conductor 227, contacts *e* of relay R'6, to the neutral of battery B'A'T'. Relay T'1 effects in turn the energization of relay T'2, which, by closing its

contacts *a*, completes an energizing circuit for relay S'5 from the positive terminal of battery B'A'T' through contacts *a* of relay T'2, conductor 228, contacts *a* of relay S'4, conductor 237, contacts *f* of relay S'6, conductor 238, winding of relay S'5, conductor 208, contacts *f* of relay D'1 to the negative terminal of battery B'A'T'.

The closing of the contacts *c* of relay S'5 connects the positive terminal of battery B'A'T' to the conductor L1 through conductor 239, contacts *d* of relay S'6, conductor 230, contacts *h* of relay C'R', conductor 231, and contacts *d* of relay D'1. Therefore, the energization of relay S'5 effects the transmission of a positive impulse over the line conductors L1 and L2. The opening of the contacts *b* of relay S'5 interrupts the heretofore described circuit for relay T'1, which in turn, by opening its contacts *a*, effects the de-energization of the relay T'2. The opening of contacts *a* of relay T'2 removes a short-circuit from around the winding of relay S'6 so that this winding is energized in series with the winding of relay S'5 in a circuit which includes the contacts *a* of relay S'5 and conductor 240. The opening of the contacts *d* of relay S'6 disconnects the positive terminal of battery B'A'T' from the conductor L1 so as to terminate the last impulse of the check code.

At the dispatcher's office each impulse of the check code effects the operation of the polarized relay L so that it closes either its contacts *a* or contacts *b*, depending upon the polarity of the impulse. Since the first impulse of the check code is a negative impulse, the relay L closes its contacts *b* and completes a circuit for relay R1 from the positive terminal of battery BAT through contacts *b* of relay L, conductor 106, contacts *b* of relay R3, conductor 141, contacts *c* of relay RL, conductor 142, winding of relay R1, conductor 109, contacts *b* of relay D1 to the negative terminal of battery BAT. When this first impulse of the check code is removed from the conductors L1 and L2, relay L opens its contacts *b*, which thereby removes a short-circuit from around the winding of relay R3, which is now energized in series with the winding of relay R1 in a circuit which includes the contacts *a* of relay R1 and conductor 143.

The second impulse of the check code, which is a negative impulse, causes the relay L to close its contacts *b* and complete an energizing circuit for the relay R5 from the positive terminal of battery BAT through contacts *b* of relay L, conductor 106, contacts *c* of relay R3, conductor 143', contacts *b* of relay R6, conductor 144, winding of relay R5, conductor 109, contacts *b* of relay D1 to the negative terminal of battery BAT. When the second impulse of the check code is removed from the line conductors L1 and L2, relay L opens its contacts *b* and removes a short-circuit from around the winding of relay R6, which is then energized in series with the winding of relay R5 in a circuit which includes the contacts *a* of relay R5, and conductor 145.

The third impulse of the check code, which is a positive impulse, causes the relay L to close its contacts *a* and complete an energizing circuit for the relay R7 from the positive terminal of battery BAT through contacts *a* of relay L, conductor 140, contacts *c* of relay R6, conductor 146, contacts *d* of relay R9, conductor 147, winding of relay R7, conductor 109, contacts *b* of relay D1 to the negative terminal of battery BAT. When this last impulse of the check code is removed from the conductors L1 and L2, relay L opens its con-

tacts *a* and removes a short-circuit from around the winding of relay R9, which is now energized in series with the winding of relay R7 in a circuit which includes contacts *a* of relay R7 and conductor 148.

When the relay R9 is energized, the opening of its contacts *f* interrupts the heretofore described circuit of relay 3, which was completed through the contacts *a* of the operated select key SK3. However, if the select code agrees with the select code sent out from the dispatcher's office, the relays R1 to R8 are energized in the proper combination to complete another circuit for the relay 3 before the relay R9 operates so that relay 3 does not become de-energized when the relay R9 opens its contacts *f*. This auxiliary circuit for the relay 3 is from the negative terminal of battery BAT through winding of relay 3, conductor 112, contacts *c* of relay 3, conductor 149, contacts *e* of relay R7, conductor 150, contacts *c* of relay R5, conductor 151, contacts *c* of relay R1, conductor 114, contacts *d* of relay C1 to the neutral of battery BAT.

