

June 6, 1933.

W. BRÜCKEL ET AL

1,913,188

SUPERVISORY SYSTEM

Filed June 9, 1930

4 Sheets-Sheet 1

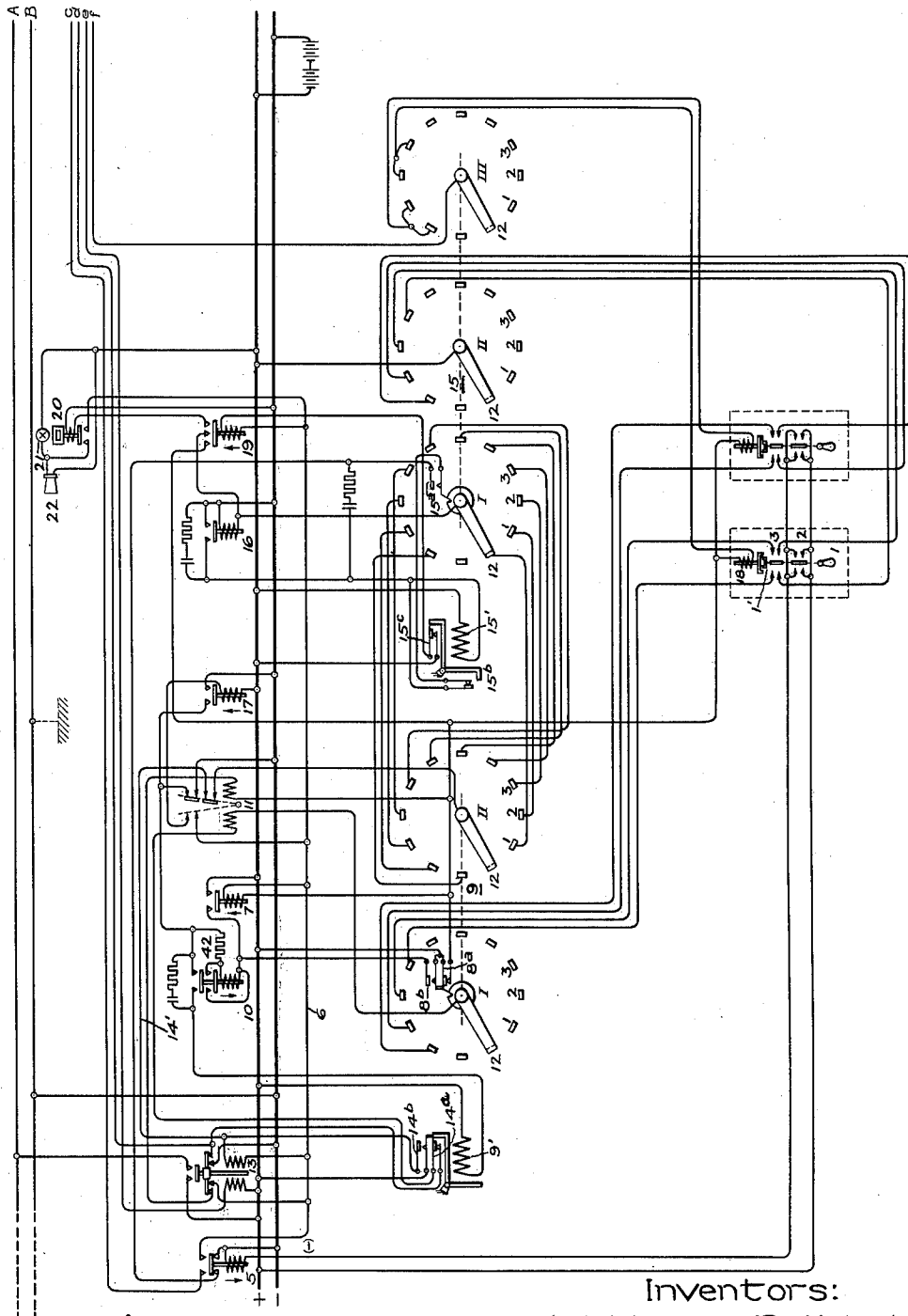


Fig. 1.

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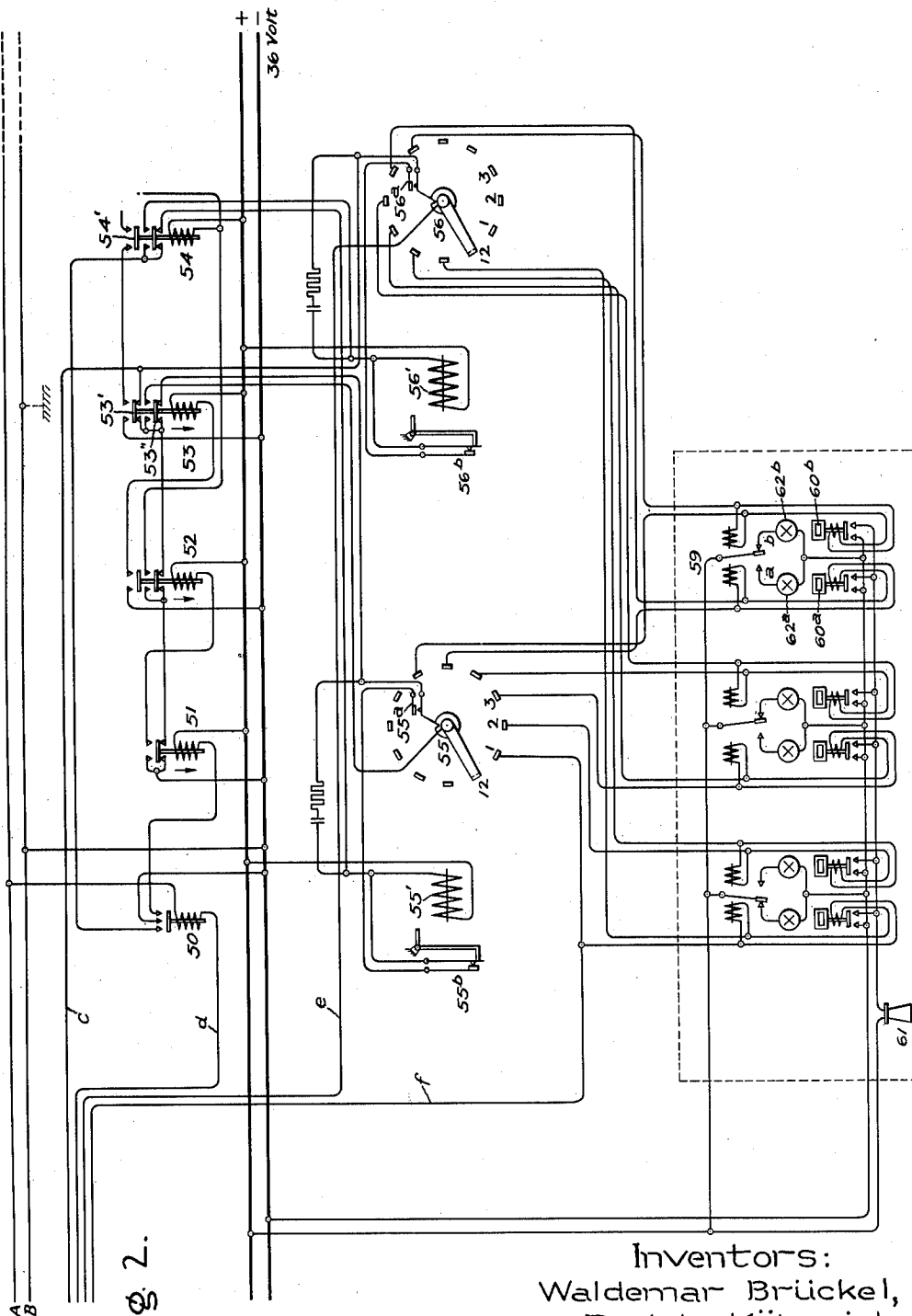
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4 Sheets-Sheet 2



