

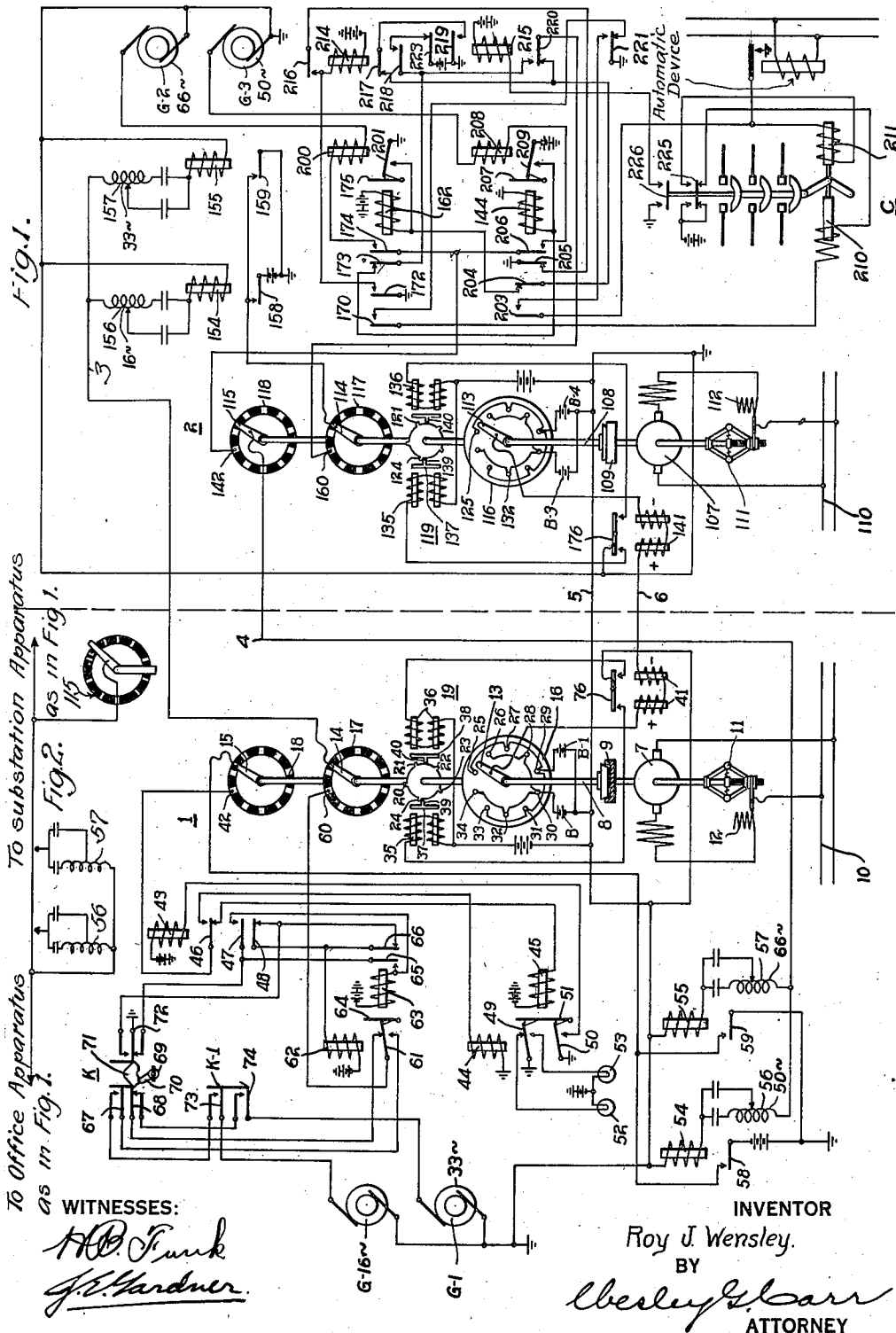
May 28, 1929.

R. J. WENSLEY

1,714,967

SUPERVISORY CONTROL SYSTEM

Filed April 8, 1924



To Substation Apparatus

To Office Apparatus

Fig. 2. as in Fig. 1.

as in Fig. 1.

WITNESSES:

H.B. Funk
J.E. Gardner

J. E. Gardner

INVENTOR

Roy J. Wensley.

BY

Chester G. Barr
ATTORNEY

ATTORNEY

Patented May 28, 1929.

1,714,967

UNITED STATES PATENT OFFICE.

ROY J. WENSLEY, OF EDGEWOOD, PENNSYLVANIA, ASSIGNOR TO WESTINGHOUSE ELECTRIC & MANUFACTURING COMPANY, A CORPORATION OF PENNSYLVANIA.