The closing of the contacts *a* of relay R9 completes an energizing circuit for a slow-to-operate relay C1 from the positive terminal of battery BAT through winding of relay C1, conductor 153, contacts *c* of relay 9, conductor 154, contacts *a* of relay R9 to the neutral of battery BAT. The closing of the contacts *g* of relay C1 completes another holding circuit for relay 3 from the negative terminal of battery BAT through the winding of relay 3, conductor 112, contacts *c* of relay 3, conductor 149, contacts *c* of select key SK3, conductor 155, contacts *g* of relay C1 to the neutral of battery BAT. Therefore, the relay 3 is not de-energized when the heretofore traced auxiliary circuit for this relay is opened at the contacts *d* of relay C1, which are arranged in any suitable manner so that they do not open until after contacts *g* are closed. The energization of relay C1 is now dependent again upon the position of the select key SK3. The closing of the contacts *i* of relay C1 completes a circuit for the lamp LA3 from the positive terminal of battery BAT through contacts *i* of relay C1, conductor 156, contacts *k* of relay 3, conductor 157, lamp LA3 to the negative terminal of battery BAT. The lighting of the lamp LA3 indicates to the dispatcher that the proper remote station equipment has been selected and that he may effect the transfer thereof to the conductors L1 and L2 by operating the operate key OK.

When the dispatcher operates the operate key OK, an energizing circuit is completed for the relay P from the positive terminal of battery BAT through contacts *e* of relay C1, conductor 158, contacts *a* of operate key OK, conductor 127, winding of relay P to the negative terminal of battery BAT. The energization of relay P causes a positive impulse to be transmitted over the conductors L1 and L2 in a manner heretofore described. Also, by closing its contacts *a*, relay P completes an energizing circuit for the reset relay D1 from the positive terminal of battery BAT through the winding of relay D1, conductor 159, contacts *a* of relay P, conductor 160, contacts *c* of relay C1, to the neutral of battery BAT. The opening of the contacts *b* of relay D1 interrupts the circuits of the energized relays R0, RL, R1, R3, R5, R6, R7, and R9 and the opening of the contacts *d* of the relay D1 interrupts the circuits of the energized relays S1 to S6, inclusive, of the sender S so that all of the relays of the dispatcher's office equipment except relays 3, C1, and D1

are de-energized. The closing of the contacts *a* of the relay D1 completes a locking circuit for itself from the positive terminal of battery BAT through the winding of relay D1, conductor 159, contacts *a* of relay D1, conductor 161, to the neutral of battery BAT through contacts *k* of relay R7, contacts *e* of relay R5, contacts *e* of relay R1, and contacts *e* of relay 9 in parallel so that the relay D1 remains energized until all of these relays have been restored to their respective normal positions.

The closing of the contacts *g* of relay P completes a locking circuit for relay C1 from the positive terminal of battery BAT, winding of relay C1, conductor 153, contacts *a* of relay C1, conductor 162, contacts *b* of relay R, conductor 163, contacts *g* of relay P, to the neutral of battery BAT. As soon as the relay RO is de-energized in response to the energization of the reset relay D1, the contacts *b* of relay RO completes a circuit around the contacts *g* of relay P so that the relay C1 remains energized after the relay P is deenergized by the dispatcher's releasing the operate key OK to remove the operating impulse from the conductors L1 and L2.

At the selected remote station, the positive operating impulse causes the relay L'T' to close its contacts *a* and effect the energization of relay L'P'. The closing of the contacts *a* of relay L'P' completes an energizing circuit for relay C'R'X' from the positive terminal of battery B'A'T' through contacts *a* of relay L'P', conductor 206, contacts *a* of relay S'6, conductor 241, winding of relay C'R'X' to the negative terminal of the battery B'A'T'. When the operating impulse is removed from the conductors L1 and L2 an energizing circuit is completed for the relay C'R' from the positive terminal B'A'T' through contacts *d* of relay D'3, conductor 242, winding of relay C'R', conductor 243, contacts *a* of relay C'R'X', conductor 241, winding of relay C'R'X', to the negative terminal of battery B'A'T'. By opening its contacts *b* and *d* and closing its contacts *a* and *c*, relay C'R' transfers the remote station equipment B from its normal set of conductors E to the spare set of conductors L1 and L2. By closing its contacts *e*, relay C'R' completes an energizing circuit for reset relay D'1 from the positive terminal of battery B'A'T' through winding of relay D'1, conductor 243, contacts *e* of relay C'R' to the neutral of battery B'A'T'.