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4 Sheets-Sheet 3

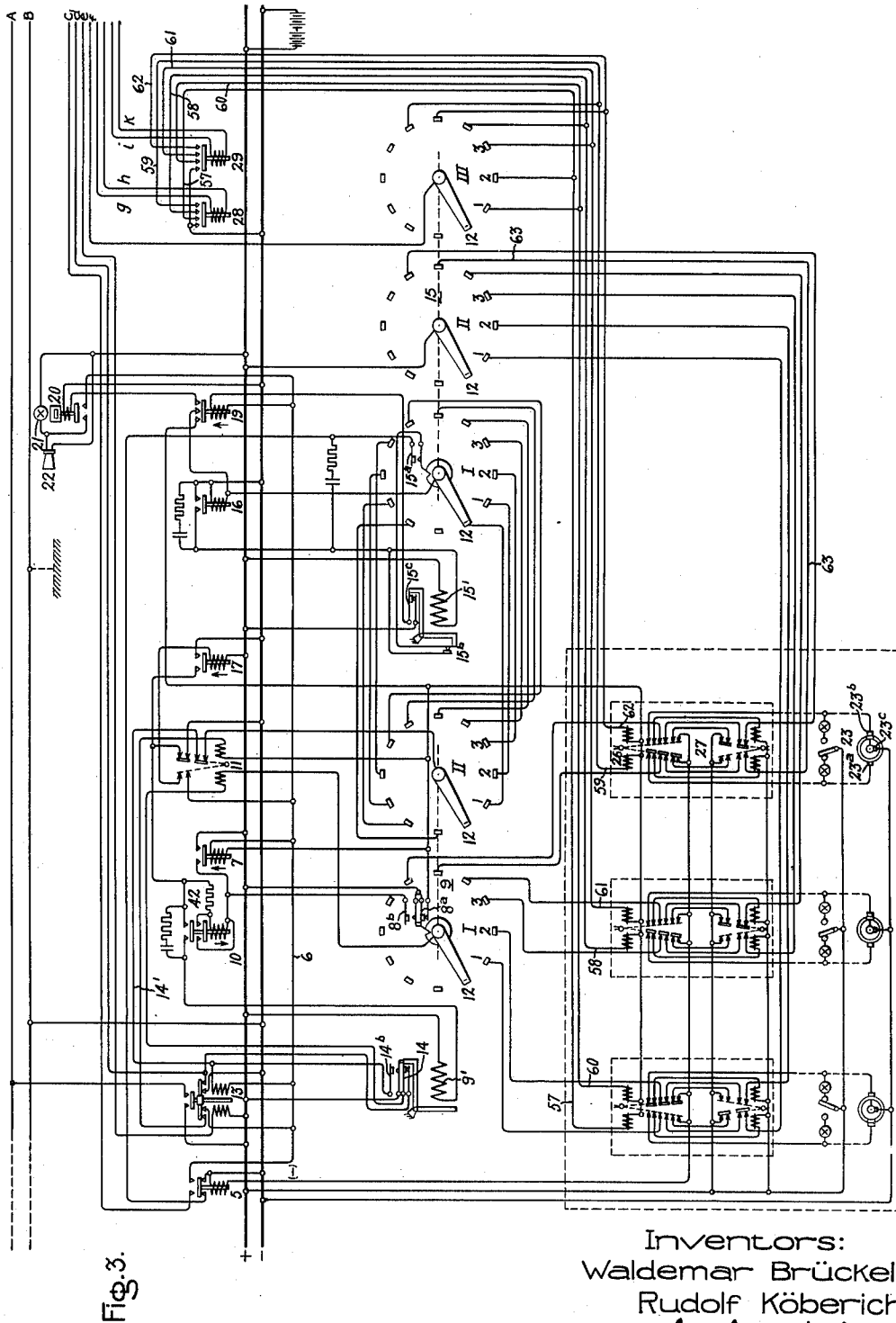


Fig. 3.