SUPERVISORY CONTROL SYSTEM.

Application filed April 8, 1924. Serial No. 704,997.

My invention relates to supervisory control systems and particularly to systems for controlling, from a central point or dispatcher's office, remotely-disposed power apparatus.

One object of my invention is to provide improved signalling means for supervisory control systems that employ synchronously-moving devices at the dispatcher's office and at a remotely-disposed station. The means for controlling the synchronously-moving devices are the subject of claims in my copending application Serial No. 293,563, filed July 18, 1928, and assigned to the assignee of this application.

Another object of my invention is to provide means for rendering it impossible for the dispatcher to inadvertently control an apparatus unit.

Another object of my invention is to provide means at the remote station for signalling to the dispatcher all operations of the apparatus units under supervision, even though such operations occur before the selective apparatus has had time to function.

Another object of my invention is to provide improved mechanical locking means for maintaining the signalling devices at the dispatcher's office and the control relays at the station in their operated positions, even though the battery that supplies the current for these devices is disconnected and reconnected.

A further object of my invention is to provide means whereby one signalling circuit may be employed to send signals to the station to control the apparatus units therein and the same signalling circuit may be used for returning answer-back signals to the dispatcher's office.

The above and other objects of the invention will be hereinafter described in conjunction with the accompanying drawing.

In practicing my invention, I provide a selecting device or a "sunflower" at both the dispatcher's office and station. Control circuits are also provided for operating the "sunflowers" in synchronism with respect to each other. In addition, at the dispatcher's office, a plurality of double-throw keys are provided, one for each apparatus unit at the station that it is desired to control. Further, a plurality of signalling devices are employed, two for each apparatus unit that it is desired to supervise. Also, at the dispatcher's

office are sources of alternating currents of different frequencies, mechanically locking relays for controlling the operation of the signalling devices and wave filters and relays that control the mechanically locking relays. At the substation, mechanically locking relays are provided for controlling the operation of the apparatus units. In addition, sources of alternating currents of different frequencies and wave filters and controlling relays are also provided.

Referring now to the drawing,

Fig. 1 is a circuit diagram of the apparatus and circuits employed in the preferred embodiment of my invention.

Fig. 2 is a modification of Fig. 1. Sufficient apparatus and circuits have been shown by means of the conventional diagrams to enable my invention to be readily explained and understood.

The apparatus in Fig. 1 located on the left of the dotted line is that at the dispatcher's office, while the apparatus located on the right is that at the station.

In general, the operation of my invention proceeds as follows: By the control circuits previously mentioned, the selecting devices or "sunflowers" at the dispatcher's office and station are operated in synchronism. When the dispatcher desires to control a particular apparatus unit, he will operate the key corresponding to that unit at the office and also the common control key. By the operation of the control key and the key associated with the predetermined unit, when the "sunflowers" are in a predetermined position, alternating current of a predetermined frequency will be connected to the signalling circuit and will actuate a relay at the station. The relay at the station that is operated is connected in circuit with the wave filter that is resonant to the particular frequency of alternating current applied.

The operation of the relay at the substation completes a circuit for operating one of the mechanically locking relays to control the apparatus unit. By the operation of the apparatus unit, circuits are prepared whereby, when the "sunflowers" are in another predetermined position, signalling current from one of the alternating-current sources at the station will be applied to the signalling circuit. This signalling current operates a relay in circuit with the wave filter at the office, the wave filter being resonant to the

particular frequency of alternating current applied.

The operation of the relay at the office causes the operation of one of the mechanically locking relays to change the supervisory signals to indicate the operation of the apparatus unit at the substation. The operation of the mechanically locking relays also opens the control circuit, thereby rendering it impossible for the dispatcher to again control such apparatus unit in the same direction. This last statement holds true even if automatic devices at the station function to control the apparatus unit in an opposite manner.

To operate again the apparatus unit, the despatcher must restore the particular key associated with that unit to its opposite position and reoperate it, that is, the operation of the particular key associated with the unit must follow the operation of the apparatus unit itself, in order that it will be effective to control the operation.

Referring now to the drawing, the "sunflowers" 1 and 2 at the dispatcher's office and station are connected together by means of trunk conductors 3, 4, 5 and 6. The "sunflower" 1 is provided with a motor 7 that rotates a shaft 8 through the medium of a clutch 9. The speed of the motor 7 is regulated by the voltage from the current source 10 and by a centrifugal governor 11 attached to the motor. The centrifugal governor 11 varies the resistor 12 in the motor circuit. The shaft 8 rotates brushes 13, 14 and 15 over contact segment groups 16, 17 and 18, respectively. The shaft 8 also carries a stopping device 19 having five projections or knobs 20 to 24, inclusive, thereon.