The opening of the contacts *f* of relay D'1 interrupts the circuits of the energized relays R'O', R'L', R'1 to R'6, inclusive, and S'1 to S'6, inclusive, so that all of these relays are restored to their respective normal positions. The closing of the contacts *a* of relay D'1 extends the conductor L2 to the further remote stations so that they may be reset by the dispatcher in a manner hereinafter described. The closing of the contacts *e* of relay D'1 completes a locking circuit for the relay D'1 from the positive terminal of the battery B'A'T' through winding of relay D'1, conductor 243, contacts *e* of relay D'1, conductor 244, contacts *f* of relay D'3, to the neutral of battery B'A'T'.

After having released the operate key OK, the dispatcher opens the switch LDSW at the dispatcher's office and operates the switch LTSW so as to transfer the dispatcher's office equipment A from its normal set of conductors E to the spare set of conductors L1 and L2. The dispatcher can then control the remote station equipment B over the spare set of conductors L1

and L2 by operating the dispatcher's office equipment A.

When it is desired to restore the equipments A and B to their normal set of conductors E, the dispatcher first operates the switch LTSW so as to transfer the dispatcher's office equipment A from the conductors L1 and L2 to the conductors E. Then the dispatcher opens the switch LDSW and restores the select key SK3 to its normal position, thereby effecting the de-energization of the relay 3. The dispatcher next operates the release key RK for several seconds and then releases it. The operation of the release key RK completes an energizing circuit for the release relay R from the positive terminal of battery BAT through contacts *a* of key RK, conductor 164, winding of relay R to the negative terminal of battery BAT. The closing of the contacts *c* of relay R connects the positive terminal of battery BAT to the conductor L2 and the closing of the contacts *e* of relay R connects the negative terminal of the battery BAT—1 to the conductor L1 so that the batteries BAT and BAT—1 are connected in series across the conductors L1 and L2 to transmit a boosted negative impulse. The opening of the contacts *d* of relay R interrupts the heretofore described locking circuit for relay C1 so that it is restored to its normal position. The closing of the contacts *a* of relay R completes an energizing circuit for the reset relay D1 to insure that all of the relays of the dispatcher's office equipment are restored to their normal positions.

At each of the remote stations, the high negative potential impressed across the conductors L1 and L2 effects the operation of a glow tube G'T', the grid circuit of which is operatively connected in a well-known manner across the conductors L1 and L2 by the contacts *c* of the energized reset relay D'1 so that the relay D'2, which is connected in series with the output circuit of the glow tube G'T', is energized. The closing of the contacts *c* of the relay D'2 completes another energizing circuit for the relay D'1 so as to insure that this relay remains energized as long as the relay D'2 is energized. The closing of the contacts *a* of relay D'2 completes through conductor 246 an energizing circuit for the relay D'3. By opening its contacts *b*, relay D'3 interrupts the circuit of the relay D'2, but the relay D'3 is not de-energized by the opening of the contacts *a* of the relay D'2 because a locking circuit is completed for the relay D'3 from the positive terminal of battery B'A'T' through contacts *b* of relay R'O', conductor 247, contacts *a* of relay D'3, conductor 246, winding of relay D'3 to the neutral of battery B'A'T'. The opening of the contacts *d* of relay D'3 at the selected remote station effects the de-energization of the relays C'R' and C'R'X' so that the remote station equipment is reconnected to its normal set of conductors E. The opening of the contacts *e* of relay D'3 in each of the intermediate stations opens the locking circuit of the associated relay D'1 so that this relay is restored to its normal position when all of the other relays controlled thereby have been restored to their normal position. In the end station, the relay D'1 is not de-energized until the reset impulse is removed from the line conductors. This result is accomplished by having the relay D'2 thereat complete through its contacts *e* an energizing circuit for a relay X'2 across the conductors L1 and L2. Relay X'2, by closing its contacts *a*, completes a locking circuit for itself and by closing its contacts *c* com-

pletes a circuit for relay D'1 as long as the reset impulse continues to flow.