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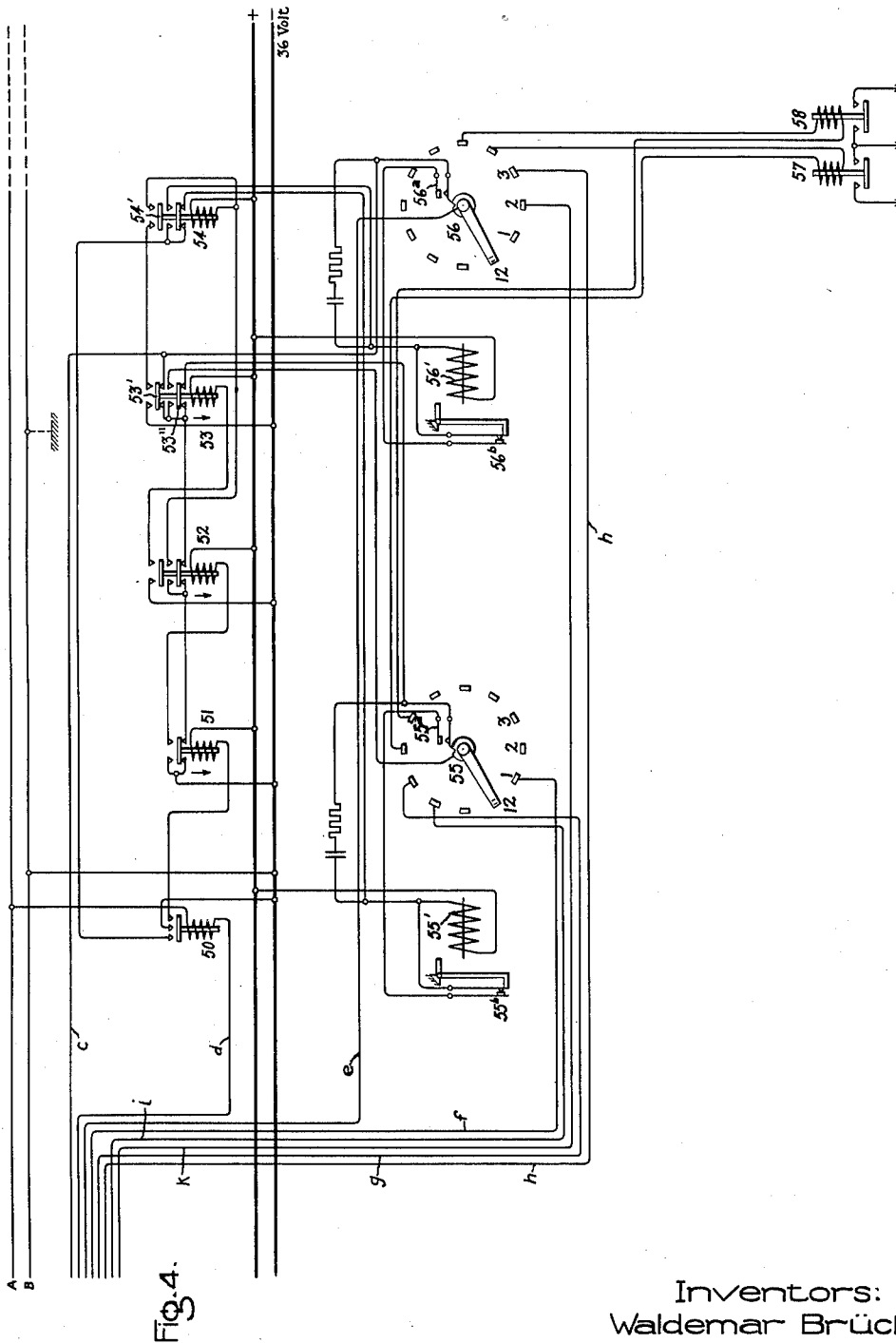
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SUPERVISORY SYSTEM

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4 Sheets-Sheet 4



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UNITED STATES PATENT OFFICE

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SUPERVISORY SYSTEM

Application filed June 9, 1930, Serial No. 459,945, and in Germany December 22, 1928.

Our invention relates to supervisory systems, and more particularly to systems employing rotary selector switches in the different stations thereof.

One of the objects of our invention is to provide certain improvements in systems of the type indicated more particularly with reference to coordination of the code transmitting means and code responsive selecting means, the operation of the system over a single line conductor, the manner in which signals are repeated in the case of faulty operation of the equipment and the storing of signals when two or more apparatus units operate simultaneously or in close succession.

In accordance with the invention a complete transmitting and receiving system is provided in the dispatcher's station and in the remote stations where the supervised apparatus units are located. A control device, or key, is provided in the dispatcher's station corresponding to each apparatus unit supervised. Upon operation of any control device in the dispatcher's station a pair of rotary selector switches in the dispatcher's station are set into operation. These switches rotate until they each occupy positions corresponding to the operated control device. In this position a circuit is completed which energizes means for interrupting the driving circuits of the two switches and for energizing a time responsive relay. Upon operation of the time responsive relay one of the switches is again set into operation and rotates over the remaining portion of its contacts to the normal position leaving the second switch in the position in which the time responsive means became energized. Means are provided whereby upon each operation, or step, of said first selector switch a potential impulse is applied to a conductor which extends to the remote station. Thus during the rotation of said switch through its complete cycle two groups of impulses are transmitted. The groups of impulses constitute the transmitted code. It will be apparent that all codes thus transmitted comprise the same number of impulses divided in groups by an intervening time interval so spaced

in the series of impulses as to render the codes distinctive.

A pair of similar selector switches is provided in the remote station together with a relay arrangement whereby in response to the first impulses received one of the selector switches is operated to a position corresponding to the number of impulses in the first group. During the interval between groups, timing means in the relay arrangement operates to render the first operated switch unresponsive to further impulses and to render the other switch responsive. The second switch then responds to the second group of impulses. Thus at the end of the series of impulses the two switches occupy complementary positions in their paths of rotation.

In response to operation of these receiving switches to the position indicated the remote device corresponding to the operated control device is selected and an impulse is transmitted back over the line conductor to the dispatcher's station where means is operated through the second selector switch in that station to restore the operated control device and the second selector switch to the normal position and to interrupt operation of the first selector switch in the normal position.