The contact segment group 17 is made up of a number of conducting and non-conducting segments. The contact segment group 18 is constructed in a manner similar to the group 17. The contact segment group 16 is made up of ten conducting segments 25 to 34, inclusive. These segments are adapted to connect the batteries B and B—1 alternately in circuit with the brush 13 for a purpose to be described.

Magnets 35 and 36 are associated with the stopping device 19 and carry armatures 37 and 38, respectively. The armature 37 carries a projection 39 which is positioned in the path of the stops, such as 20. The armature 38 likewise carries a projection 40 that is positioned in the path of the stops, such as 20. The magnets 35 and 36 are relatively positioned so that, when the projection 39 engages the stop 24, the stop 40 will be midway between the projections 21 and 22. By this arrangement, the projections 37 and 38 are alternately effective to arrest the rotation of the shaft 8.

The circuits of the magnets 35 and 36 are controlled by a polarized relay 41. The conducting segments of the contact segment

group 15 are connected to controlling relays in the same manner that conducting segment 42 is connected through an armature of a relay 43 to relays 44 and 45. The relay 43 is of the ordinary type and is adapted to operate armatures 46, 47 and 48. The relay 44 controls armatures 49 and 50. The relay 45 carries an armature 51 that is adapted to maintain the armatures 49 and 50 of the relay 44 in operative position when retracted. The armature 49 of the relay 44 controls signalling devices 52 and 53. The relays 44 and 45 are controlled, through the action of the brush 15 and the conducting segment 42, by relays 54 and 55 connected in circuit with wave filters 56 and 57. The relays 54 and 55 are alternating-current relays and respectively control armatures 58 and 59. The wave filters 56 and 57 are resonant to predetermined frequencies of alternating current, such as, for example, 50 and 66 cycles, respectively.

The conducting segments of the segment group 17 extend to control relays in the same manner as the conducting segment 60 extends to an armature 61 of a relay 62. The relay 62 is of the usual type. A relay 63 is associated with the relay 62 and controls an armature 64 that is adapted to lock the armature 61 of the relay 62 in an operated position. In addition, the relay 63 controls armatures 65 and 66.

The armature 61 of the relay 62 is adapted to control the connection of springs 67 and 68 of a key K. The key K is of a two-position type and may be termed a twist key. The construction of the key K is such that, when a handle 69 is rotated, an operating member 70 causes a bushing 71 to operate the springs 67, 68 and 72. When the handle 69 of this key is again rotated, the springs 67, 68 and 72 are released.

A key K—1 is common to all the keys, such as K. The key K—1 is of an ordinary type of a single-throw key and is adapted to operate springs 73 and 74 into engagement with their working contacts. The spring 73 of the key K—1 is connected to a generator G that generates an alternating current of predetermined frequency, viz, 16 cycles, while the spring 74 of the key K—1 is connected to a generator G—1 that generates an alternating current of a frequency of 33 cycles.

The apparatus at the station is very similar to the apparatus at the dispatcher's office. The "sunflower" 2 comprises a motor 107, a clutch 109 and a shaft 108. The motor 107 is controlled by the voltage of current source 110 and by the operation of the governor 111 varying the resistor 112 in circuit with the motor. Brushes 113, 114 and 115 are rotated over the contact segment groups 116, 117 and 118.

The "sunflower" 2 is constructed in identically the same manner as the "sunflower" 1

and the corresponding parts of the "sunflower" 2 have been numbered 100 higher than the parts of the "sunflower" 1 to facilitate the explanation.

Relays 154 and 155 are associated with the signaling conductor 3 in circuits including wave filters 156 and 157 that are resonant to predetermined frequencies of alternating current, such as, for example, 16 cycles and 33 cycles, respectively. The relays 154 and 155 are alternating current relays and are adapted to control, through the medium of the "sunflower" brush 114 and a segment such as 160, relays such as 162 and 144.

The relay 162 is provided with armatures 170, 172, 173, 174 and 175. The armature 175 is so positioned with respect to a relay 200 that an armature 201 of the relay 200 is adapted to be held in operated position by the armature 175. In a like manner, the relay 144 is provided with armatures 203, 204, 205, 206 and 207, the armature 207 being so positioned with respect to a relay 208 that an armature 209 thereof is held in operated position by the armature 207.