When the relays D'1 in all of the remote stations have been restored to their normal positions, the heretofore described check circuit is completed so that the relay R'O' in each of the remote stations is energized to open its contacts b and restore its associated relay D'3 to its normal position. At the dispatcher's office, this check circuit effects the lighting of the start lamp ST to inform the dispatcher that the equipment is in its normal condition.

In each of the remote stations, the first energization of the relay L'P' or L'N' thereat during the transmission of a select code completes an energizing circuit for the associated relay R'7 from the positive terminal of the battery B'A'T' through the winding of relay R'7, conductor 249, contacts a of relay R'L', conductor 250, to the neutral of battery B'A'T' through either contacts e of relay L'P' or contacts e of relay L'N'. By closing its contacts a, relay R'7 completes a locking circuit for itself through conductor 260 and contacts i of relay D'1. By opening its contacts b, relay R'7 opens the circuit of the slow-to-drop-out relay D'4, but each time the relay L'P' is energized, its contacts c completes an energizing circuit for relay D'4 and each time the relay L'N' is energized its contacts c completes through the contacts d of relay R'6 an energizing circuit for relay D'4. Normally, the duration elapsing between select code impulses is sufficiently short to prevent the relay D'4 from closing its contacts b.

When the last impulse of the select code is removed from the conductors L1 and L2 and relay R'6 becomes energized in the selected station, a circuit is completed for the relay D'4 from the positive terminal of battery B'A'T' through the winding of relay D'4, conductor 209, contacts d of relay L'N', conductor 251, contacts a of relay R'6 to the neutral of battery B'A'T'. In each of the other remote stations, however, the select code has not effected the energization of the relay R'6 thereat. Therefore, in each of these other remote stations the relay D'4 becomes deenergized after the last select code impulse has been removed from the conductors L1 and L2. By closing its contacts b, relay D'4 in these other remote stations completes through conductor 243 an energizing circuit for the associated reset relay D'1, which in turn resets all of the energized receiving relays R'1 to R'4, inclusive, in the manner heretofore described. Each relay D'1 completes the heretofore described locking circuit for itself through the contacts e of the associated relay D'3 so that each relay D'1 remains energized until its associated relay D'3 is energized by the release impulse transmitted from the dispatcher's office.

The selection of each of the other remote stations common to the conductors L1 and L2 in response to the transmission of the select code individual thereto is effected by having the relays R'1, R'3, and R'5 connected in a different manner in each of these other stations from that shown in Fig. 2 so that they are successively energized by the three impulses of the individual select code. For example, if the select code of a remote station is one negative followed by two positive impulses, the relays R'1 and R'5 in that station are connected in the same manner as in Fig. 2, but the relay R'3 is connected so that its energizing circuit includes the contacts a of relay L'P' instead of contacts a of relay L'N'. Also

in that remote station, the contacts c of relay S'3 of the sender S' are arranged to connect the positive terminal instead of the negative terminal of battery B'A'T' to the conductor L1 in order to produce a check code of three positive impulses. If the select code of a remote station is three negative impulses, the relays R'1 and R'3 are connected in the same manner as in Fig. 2, but the relay R'5 is connected so that its energizing circuit includes the contacts a of relay L'N' instead of the contacts a of relay L'P'. Also in this remote station, the contacts c of relay S'5 of the sender S1 are arranged to connect the negative terminal instead of the positive terminal of battery B'A'T' to the conductor L1 in order to produce a check code of a positive impulse followed by two negative impulses.

If for any reason the normal check circuit through the conductors L1 and L2 becomes interrupted or a short-circuit is completed across the conductors, relay L in the dispatcher's office becomes de-energized and by opening its contacts b effects, in a manner heretofore described, the energization of the relay RL in series with the relay RO. The opening of the contacts d of relay RL interrupts the circuit of the start lamp ST. The closing of the contacts a of the relay RL completes a circuit for the pilot lamp PL from the positive terminal of battery BAT through the contacts b of relay R9, conductor 136, contacts a of relay RL, conductor 167, lamp PL to the negative terminal of battery BAT. The lighting of the pilot lamp PL informs the dispatcher that the spare set of conductors is not in an operative condition.