Upon operation of the apparatus unit in the remote station the transmitting equipment in that station functions in the same manner to send impulses to the dispatcher's station over the line conductor. The receiving equipment responds to these impulses to operate appropriate signal devices and to transmit the return signal to the remote station.

One of the objects of the invention is to provide means whereby the above operations may be carried out over a single line conductor.

Another object of the invention is to provide timing means whereby the different series of impulses are divided into complementary groups and whereby the selector switches in the remote station are operated to complementary positions dependent upon the number of impulses in each of the time spaced complementary groups.

Another object of the invention is to provide means whereby in case of failure of the return impulse the code will be continuously repeated until the return impulse is received or until a further control device is operated. Thus when a fault occurs resulting in failure of the return impulse, in accordance with the invention, the code will be continuously repeated until the return impulse is received, or until a further control device is operated. When the latter occurs its corresponding code is automatically transmitted after which the equipment will again repeatedly transmit the former code. If the code corresponding to operation of the further control device also results in a fault such that no return impulse is received then the two codes will be transmitted alternately, each code being repeated twice in succession until a return impulse is received.

The novel features which we believe to be characteristic of our invention are set forth with particularity in the appended claims. Our invention itself, however, both as to its organization and method of operation together with further objects and advantages thereof, may best be understood by reference to the following description taken in connection with the accompanying drawings in which Fig. 1 illustrates a transmitting system, and Fig. 2 a receiving system for a dispatcher's station and Figs. 3 and 4 illustrate respectively a transmitting system and a receiving system for a remote station.

Referring to Fig. 1 of the drawings, at 1 we have represented a plurality of manually operated switches each of which corresponds to one of the remote switches which are to be controlled and supervised. Each of these switches 1 has a pair of contacts 2 for initiating the operation of the supervisory system and an additional pair of contacts 3 for selecting the particular remote switch which is to be controlled. When any of the switches 1 is operated either to its left-hand position or to its right-hand position thereby to close or open a remote switch it is arranged to be mechanically latched in that position by means of a latching mechanism 1' of any suitable construction. These latching mechanisms are each provided with an actuating winding 18 which when energized releases the armature member of the switch 1 and causes it to return to the initial position. As will be pointed out, this occurs after the supervisory system has been actuated to perform the desired operation.

The transmitting system also comprises a pair of selector switches 9 and 15 together, with associated relays including a time delay relay 17. The arrows shown adjacent the relay 17 and the other time relays indicate the direction in which relays operate their contacts with a time delay. These selector switches are so connected that, in response to

operation of any switch 1, they actuate their armatures synchronously over a portion of their contacts after which an interruption occurs and selector 9 then returns to the initial position leaving selector 15 in the position in which the interruption occurred. In so doing, by means of an impulse relay 13, selector switch 9 supplies a series of impulses over the line conductor A to the remote station, the number of impulses transmitted corresponding to the number of contacts upon the selector switch 9. This series of impulses is interrupted, as stated, through action of relay 17 for a definite interval after a predetermined number of impulses, as determined by the switch 1, has been transmitted after which interruption the series of impulses is completed by switch 9.

In the remote station as illustrated in Fig. 4 selector switches 55 and 56 are provided. Selector switch 55 is arranged to respond to the first group of the series of impulses, and selector switch 56 is arranged to respond to the second group of impulses whereby after the completion of the entire series of impulses these switches are upon contacts which are connected in circuit with the one of the relays 57, 58 which is to be operated to control the remote switch, not shown.

Impulses may be transmitted from the remote station to the dispatcher's station for the purpose of indicating in the dispatcher's station the automatic operation of any remote switch by means of a transmitting system shown in Fig. 3 which is identical with the transmitting system shown in Fig. 1 with the principal exception that the equipment represented by the rectangle in Fig. 3 is provided instead of switches 1 shown in Fig. 1. In this transmitting equipment the starting and selecting circuits are completed through contacts on relays 26 and 27. A pair of these relays 26 and 27 is associated with each remote switch and the operation of any relay 27 causes a series of impulses to be transmitted over the line conductor A to the dispatcher's station, the number of impulses transmitted corresponding to the selector switch 9 of the transmitting means shown in Fig. 3. The dispatcher's office is provided with a receiving system shown in Fig. 2 which is identical with that at the remote station with the exception that indicating relays, as shown in the rectangle in the lower left-hand corner of Fig. 2 are provided instead of relays 57 and 58 shown in Fig. 4.

The transmitter at the remote station is provided with additional relays 28 and 29 which are controlled through conductors *g*, *h*, and *i*, *k* respectively by the remote receiver for purposes later to be indicated.

Having now indicated the general character of the system to be described, a further and more detailed understanding thereof may be had by reference to its operation.

Let us assume that the operator desires to actuate the contacts of relay 57 at the remote station thereby to operate a remote oil switch or other suitable device controlled by that relay. He will actuate the switch 1 shown in Fig. 1 to the left thereby closing its left-hand contacts 2 and its right-hand contacts 3, the latching mechanism 1' retaining this switch in the position to which it is actuated. Contacts 2 energize through an obvious circuit starting relay 5 in the dispatcher's office and right-hand contacts 3 prepare a selecting circuit to determine the number of impulses in each group of the series which is to be transmitted thereby to select the desired remote switch.

Upon operation of relay 5 in the dispatcher's station its upper contacts complete a circuit which extends from the negative side of the battery through the lower contacts of relays 51 and 52 of the receiver in the dispatcher's station, contacts 53' of relay 53 of that receiver, conductor *c*, upper contacts of relay 5, negative bus 6, relay 7, and contacts 8^a on selector switch 9 to the positive side of the battery. Upon operation of relay 7 a circuit is completed from the positive side of the battery through contacts of relay 7, winding of relay 10 and right-hand upper contacts of relay 11 to the negative side of the battery. Relay 10 then operates and by means of its upper armature establishes a circuit for motor magnet 9' through the same contacts of relay 11. At the same time, by means of its lower armature and contacts relay 10 deenergizes itself. Thus a buzzer action of this relay is established, the relay alternately opening and closing its upper and lower contacts at a rate determined by a suitable time delay means (not shown) which is associated with the relay whereby its operation to the lower position is delayed. This buzzer action is utilized to control the operation of selectors 9 and 15.