The relay 162 controls the closing coil 210 of a circuit breaker C, while the relay 144 controls the opening coil 211 of the circuit breaker C. The circuit breaker C is of the usual type and is adapted to perform any desired function at the substation. Relays 214 and 215 are provided, respectively, with armatures 216, 217 and 218 and 219, 220, 221 and 223. A generator G—2 is adapted to generate an alternating current of predetermined frequency, such as 66 cycles, while a generator G—3 is adapted to generate an alternating current of another predetermined frequency, such as 50 cycles.

In view of the fact that alternating current is used for signalling, it is evident that, instead of the two signalling conductors shown in Fig. 1, a single conductor could be used, all the signalling frequencies being different. This is shown in the modification in Fig. 2 in which the lead from brush 115 and the lead from filters 56 and 57 are connected to line 3.

Having described the apparatus shown in the drawing, I will now explain its detailed operation. As mentioned before, the motors 7 and 107 are energized from sources of direct current 10 and 110. These motors are adapted to run at substantially the same speed and to drive or rotate the brushes 13 to 15, inclusive, and the brushes 113 to 115, inclusive. By the synchronizing circuit to be described, the brushes 13 to 15, inclusive, are rotated synchronously with the brushes 113 to 115, inclusive. These respective sets of brushes occupy the same relative position with respect to any particular segment in the segment groups at the same time.

The speed of the motor 107 is adjusted to be slightly faster than the speed of the motor 7. Thus, the motor 7 may be termed the con-

trolling motor. The motors 7 and 107 are each provided with governors 11 and 111 by which they are maintained operating at substantially the same speed.

In the normal operation of the system, the brush 13 will engage the segment 25 slightly behind the brush 113 engaging the segment 125. At this time, a knob 124, carried by a stopping device 119, engages a projection 139 on an armature 137. The engagement of the projection 137 with the knob 124 momentarily arrests the movement of the brushes 113 to 115, inclusive, the clutch 109 permitting the movement of the shaft 108 to be arrested with the motor 107 operating. In this position of the brushes 113 to 115, inclusive, the brush 113 will be in engagement with the segment 125.

At the dispatcher's office, when the brushes 13 to 15, inclusive, are rotated to this same relative position, the projection 39 will engage the knob 24 and the movement of the brushes 13 to 15, inclusive, will be momentarily arrested. Simultaneously, the brush 13 will be in engagement with the contact 25 and a circuit will be completed extending from the negative pole of the battery B—1 by way of segment 25, brush 13, winding of polarized relay 41, trunk conductor 6, winding of polarized relay 141, brush 113, segment 125, positive pole of battery B—4, trunk conductor 5 and to the positive pole of the battery B—1. It will be seen that the current flow over this circuit is such that the batteries B—1 and B—4 assist each other and the flow is in given directions.

The polarized relays 41 and 141 are thus energized to cause the armatures 76 and 176 to engage their front left-hand contacts. As a result of this operation, a circuit is completed at the dispatcher's office extending from battery by way of armature 76 and its left-hand contact and winding of release magnet 35 to battery. The release magnet 35 operates the armature 37 to withdraw the projection 39 from the path of the knob 24, thereby permitting the brushes 13 to 15 to be rotated.

Simultaneously, at the substation, a circuit is completed extending from battery by way of armature 176 and its front left-hand contact and winding of release magnet 135 to battery. The release magnet 135 is operated to attract the armature 137, thereby withdrawing the projection 139 from the path of the knob 124 and permitting the brushes 113 to 115 to be rotated.

The brushes 13 to 15 inclusive, are now rotated by the motor 7 until the projection 38 engages the knob 21, whereupon the rotation of the brushes ceases. In a like manner, at the substation, the brushes rotate until they are stopped by the operation of the projection 140 engaging the knob 121. The polarized relays 41 and 141 are now operated by the batteries B and B—3 to operate their ar-

matures in the opposite direction, thereby operating the release magnets 36 and 136.

The synchronizing operation, in the event that the brushes 113 to 115, inclusive, lag behind the brushes 13 to 15, inclusive, is similar to that above described with the exception that the brushes 13 to 15, inclusive, are those first stopped by the operation of the stopping device 19.

In the above manner, the brushes 13 to 15, inclusive, and the brushes 113 to 115, inclusive, are operated in synchronism.

To describe the manner in which the dispatcher controls an apparatus unit, it will be assumed that the dispatcher desires to close the circuit breaker C. The dispatcher will operate the handle 69 of key K so as to release the springs 67, 68 and 72. These springs are then in the position shown in the drawing. The dispatcher will now operate the common control key K—1.