After the short-circuit across the conductors L1 and L2 has been removed or the open circuit through these conductors has been repaired, the dispatcher operates the reset key RK to effect the energization of the reset relay R. The opening of the contacts d of the relay R interrupts the circuit through the contacts L1 and L2 and the closing of the contacts c and e of relay R causes the relatively high voltage negative reset impulse to be transmitted over the conductors L1 and L2. Also, the closing of the contacts a of the relay R completes through conductor 159 an energizing circuit for the relay D1 which effects, in the manner heretofore described, the de-energization of the relays RO and RL.

At each of the remote stations which is not in its normal position, either the relay R'L' or the relay D'1 is energized so that the associated glow tube G'T' is operatively connected across the conductors L1 and L2 by either the contacts c of the relay R'L' or the contacts c of relay D'1. Therefore, in each of these remote stations the negative reset impulse effects the energization of the associated relay D'2 which, in a manner heretofore described, causes the apparatus at the station to be reset to its normal position.

In case the equipment at the end station is in its normal reset position so that the battery B'A'T' is connected to the conductors L1 and L2 when the negative reset impulse is transmitted, this reset impulse does not effect the immediate operation of the glow tube G'T' thereat because of the short-circuit effect of the battery B'A'T'. However, the current through the relay X'1' is now sufficient to cause this relay to close its contacts a and complete an energizing circuit for relay D'1. The opening of contacts b and d of relay D'1 removes the battery B'A'T' from across the conductors L1 and L2 so that the voltage across these conductors increases to a

value sufficient to effect the operation of the tube G'T' and the associated relay D'2. The energization of relay D'2 then effects, in the manner heretofore described, the energization of relay X'2 and the resetting of the apparatus at the end station to its normal reset position when the reset impulse is removed from the conductors L1 and L2.

While we have, in accordance with the patent statutes, shown and described our invention as applied to a particular system and as embodying various devices diagrammatically indicated, changes and modifications will be obvious to those skilled in the art, and we therefore aim in the appended claims to cover all such changes and modifications as fall within the true spirit and scope of our invention.

What we claim as new and desire to secure by Letters Patent of the United States is:

1. In combination, a plurality of supervisory control systems, each system including equipment at a controlling station, equipment at a remote station and an individual set of conductors interconnecting the station equipments of the system, a spare set of conductors common to all of said station equipments, means for transmitting over said spare set of conductors an impulse code individual to each remote station equipment, means including means associated with each remote station equipment responsive to said impulse codes for selectively connecting to said spare set of conductors the remote station equipment individual to a transmitted impulse code, and means for connecting to said spare set of conductors the controlling station equipment corresponding to the selected remote station equipment connected thereto.

2. In combination, a plurality of supervisory control systems, each system including equipment at a controlling station, equipment at a remote station and an individual set of conductors interconnecting the station equipments of the system, a spare set of conductors common to all of said station equipments, means for transmitting over said spare set of conductors an impulse code individual to each remote station equipment, means including means associated with each remote station equipment responsive to said impulse codes for selectively connecting to said spare set of conductors the remote station equipment individual to a transmitted impulse code and for disconnecting the selected remote station equipment from its individual set of conductors, and means for connecting to said spare set of conductors the controlling station equipment corresponding to the selected remote station equipment connected thereto.

3. In combination, a dispatcher's office, a plurality of remote stations, a separate supervisory control system interconnecting said dispatcher's office and each remote station, each system including equipment at the dispatcher's office, equipment at the remote station and an individual set of conductors interconnecting the two equipments of the system, a spare set of conductors common to the equipments of all of said systems, means at the dispatcher's office for transmitting over said spare set of conductors an impulse code individual to each remote station equipment, means including means associated with each remote station equipment responsive to said impulse codes for selectively connecting to said spare set of conductors the remote station equipment individual to a transmitted impulse code, and switching means at the

dispatcher's office for connecting the dispatcher's office equipment of each system to said spare set of conductors.