As stated above when the relay 10 is in its upper position a circuit is completed through motor magnet 9' of switch 9. Thus this motor magnet is successively energized and deenergized thereby stepping switch 9 over its contacts synchronously with the buzzer action of relay 10. Upon each energization of motor magnet 9', contacts 14^b associated therewith close thereby completing a circuit for the right-hand coil of impulsing relay 13 which, in turn, successively connects line A to the positive side of the battery. This circuit for relay 13 extends from the positive side of the battery through contacts 14^b of motor magnet 9', right-hand coil of relay 13, conductor 6, upper contacts of relay 5, conductor *c*, contacts 53' of relay 53 in the dispatcher's station, lower contacts of relays 52 and 51 to the negative side of the battery. Contacts 14^b also complete a circuit upon each successive energization of magnet 9' which extends through conductor 14', lower right-hand contacts of relay 11, wiper II which is in engagement with its first contact after the first energization of motor magnet 9', wiper 1 of selector switch 15 in its normal position and relay 16 to the negative side of the battery. Relay 16 then operates to complete an obvious circuit for motor magnet 15' of the selector switch 15.

This motor magnet 15' is then energized and steps its armature on to its first off normal contact thereby deenergizing relay 16. Relay 16 cannot then again be energized until selector switch 9 has been advanced to its second contact by action of its motor magnet 9' in response to successive operation of relay 10. When this occurs relay 16 is again energized and the switch 15 is stepped to its second position. In this way switches 9 and 15 operate synchronously until a contact is reached where the one of the selecting circuits which include contacts 3 of the particular switch 1, which has been operated, is completed. In the case assumed this circuit extends from negative battery through the right-hand lower contacts of relay 13, contacts 14^a of motor magnet 9', left-hand winding of relay 11, wiper I on its eighth contact, right-hand contacts 3 of switch 1, wiper II of switch 15 on its eighth contact to the positive side of the battery. Since relay 13 must be in its lower position before this circuit can be completed, it will be apparent that this cannot be effected during the transmission of an impulse to the remote station.

When this circuit is completed the armature of relay 11 is operated to its left-hand position thereby completing a circuit from the negative bus 6 through left-hand contacts of relay 11 and slow closing relay 17. During the period of closing of relay 17 an interruption is produced in the transmission of impulses. The contacts of this relay are connected in parallel with the upper right-hand contacts of relay 11 so that when this relay is in its closed position the buzzer circuit of relay 10 is again completed. This circuit now extends through contacts 8^b of switch 9, however, rather than 8^a since switch 9 is in an off-normal position. The circuit of motor magnet 9' is also again completed through the contacts of relay 17. The selector switch 9 will now actuate itself to its normal position in which position the movable contacts 8^b open thereby interrupting the circuit of relay 10, and causing the switch to stop. It will be noticed that relay 7 was deenergized by contacts 8^a when switch 9 left its normal position. Selector 15, however, remains upon its eighth contact for the reason that the circuit of relay 16 is now open at the right-hand lower contacts of relay 11. When contacts 8^a close a circuit is again completed through the right-hand winding of relay 11 and the left-hand contacts of relay 13 to the

negative bus whereby relay 11 is actuated back to the position shown in the drawings where it remains until the next operation.

The selector 9 would now again transmit a second series of impulses to the line A were it not for the fact, as will be indicated, that when the remote switch is operated a return impulse energizes magnet 18 thereby restoring switch 1 to the normal position and deenergizing the starting relay 5 which in turn deenergizes relay 7 and the negative bus 6.

At the remote station shown in Figs. 3 and 4 the positive impulses are received over conductor A through relay 50, conductor *d*, and right-hand lower contacts of relay 13 of the transmitter at the remote station. Thus relay 50 of neither receiving system can respond when the transmitter in the same station is operating. Similarly since the bus 6 in each station is energized through relays 51, 52 and 53 thereat neither transmitter can operate when the receiver in the same station is operating. This relay 50 in Fig. 4 is operated in response to each impulse received from the dispatcher's station and supplies the first group of impulses through a circuit which extends from the negative side of the battery through the left-hand contacts of relay 50, lower contacts of relay 54, motor magnet 55' of selector switch 55 to the positive side of the battery. Thus selector switch 55 steps its wiper over its bank of contacts through as many steps as there are impulses in the first group. Thus this switch will come to rest upon its eighth contact. The first closing of relay 50 causes relays 51, 52 and 53, all of which are cascade connected through obvious circuits, to operate their armatures to the upper position. When an interruption in the impulses, caused by the slow closing of relay 17 at the dispatcher's station, occurs relay 51 at the remote station will actuate its armature to the lower position. A circuit will then be completed which extends from the negative side of the battery through the lower contacts of relay 51, middle contacts of relay 52 and actuating winding of relay 54 to the positive side of the battery. Relay 54 will then actuate its armature to its upper position and through its upper bridging member 54' will complete a holding circuit for itself which extends through bridging member 53' of relay 53 in its upper position. This transfers the circuit of the left-hand contacts of relay 50 from motor magnet 55' to motor magnet 56'. Thus when the remaining group of impulses are received motor magnet 56' will be actuated in response thereto thereby actuating the wiper to a contact depending upon the number of impulses included in the last group. Since it is assumed that the entire series of impulses includes twelve impulses, for example, and the interruption occurred after the eighth impulse it will appear that wiper

55 will now engage its eighth contact and wiper of switch 56 will engage its fourth contact.

When the second group of impulses is completed relay 51 and subsequently relay 52 at the remote station are deenergized. When relay 52 reaches its lower position a circuit is completed which extends from the negative side of the battery through the lower contacts of relays 51 and 52, bridging member 53'' of relay 53 in its upper position, wiper of switch 55 on its eighth contact, winding of relay 57, wiper of selector switch 56 on its fourth contact, conductor *e* and left-hand winding of relay 13 of the transmitter at the remote station to the positive side of the battery. This winding of relay 13 actuates the armatures of the relay in the same manner in which the right-hand winding does, but is electrically independent of the right-hand winding. Relay 13 at the remote station then actuates its armature and supplies positive potential to the conductor A. This potential comprises the return signal impulse which occurs only when switches 55 and 56 have properly operated. This potential, however, will not cause operation of relay 50 of the remote receiver for the reason that the circuit of relay 50 is completed through conductor *d* and the right-hand lower contacts of the relay 13 of the remote transmitter which are now open.