When the brushes 14 and 15 are in engagement with the conducting segments 60 and 42, the brushes 114 and 115 at the substation will be in engagement with the segments 160 and 142. A circuit is now completed extending from the ungrounded brush of the 33 cycle generator G—1, spring 74 and its working contact, resting contact of spring 68 and said spring, front contact and armature 61, segment 60, brush 14, trunk conductor 3, wave filters 156 and 157 and relays 154 and 155 in parallel to ground.

As the wave filter 157 is resonant to the particular frequency of alternating current applied, the alternating-current relay 155 is operated and, by such operation, a circuit is completed extending from ground by way of armature 159 and its front contact, brush 114, segment 160, armature 220 and its back contact, armature 204 and its back contact and winding of relay 162 to battery.

The relay 162 is energized over the above circuit and operates to release the armature 201, thereby completing a locking circuit for itself. The relay 162, upon operating, also completes a circuit for the relay 214 at armature 172, opens one point in the circuit of the relay 144 at armature 173, and at armature 170 completes a circuit extending from ground by way of armature 221 and its back contact, front contact and armature 170, winding of closing coil 210, and pallet switch 225 to battery.

The closing coil 210 operates to close the circuit breaker C. The operation of the circuit breaker C may perform any desired function. A pallet switch 226 on the circuit breaker C completes a circuit for the relay 215. The relay 215 operates to open the original energizing circuit of the closing coil 210 at armature 221, to complete another circuit for the relay 162 at armature 219, and to prepare a circuit at armature 221 for the tripping coil 211 of the circuit breaker.

Another circuit completed by the operation of the relay 162 extends from the ungrounded brush of the 66 cycle generator G—2, winding of alternating current relay 200, front contact and armature 174, segment 142, brush 115, trunk conductor 4, wave filters 56 and 57, and relays 54 and 55 in multiple to ground. The wave filter 57 is resonant to the particular frequency of alternating current applied and the relay 55 is operated.

Another circuit is completed extending from ground by way of armature 59 and its front contact, brush 15, segment 42, armature 46 and its back contact and winding of relay 45 to battery. The relay 45 operates to attract the armature 51, thereby extinguishing the signalling device 52 and lighting the signalling device 53 at armature 49 and, at armature 50 completing a circuit for the relay 43. The relay 43 operates to open the circuit of the relay 45, thereby permitting this relay to be deenergized at armature 46, at the front contact of this armature to prepare a circuit for the relay 44 and, at armature 47, to complete a circuit extending from ground by way of spring 72 and its resting contact, armature 47 and its front contact and winding of relay 63 to battery.

The relay 63 is operated to establish a locking circuit for itself from battery, winding 63, armature 65, spring 72 of key K to ground, to open one point in the energizing circuit of the relay 62 at armature 66 and to operate the armature 64 to permit the armature 61 to be restored. By the restoration of the armature 61, the previously traced controlling circuit, extending from the 33 cycle generator G—1, is opened.

By the operation of the "sunflower" brushes, the previous signalling circuit is opened and the relay 155 at the substation is deenergized to open one point in the circuit of the relay 162. By the change in supervisory signals, the dispatcher is apprised of the operation of the circuit breaker C.

The relay 200 at the substation is energized in series with the relay 55 at the dispatcher's office. The relay 200 operates to open the locking circuit of the relay 162. The relay 162 releases its armatures, thereby opening the previously traced circuit for the relays 55 and 200. By the retraction of the armature 175 of the relay 162, the armature 201 is maintained in operated position.

It will be seen that no further controlling current is sent to the substation by reason of the key K being operated as the relay 62 is released.

It will now be assumed that the circuit breaker C trips under the control of the associated automatic devices at the substation. As a result of this operation, the circuit of the relay 215 is opened and this relay is deenergized.

A circuit is now completed extending from battery by way of armature 223 and its back contact, front contact and armature 218, armature 173 and its back contact and winding of relay 144 to ground. The relay 144 operates to attract the armature 207, thereby establishing a locking circuit for itself by releasing the armature 209, to complete a signalling circuit at armature 206, to open the locking circuit of the relay 214 at armature 205, to open one point in the circuit of the relay 162 at armature 204, and to prepare a circuit for the tripping coil 211 at armature 203.

The previously mentioned signalling circuit extends from the ungrounded brush of the 50 cycle generator G—3, winding of alternating current relay 208, front contact and armature 206, segment 142, brush 115 when it engages this contact, trunk conductor 4, wave filters 56 and 57 and relays 54 and 55 in multiple to ground. The relay 54 is energized over this circuit and a circuit is completed extending from battery by way of armature 58 and its front contact, brush 15, segment 42, armature 46 and its front contact and winding of relay 44 to ground.