4. In combination, a dispatcher's office, a plurality of remote stations, a separate supervisory control system interconnecting said dispatcher's office and each remote station, each system including equipment at the dispatcher's office, equipment at the remote station and an individual set of conductors interconnecting the two equipments of the system, a spare set of conductors common to the equipments of all of said systems, means at the dispatcher's office for transmitting over said spare set of conductors an impulse code individual to each remote station equipment, means including means associated with each remote station equipment responsive to said impulse codes for selectively connecting to said spare set of conductors the remote station equipment individual to a transmitted impulse code and for disconnecting the selected remote station equipment from its individual set of conductors, and manually controlled switching means at the dispatcher's office for disconnecting the dispatcher's office equipment of each of said systems from its individual set of conductors and for connecting it to said spare set of conductors.

5. In combination, a dispatcher's office, a plurality of remote stations, a separate supervisory control system interconnecting said dispatcher's office and each remote station, each system including equipment at the dispatcher's office, equipment at the remote station and an individual set of conductors interconnecting the two equipments of the system, a spare set of conductors common to the equipments of all of said systems, means at the dispatcher's office for transmitting over said spare set of conductors an impulse code individual to each remote station equipment and a subsequent control impulse, switching means associated with each remote station equipment for connecting it to said set of spare conductors, means associated with each remote station equipment responsive to said impulse codes for selecting the switching means associated with the remote station equipment individual to the transmitted impulse code, means responsive to the control impulse for effecting the operation of the selected switching means, and switching means at the dispatcher's office for connecting the dispatcher's office equipment of each system to said spare set of conductors.

6. In combination, a plurality of stations, a pair of conductors interconnecting said stations, selective means at each of said stations having a control relay normally connected between said conductors, a source of relatively low potential normally connected in series with the control relay in one of said stations, means for applying a relatively high potential across said conductors in opposition to said source whereby the current through said source and the associated control relay is reversed, means responsive to said current reversal for effecting the connection of said last-mentioned control relay across said conductors independently of said source, and means for transmitting over said conductors to said control relays impulse codes individual to each station to effect the operation of the associated selective means.

7. In combination, a plurality of stations, a pair of conductors interconnecting said stations, supervisory control equipment at each of said stations, selective means at each of said stations

having a control relay normally connected between said conductors, a source of relatively low potential of a predetermined polarity connected in series with the control relay in one of said stations, means for applying a relatively high potential of said predetermined polarity across said conductors whereby the current through said source and associated relay is reversed, means responsive to said current reversal for effecting the connection of said last-mentioned control relay across said pair of conductors independently of said source, means for transmitting over said pair of conductors to said control relays an impulse code individual to each station, and means including said selective means for selectively connecting to said pair of conductors in response to the transmission of an impulse code only the supervisory control equipment at the station individual to the transmitted code.

8. In combination, a plurality of stations, a pair of conductors interconnecting said stations, supervisory control equipment at each of said stations, selective means at each of said stations having a control relay normally connected between said conductors, a source of relatively low potential of a predetermined polarity connected in series with the control relay in one of said stations, means for applying a relatively high potential of said predetermined polarity across said conductors whereby the current through said source and associated relay is reversed, means responsive to said current reversal for effecting the connection of said last-mentioned control relay across said pair of conductors independently of said source, means for transmitting over said pair of conductors to said control relays an impulse code individual to each station, means including said selective means for selectively connecting to said pair of conductors in response to the transmission of an impulse code only the supervisory control equipment at the station in-

dividual to the transmitted code, means for transmitting over said pair of conductors a release impulse of a predetermined character, and means responsive to said release impulse at the station in which the associated supervisory control equipment is connected to said pair of conductors for effecting the disconnection of that equipment therefrom.

9. In combination, a plurality of stations, a pair of conductors interconnecting said stations, supervisory control equipment at each of said stations, selective means at each of said stations having a control relay normally connected between said conductors, a source of relatively low potential of a predetermined polarity connected in series with the control relay in one of said stations, means for applying a relatively high potential of said predetermined polarity across said conductors whereby the current through said source and associated relay is reversed, means responsive to said current reversal for effecting the connection of said last-mentioned control relay across said pair of conductors independently of said source, means for transmitting over said pair of conductors to said control relays an impulse code individual to each station, means including said selective means for selectively connecting to said pair of conductors in response to the transmission of an impulse code only the supervisory control equipment at the station individual to the transmitted code, means for transmitting over said pair of conductors a release impulse having a relatively high potential of a predetermined character, and means responsive to said release impulse for disconnecting from said conductors any supervisory control equipment that may be connected thereto and for restoring the normal connection of said control relays to said conductors.

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