After a further time delay relay 53 at the remote station operates its armature to the lower position thereby closing circuits which extend from the negative side of the battery through the lower contacts of relays 51 and 52, bridging member 53' of relay 53 in its lower position, contacts 56^a which are now closed due to the fact that the wiper of switch 56 is not in its normal position, contacts 56^b of the motor magnet 56' and winding thereof to the positive side of the battery. This circuit constitutes a buzzer circuit for the motor magnet 56' which actuates the switch 56 to its initial position, in which position the contacts 56^a are opened and the operation ceases. A similar circuit is completed through the bridging member 53'' of relay 53 and its lower contacts for the motor magnet 55' which likewise actuates its armature to the normal position.

It has been seen that at the same time that relay 57 at the remote station was energized positive potential was supplied by the transmitter at the remote station to the conductor A. Relay 50 of the receiver at the dispatcher's station shown in Fig. 2 responds to this positive potential and causes the operation of relays 50, 51, 52 and 53 thereat to their upper position thereby energizing motor magnet 55' at the dispatcher's station. When the switches 55 and 56 at the remote station return to their initial position, however, the circuit of the left-hand winding of relay 13

at the remote station is deenergized and hence positive potential is removed from the conductor A, and relays 50, 51 and 52 at the dispatcher's station are returned in succession to the position shown in the drawings thereby deenergizing motor magnet 55' at the dispatcher's station. Switch 55 in the dispatcher's station now occupies its first contact position.

10 A circuit is then completed in the dispatcher's office from the negative side of the battery through the lower contacts of relays 51 and 52, bridging member 53'' of relay 53 in its upper position, wiper of switch 55 on its first contact, conductor f, wiper III of selector switch 15 at the dispatcher's station on its eighth contact, winding 18 of latching member 1', contacts 8^a of selector switch 9 to the positive side of the battery. Winding 18 then releases the latching member 1' and thereby restores the switch 1 to the position shown in the drawings. This in turn deenergizes the starting relay 5 which operates to its lower position after a time delay.

25 In its lower position relay 5 completes a circuit which extends from negative battery through the lower contacts thereof, contacts 15^a, contacts 15^b, motor magnet 15' to the positive side of the battery. This constitutes a buzzer circuit for motor magnet 15' which in turn actuates its wipers to the initial position in which position contacts 15^a are opened thereby interrupting the operation of the switch. After a time delay relay 53 at the dispatcher's station returns to its lower position thereby completing the buzzer circuit for the motor magnet 55' which in turn actuates the corresponding selector switch to its initial position. Thus the entire system is now returned to its initial position.

Let us assume that when the selector switch 9 in the dispatcher's office is returned to its initial position the above described final impulse caused by relay 13 at the remote station does not occur due, for example, to faulty operation of one of the switches 55 or 56 at the remote station. It will be seen that when the contact of switch 9 returns to its initial position relay 7 is energized through contacts 8^a and completes the buzzer circuit for relay 10. Through operation of this relay as described above, the series of impulses will be repeated to the remote station. The selector switch 15, however, will remain upon the contact to which it was actuated, viz: in the case above assumed, contact 8 since the circuit of the control relay 16 is not again completed before the relay 11 is reenergized to open its contacts in the energizing circuit for the relay 16.

When switch 9 reaches its eighth contact the left-hand winding of relay 11 will be energized thereby, as before, energizing relay 17 and producing the interruption between the two series of impulses.

By making relay 7 sufficiently slow to operate, or otherwise, producing sufficient time interval after the first series has been sent out switches 55 and 56 in the remote station will return to their normal positions and be in readiness for receipt of the second series of impulses which may effect the desired operation.

To produce an indication that trouble has developed a circuit is completed through contacts 15^c for energizing relay 19 which after a time interval equal to the time required for two complete series of impulses when no remote operation is had closes its contacts thereby completing a circuit which extends from the positive side of the battery through contacts 8^a which are closed when this switch is in its normal position, left-hand contacts of relay 19 and winding of relay 16 to the negative side of the battery. Relay 16 closes thereby energizing motor magnet 15' and stepping selector switch 15 an additional step. When this occurs relay 19 is deenergized through a momentary interruption of contacts 15^c after which it again becomes energized. In its upper position it also completes a circuit which extends from the negative side of the battery through relay 20, armature of relay 19, contacts 8^a on selector switch 9 to the positive side of the battery. Relay 20 by closing its contacts completes between the positive side of the battery and the negative conductor 6 obvious circuits for visual and audible indicating devices 21 and 22 which inform the operator that faulty operation of the equipment has taken place.

Relay 20 may be employed to operate a drop as indicated in the drawings thereby to furnish a permanent indication that trouble has occurred.

Since switch 15 is no longer on a contact corresponding to the operated signal lever 1 the left-hand winding of relay 11 will not be operated on the following rotation of switch 9 but will remain in its right-hand position. Thus if no other switch has been operated the switch 15 will then be actuated along with switch 9 to the normal position. The system is then in readiness to respond to another signal operation. If, however, the switches 1 corresponding to subsequent contacts on switch 15 have been operated, the switches 9 and 15 instead of being restored to their normal positions in the manner above described will stop when the switch 15 engages the first of these contacts, and after a time delay the switch 9 will return to its normal position. In this manner the code corresponding to the contact with which the switch 15 remains in engagement is transmitted to the switches 9 and 15 at the remote station. Thus, when a faulty operation occurs the equipment not only transmits the code during which the faulty operation occurred but also transmits any

further codes corresponding to other operated control switches. That is, let us assume that these control devices 1 are operated substantially simultaneously or one following the other in succession without intervening interval sufficient to permit the equipment to return to normal after any operation. Normally the equipment will proceed to transmit the respective codes in succession.