The relay 44 is energized over the above circuit to extinguish the lamp 53 and to light the lamp 52 at armature 49, and to open the circuit of the relay 43. The armatures of the relay 44 are locked in operated position by reason of the fact that the relay 45 is deenergized. The relay 43 is deenergized to prepare a circuit for the relay 45 at armature 46, to open the original energizing circuit of the relay 63 at armature 47, and to prepare a circuit for the relay 62 at armature 48. By the change in supervisory signals, the dispatcher is apprised of the automatic operation of the circuit breaker C.

The relay 208 at the substation is energized over the above traced signalling circuit and operates to open the locking circuit of the relay 144 at armature 209. The relay 144 is deenergized to maintain the armature 209 in operated position, to open the signalling circuit at armature 206, to prepare a circuit for the relay 162 at armature 204 and to open one point in the tripping circuit at armature 203.

Attention is directed to the fact that, even though the supervisory signalling devices have changed, the dispatcher is not able to again close the circuit breaker C by reason of the fact that the armature 61 of the relay 62 is in a retracted position and the signalling circuit from the 33 cycle generator G—1 is opened at armature 61. In order to be able to control this circuit breaker, it is necessary for the dispatcher to operate the key K to operate the springs 67, 68 and 72. In this manner accidental closing of the circuit breaker is prevented. By the operation of the spring 72, the locking circuit of the relay 63

is opened and a circuit is completed for the relay 62 from ground 72, upper contact, armature 66, winding 62, battery to ground. The relay 62 now attracts the armature 61, which is maintained in its operated position. After doing this, the dispatcher may close the circuit breaker C by so releasing the key K as to release the springs 67, 68 and 72, and then operating the control key K—1. After these operations, the closing of the circuit breaker C takes place in the same manner as before described.

In the event that the dispatcher desires to trip the circuit breaker C, he will so operate the key K as to operate the springs 67, 68 and 72. As a result of this operation, controlling current from the 16 cycle generator is sent over the controlling circuit and the relay 154 at the substation is operated. The operation of the relay 154 completes a circuit for the relay 144. The relay 144 operates to complete a circuit for the tripping coil 211 of the circuit breaker C at armature 203, to open one point in the circuit of the relay 162 at armature 204, to open the locking circuit of the relay 214 at armature 205, to complete a signalling circuit at armature 206 and to complete a locking circuit for itself at armature 209. The signalling circuit includes the alternating-current relay 208 and the relay 54 at the dispatcher's office. The relays 54 and 208 perform the same functions as above described, and the apparatus is restored to normal in substantially the same manner as before described.

In the event that the circuit breaker C is closed under automatic control, the dispatcher is apprised of such operation by the energization of the relays 215 and 162, in the manner as outlined above.

It sometimes occurs that, after the dispatcher closes the circuit breaker at the substation, under overload conditions, such breaker will be immediately tripped by the action of the automatic overload or other automatic devices associated with it. Under such conditions, it is desirable that the dispatcher obtain an indication of such operation. The manner in which this result is brought about has been described hereinbefore and will be but briefly outlined. The relay 162 is controlled from the dispatcher's office to cause the operation of the circuit breaker C and to send out the signalling current from generator G—2 to operate the relay 55 and to light the lamp 53 at the dispatcher's office. When the circuit breaker C trips under automatic control, the relay 144 is energized and signalling current from the generator G—3 is sent to the dispatcher's office, whereby the relay 54 is operated. The operation of the relay 54 causes the operation of the relay 44 and the consequent change in supervisory signals.

It will be understood, of course, that the cir-

cuit operations described occur upon successive cycles of the brushes 13 to 15, inclusive, and the brushes 113 to 115, inclusive, of the "sunflowers" or distributors 1 and 2.

5 It is obvious that, while, in the present case, two signalling circuits have been used, that is, those circuits including the conductors 3 and 4, but one signalling circuit may be used, and it is possible to accomplish the desired
10 results by the use of one conductor inasmuch as different frequencies of alternating current are used in connection with wave filters and alternating-current relays to secure differentiation in, or selection of, the devices to
15 be operated.

My invention is not limited to the particular arrangement of the apparatus illustrated, but may be variously modified without departing from the spirit and scope thereof, as
20 set forth in the appended claims.

I claim as my invention:

1. In an electrical control system, comprising a dispatcher's office, a station and apparatus units in said station, a first distributor at
25 said office, a second distributor at said station, a signalling circuit extending from said office to said station, and signalling devices at said office, the combination with means for operating said two distributors in synchronism, of means including said distributors for
30 selecting one of said signalling devices, a source of current, means operative when the said signalling device is selected, dependent upon the condition of one of said units, for
35 applying said source of current to said signalling circuit, and means dependent upon the continuity of the signalling circuit for disconnecting said source of current from said circuit.