10 If we assume that no return impulse occurs after the first code is transmitted the equipment will repeat this code once and then proceed to send the codes corresponding to each of the other operated units in succession, after which it will continuously repeat the first code. If we assume that no return impulse is received corresponding to two or a greater number of operated devices 1, it will be seen that the equipment will re-transmit the codes corresponding to each of these devices once. After repeating each code the equipment proceeds to the next operated control device thereby to transmit its code. After all codes in response to which proper operation at the remote station occurs, have been transmitted, the equipment will then repeatedly transmit the two codes resulting from which it is assumed that faulty operation occurred. These codes will be transmitted alternately each code being repeated twice in succession until the proper operation of the remote equipment is had.

To indicate the manner in which the remote switches in Fig. 3 are caused, upon operation thereof, to actuate the remote transmitter thereby to operate signals in the dispatcher's station the equipment indicated in the rectangle at the lower left-hand corner of Figs. 2 and 3 is provided. The equipment shown in the rectangle of Fig. 3 includes the relays 26 and 27 which are associated with each remote switch at the remote station and that in the rectangle of Fig. 2 includes the relays 59, 60^a and 60^b which are located in the dispatcher's station and which correspond to the remote switches.

If we assume that a remote switch (not shown) is operated from one position to the other a contacting device 23 is rotated through one-half of a revolution and thereby completes a conductive connection between contacts 23^a and 23^c. A circuit will then be completed which extends from negative battery through contacts 23^c and 23^a of contacting devices 23, upper contacts and armature of relay 26 in the position shown and the left-hand winding of relay 27 to the positive terminal of the battery. Relay 27 will then be actuated to the left thereby completing a starting circuit which extends from the negative side of the battery through starting relay 5 of the remote transmitter, lower left-hand contacts and armature of relay 26, upper contacts and armature of relay 27 in its left-hand position to the positive side

of the battery. Likewise a selecting circuit will be completed which extends from the fifth contact on bank I of switch 9 through the middle contacts and armature of relay 26 in the position shown, lower contacts and armature of relay 27 in its left-hand position, conductor 63, and fifth contact of bank II of switch 15. Thus the starting circuit and the selecting circuit is completed in the same way as is done by means of switches 1 at the dispatcher's station.

When a corresponding signal is received at the dispatcher's station the selector switch 55 of the dispatcher's receiver shown in Fig. 2 will be operated to its fifth contact and selector switch 56 will be operated to its seventh contact, thereby operating the left-hand coil of relay 59 and relay 60^a in parallel. By means of its lower contact relay 60^a energizes an obvious circuit for audible signaling device 61. Relay 59 similarly closes an obvious circuit for the visual indicating devices 62^a which may comprise a lamp. When the return signal impulse is received at the remote station a circuit will be completed for the right-hand coil of relay 26 which in turn operates the armature to the dotted line position thereby interrupting both the starting circuit and the selecting circuit in a manner equivalent to the return of switch 1 to its normal position.

In case the switch 27 has then been actuated back to its initial position a circuit for the starting relay will again be completed through lower right-hand contacts and armature of relay 26, and the upper right-hand contacts and armature of relay 27. Similarly a selecting circuit will be completed through the middle right-hand contacts of relay 26 and lower right-hand contacts of relay 27. These circuits in turn will cause the apparatus to operate through a complete cycle sending its signal to the remote station and finally energizing the left-hand coil of relay 27 and returning the armature to the position shown in the drawings.

It will be apparent that if a number of remote switches are operated simultaneously the selector switches 9 and 15 will operate to the contacts corresponding to the first of these switches after which its signal will be sent to the dispatcher's station. The supervisory system will then proceed to send signals corresponding to each of these switches in sequence and repeating the signals following which no return signals are received all in the manner above explained.

Relays 28 and 29 are arranged to be operated by the receiver at the remote station in the same way that relays 57 and 58 are operated, and are used for the purpose of checking the position of the remote switches. Thus, for example, if the operator desires to check the position of the remote switches he will first operate relay 28. This relay

through conductors 57, 58 and 59 will energize the left-hand coils of all of the relays 26. The armatures of all of the relays which are not in the left-hand position will thus be actuated. These switches will then cause a signal to be sent to the dispatcher's station indicating the position which they occupy. The operator will then operate relay 29 which in turn through conductors 60, 61 and 62 will energize the right-hand coils of all of the relays 26. This in turn will cause all of the armatures which are not already in the right-hand position to be actuated to the right and corresponding signals to be sent to the dispatcher's station.

It will be noticed that the operating windings of the relays 60^a and 60^b are respectively connected in parallel with the left-hand winding and the right-hand winding of the relay 59. When the positions of remote switches are being checked as by relays 28 and 29, if no change has occurred, only the drops will be effected. If a change has occurred both a lamp and a drop will be energized thereby informing the operator that a change has occurred which has not previously been reported. The drops will always be operated in response to each checking operation and failure thereof indicates a faulty operation of the equipment.

While we have shown a particular embodiment of our invention it will be understood by those skilled in the art that many changes and modifications, both in the circuit arrangement and in the instrumentalities employed, may be made without departing from our invention 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 pair of step-by-step rotary selector switches, each of said selector switches having a normal position and a plurality of other positions, a plurality of control devices, each of said devices corresponding to a certain position of said switches, means responsive to operation of any of said devices to operate said switches in synchronism to a position corresponding to the operated device, means dependent upon said switches occupying said corresponding positions for interrupting the operation of both of said switches for a predetermined time interval and for thereafter causing one of said switches to operate to said normal position while the other switch remains in said corresponding position, means for transmitting an impulse in response to each step of said one switch, selecting means at a remote point responsive to said impulses when the impulses received at said remote point correspond to the impulses transmitted, control

means associated with each control device and means responsive to the selecting means and said other selector switch to effect the operation of the control means associated with the operated control device and to return said other selector switch to the normal position when the impulses received at said remote point correspond to the impulses transmitted.

2. In combination, a pair of step-by-step rotary selector switches, each of said selector switches having a normal position and a plurality of other positions, a plurality of control devices each of said devices corresponding to a certain position of said switches, means responsive to operation of any of said devices to operate said switches in synchronism to a position corresponding to the operated device, means dependent upon said switches occupying said corresponding positions for interrupting the operation of both of said switches for a predetermined time interval and for thereafter causing one of said switches to operate to said normal position while the other switch remains in said corresponding position, a conductor, means responsive to each step of said first switch for transmitting an impulse over said conductor to a remote point, selecting means at the remote point responsive to said impulses when the impulses received at said remote point correspond to the impulses transmitted, means responsive to said selecting means for transmitting an impulse over said conductor when the impulses received at said remote point correspond to the impulses transmitted, control means associated with each control device and means responsive to said impulse and the position of said other selector switch to effect the operation of the control means associated with the operated control device and to restore said other switch to the normal position.

3. In combination, a pair of step-by-step selector switches, each of said selector switches having a normal position and a plurality of other positions, a drive circuit for each switch, a plurality of control devices, each of said control devices corresponding to a position of said switches, control means associated with each control device, means responsive to operation of any of said control devices to complete the drive circuit of one of said switches, means for operating the other switch synchronously with said one switch until a position corresponding to the operated control device is reached, means responsive to said switches occupying said position corresponding to the operated control device for interrupting said drive circuit and for interrupting operation of said last means, time-controlled means for again completing said drive circuit, impulse sending means responsive to operation of said one switch, impulse responsive means at a re-

- remote point, means responsive to operation of said impulse responsive means for interrupting operation of said first switch in the normal position when the impulses received at
- 5 said remote point correspond to the impulses transmitted and means controlled by said impulse responsive means and the position of said second switch for effecting the operation of the control means associated with
- 10 the operated control device and for returning said second switch to the normal position when the impulses received at said remote point correspond to the impulses transmitted.
- 15 4. In combination, a pair of step-by-step selector switches, each of said switches having a normal position and a plurality of other positions, a plurality of control devices, means responsive to operation of each of said
- 20 control devices for operating said switches to a position corresponding to the operated control device, means responsive to operation of both of said switches to said position for interrupting the operation of one of said
- 25 switches, code sending means controlled by said other switch, code responsive means at a remote point, selecting means at said remote point operated by said code responsive means when the code received by said code
- 30 responsive means corresponds to the code transmitted by said other switch means responsive to operation of said code responsive means when the code received by said code responsive means corresponds to the code
- 35 transmitted by said other switch and operable through said one selector switch to restore the operated control device to the normal condition and to prevent operation of said other switch in the normal position.
- 40 5. In combination, a pair of step-by-step selector switches, each of said switches having a normal position and a plurality of other positions, a plurality of control devices, means responsive to operation of any
- 45 control device for synchronously operating said switches through said positions, a plurality of circuits including corresponding contacts on each of said switches and the corresponding control device, means including
- 50 said circuits for interrupting the operation of said switches in a position corresponding to the operated control device and after a predetermined interval causing one of said switches to again operate, means for
- 55 transmitting a code determined in accordance with the position in which the operation of said switches was interrupted, code responsive means, selecting means at said remote point operated by said code responsive
- 60 means when the code received by said code responsive means corresponds to the code transmitted and means controlled by the code responsive means through said other switch in said position to prevent operation
- 65 of said first switch in the normal position when the code received by said code responsive means corresponds to the transmitted code.
6. In combination, a pair of step-by-step selector switches, each of said switches having a normal position and a plurality of other positions, a plurality of control devices, means responsive to operation of any control device for synchronously operating
- 70 said switches through said positions, a plurality of circuits including corresponding contacts on each of said switches and the corresponding control device, means including said circuits for interrupting the operation of said switches in a position corresponding
- 75 to the operated control device and after a predetermined interval causing one of said switches to again operate, means for transmitting a code determined in accordance with the position in which the operation
- 80 of said switches was interrupted, code responsive selecting means, and means operable upon failure of said code responsive means to effect a selection corresponding to the operated unit to actuate said other selector switch to another position thereby to
- 85 interrupt said circuit through said operated control device whereby said switches again operate synchronously through said positions.
- 90 7. In combination, a pair of step-by-step selector switches, each of said switches having a normal position and a plurality of other positions, a plurality of control devices, means responsive to operation of any
- 95 control device for synchronously operating said switches through said positions, a plurality of circuits including corresponding contacts on each of said switches and the corresponding control device, means including
- 100 said circuits for interrupting the operation of said switches in a position corresponding to the operated control device and after a predetermined interval causing one of said switches to again operate, means for transmitting
- 105 a code determined in accordance with the position in which the operation of said switches is interrupted, code responsive means, means controlled by the code responsive means through said other switch in said
- 110 position to prevent operation of said first switch in the normal position, and means operable upon failure of said code responsive means to affect a selection corresponding
- 115 to the operated control device to actuate said other selector switch to another position thereby to interrupt said circuit through said operated control device whereby said switches again operate synchronously
- 120 through said positions.
- 125 8. In combination, a pair of step-by-step selector switches, each of said switches having a normal position and a plurality of other positions, a plurality of control devices, means responsive to operation of any
- 130

control device for synchronously operating said switches through said positions, a plurality of circuits including corresponding contacts on each of said switches and the corresponding control device, means including said circuits for interrupting the operation of said switches in a position corresponding to the operated control device and after a predetermined interval causing one of said switches to again operate, means for transmitting a code determined in accordance with the position in which the operation of said switches was interrupted, code responsive selecting means, means for preventing operation of said first switch in the normal position, in response to operation of said code responsive means to effect a selection corresponding to the operated control device, whereby upon failure of said code responsive means to effect said selection said one switch continues to operate and said code is retransmitted, and means operable after said code has been retransmitted to operate said other switch to a different position thereby to interrupt said circuit through said operated control device whereby said switches again operate synchronously through said positions.

In witness whereof, we have hereunto set our hands this 21st day of May 1930.

WALDEMAR BRÜCKEL.

RUDOLF KÖBERICH.