40 2. In an electrical control system, comprising a dispatcher's office, a station, a first distributor at said office, a second distributor at said station, a signalling circuit extending from said office to said station, and signalling
45 devices at said office, the combination of means for operating said two distributors in synchronism, means including said distributors for selecting one of said signalling devices, a source of current, means operative when the
50 said signalling device is selected for applying said source of current to said signalling circuit, and means dependent upon the continuity of the signalling circuit for disconnecting said source of current from said
55 circuit.

3. In an electrical control system, the combination with a dispatcher's office, a station and apparatus units in said station, signalling
60 devices at said office, a distributor at said office and a distributor, at said station, of brushes for said distributors, means whereby one distributor maintains the second distributor in synchronism with itself, means
65 including said distributors for operating said signalling devices only when one of said

apparatus units has changed condition, and means operative if said apparatus unit changes condition twice during one revolution of said brushes for operating said signalling devices at said station to indicate
70 such changes.

4. In a supervisory control system, a first station, a second station, apparatus units at said second station, operating means individual thereto at said first station each having
75 a plurality of positions, synchronously rotating distributors at said first and said second stations for consecutively associating each of said apparatus units with its individual operating means, means responsive to
80 the operation of one of said operating means to one of its positions for operating its individual apparatus unit and means responsive to the operation of said apparatus unit for invariably rendering said operating means in-
85 effective while maintained in its operated position for further operation of said apparatus unit.

5. In a supervisory control system, a first station, a second station, automatically operable circuit breakers at said second station, controlling power circuits, means controlled
90 by said power circuits at said second station for automatically operating a circuit breaker, synchronous selectors at said first and said
95 second stations, means including said synchronous selectors for selectively closing said circuit breakers, and means at said first station for rendering said last-mentioned means inoperative to operate said circuit breakers
100 during a short-circuit on said power system.

6. In a supervisory control system, a first station, a second station, automatically operable circuit breakers at said second station, controlling power circuits, means responsive
105 to a short circuit in one of said power circuits for automatically operating a circuit breaker, synchronous distributors at said first and said second stations, means including said synchronous distributors for selectively closing
110 said circuit breakers, and means at said first station for rendering said last-mentioned means inoperative to operate said circuit breaker during a short-circuit on said power system.
115

7. In a supervisory control system, a first station, a second station, apparatus units at said second station, each being operable to a plurality of positions, signalling devices individual thereto at said first station, syn-
120 chronous apparatus at said first and said second station for selectively associating each of said apparatus units with its individual signalling device and means for transmitting a signal for each of a plurality of operations
125 of any one apparatus unit which take place during a single cycle of said synchronous selector operation.

8. In a supervisory control system, a first station, a second station, apparatus units at
130

said second station operable to a plurality of positions, means for operating each of said units to one of its positions, means for operating each of said units to its other position, means at said first station for selectively operating one of said first or said second mentioned means and means operative following the operation of either said first or said second means for rendering the other of said means of said unit momentarily ineffective.

9. In a supervisory control system, a first station, a second station, a plurality of apparatus units at said second station; each of said apparatus units being operable to a plurality of positions, an operating key individual to each of said apparatus units at said first station, each of said operating keys having a position for each of the operative positions of its individual apparatus unit, synchronously rotating distributors at each of said stations, a source of energy at said first station conditioned in response to the operation of one of said keys for transmitting energy of a predetermined character to said second station, a master key common to all of said keys for rendering operative the conditioned source of energy and means including said selector at said second station responsive to said energy for operating the apparatus unit individual to said operated key to a position individual to the operated position of said key.

10. In a supervisory control system, a first station, a second station, a plurality of apparatus units at said second station, each having a plurality of positions, an operating key individual to each of said apparatus units and each operable to a position for each position of its associated unit, a signalling line connecting said stations, a rotating distributor means for sequentially associating each of said keys to said signalling line, a source of energy conditioned for being impressed upon said signalling line in response to the operation of one of said keys to a predetermined position, a master key common to said keys for impressing said energy on said signalling line when said distributor means has associated the operated key with said line and means at said second station responsive to said energy for operating the associated apparatus unit.

11. In a supervisory control system, a first station, a second station, a signalling line connecting said stations, a plurality of apparatus units at said second station each having a plurality of positions, an operating key individual to each of said apparatus units and each operable to a position for each operated position of its associated apparatus unit, a distributor for sequentially associating each of said keys with said signalling line, a master key common to all said keys having a normal and operated position, means including a source of energy con-

ditioned for being impressed upon said signalling line in response to the operation of one of said keys to a predetermined position, said means being operative to impress said energy on said signalling line when said common master key has been operated to its operative position and said distributors have reached a position individual to said operated key, a distributor at said second station, a common means at said second station connected to said signalling line, an operating means individual to each of said apparatus units for controlling the operation of said units to a plurality of positions, said operating means being sequentially associated with said common means through said distributor at said second station simultaneously with the association of the associated key with said signalling line, said common means being responsive to the energy transmitted over said signalling line for operating the associated operating means, and means responsive to the operation of operating means for operating the apparatus unit individual to the operated key.

12. In a supervisory control system, a first station, a second station, apparatus units at said second station, an operating key individual to each of said apparatus units at said first station, rotating selectors at each of said stations, means responsive to the operation of any one of said keys including said selectors for selectively operating the associated apparatus unit, means for automatically operating said apparatus unit and means at said first station responsive to the automatic operation of said apparatus unit for rendering its associated key non-operative to restore said unit.

13. In a supervisory control system a first station, a second station, a plurality of apparatus units each operable to a plurality of positions, operating keys for each of said apparatus units, said operating keys being operable to a plurality of positions, means responsive to the operation of any one of said keys to one of its positions for operating its associated apparatus unit to a predetermined position, said means including synchronously rotated selectors at each of said stations, means at said second station for operating said apparatus unit automatically to its original position and means at said first station responsive to said automatic operation for rendering said key non-operative to again operate its associated unit to its operated position.

14. In a supervisory control system, a first station, a second station, a plurality of apparatus units at said second station, selectors at each station for selectively controlling said units from said first station, each of said apparatus units having an operated position to which it may be operated, a key individual to each of said apparatus units, each of said keys

having a plurality of positions, means responsive to the operation of any one of said keys to one of its positions for transmitting energy from said first to said second station, said
 5 means including said rotating selectors, means at said second station responsive to said energy for operating the associated apparatus unit to its operated position, means at
 10 said second station for automatically operating said apparatus unit to its original position and means at said first station responsive to said automatic operation of said apparatus unit for rendering said key when it is in
 15 its operated position, ineffective to reoperate said apparatus unit to its operated position.

15. In a supervisory control system, a first station, a second station, a plurality of apparatus units at said second station, each of said apparatus units having an operated position
 20 to which it may be operated, rotating selectors for providing selective control of said units from said first station, a key individual to each of said apparatus units, each of said keys having a plurality of positions, means
 25 responsive to the operation of any one of said keys to one of its positions for transmitting energy from said first to said second station, said means including said selectors, means at said second station responsive to
 30 said energy for operating the associated apparatus unit to its operated position, means at said second station for automatically operating said apparatus unit to its original position, means at said first station responsive
 35 to said automatic operation of said apparatus unit for rendering said key when it is in its operated position, ineffective to reoperate said apparatus unit to an operated position and means responsive to the operation of said key
 40 to its alternate position for operating said automatic responsive means to again render said key operative when in its operative position to reoperate said apparatus unit to its
 45 operative position.

16. In a supervisory control system, a first station, a second station, a signalling line con-

necting said stations, rotating selectors at each of said stations, apparatus units each having an original position and an operative position, an operating key individual to each
 50 of said apparatus units, each having a plurality of positions, means including the selector at said first station, responsive to the operation of any one of said keys to one of its positions for impressing energy on said signalling line at said second station, means including the second-station selector, responsive to said energy for operating the associated apparatus unit to its operated position,
 55 means for automatically operating said apparatus unit and means at said first station responsive to said automatic operation of said apparatus unit for rendering said key non-effective to impress further energy on said line.
 60

17. In a supervisory control system, a first station, a second station, a plurality of apparatus units at said second station, rotatable selectors at each station for providing selective control of said units, an operating key
 70 individual to each of said apparatus units at said first station, said operating key having a plurality of positions, means at said first station responsive to the operation of any one of said keys for transmitting energy of a predetermined character over said selectors to said second station, means responsive to said energy for operating the associated apparatus unit, means at said first station responsive simultaneously to the operation of said key and jointly controlled by said key and said remotely disposed apparatus unit for rendering said key non-operative to transmit the energy of predetermined character and for simultaneously conditioning said key for
 75 transmitting energy of the opposite character for operating said apparatus unit to its original position.
 80

In testimony whereof, I have hereunto subscribed my name this 31st day of March, 1924.

ROY J. WENSLEY.