Dec. 30, 1930. R. J. WENSLEY 1,786,805

SUPERVISORY CONTROL SYSTEM

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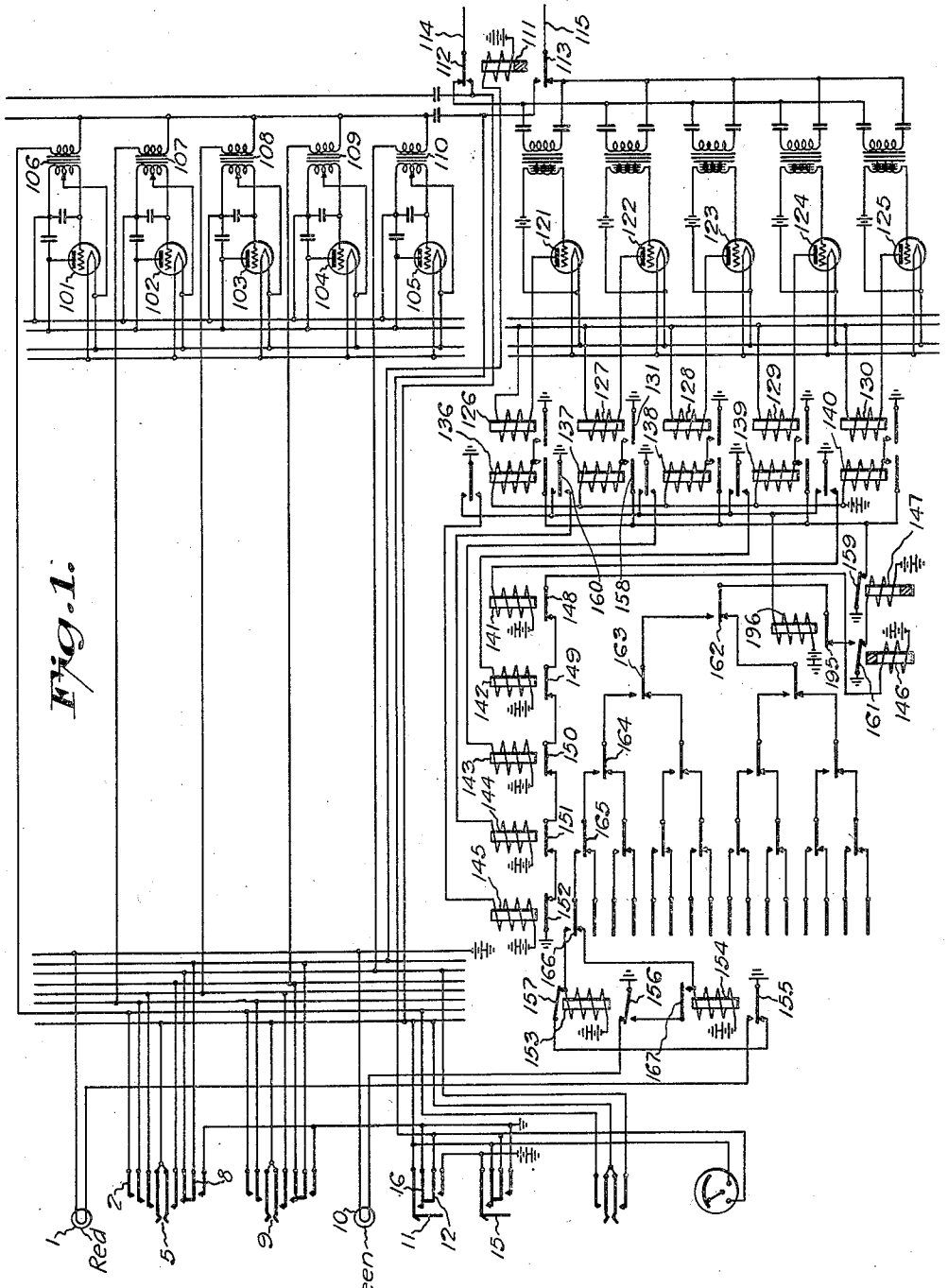



Fig. 1.

WITNESSES:

H. S. Neilson

Samuel Ostrolenk

INVENTOR

Roy J. Wensley

BY

Wesley G. Carr

ATTORNEY

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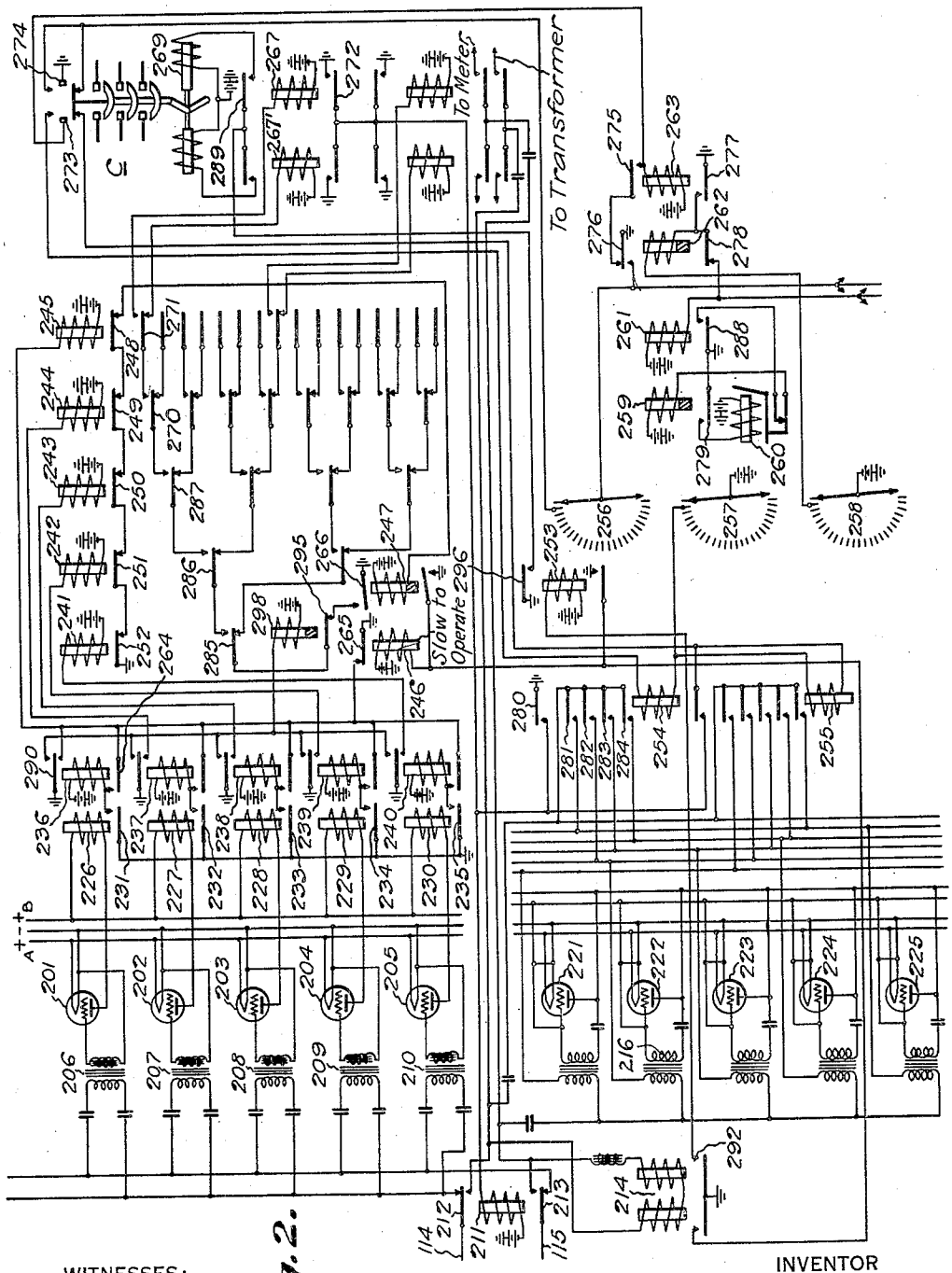



Fig. 2.

WITNESSES:

G. S. Neilson

Samuel Ostrolenk

INVENTOR

Roy J. Wensley

BY

Wesley G. Carr

ATTORNEY

Patented Dec. 30, 1930

1,786,805

# 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 August 14, 1926. Serial No. 129,167.

My invention relates to signalling systems and particularly to supervisory control systems.

An object of my invention is to provide a two conductor code selection system in which direct control and supervision is obtained.

Another object of my invention is to provide means responsive to a uniform code for remotely selecting apparatus units for operation.

Another object of my invention is to provide electronic oscillating circuits for generating alternating current voltages of different frequencies for code selection purposes in a supervisory control system.

Another object of my invention is to provide means for automatically conditioning for transmission a plurality of generators of alternating currents of different frequencies for transmitting supervisory code signals of an operated-apparatus unit to a remote point.

Another object of my invention is to provide a code operated system in which the same conductor is used for supervision and control.

Still another object of my invention is to provide code operated systems in which a single circuit connects the stations and is used for supervision, control and metering.

Another object of my invention is to provide means for automatically switching the single circuit from control to supervisory operation.

Still another object of my invention is to provide means for direct metering over a two conductor code selection supervisory control system.

There are other objects of my invention, which, together with the foregoing, will appear in the specification which follows.

It has been found that, under certain conditions, it is desirable to operate supervisory control systems by means of a uniform code, the impulses of which are preferably alternating currents. By employing a combination of impulses for making the selection, the danger of a false operation due to surge effects is considerably reduced. The use of alternating currents, further minimizes this danger, in that the receiving circuits are made responsive only to predetermined signalling frequencies, and are, therefore, not affected by the surge currents.

In such systems, it is often found necessary to perform all of the supervisory and control functions as well as metering over only two conductors. This requires the provision of means for automatically switching the line from the control to the supervisory operation, while still, at all times enabling control or supervision.

In practicing my invention I provide a dispatcher's office and a substation connected by a conductor which is normally switched to the receiving apparatus at each station and is automatically switched to the transmitter at either station by either the closing of a key at the office or the operation of a circuit breaker at the substation.

A plurality of electronic tubes, connected in oscillating circuits, are located at the office and substation each generating alternating current voltages of different frequencies and at the remote station equivalent electronic tubes placed in circuits tuned to these frequencies are made responsive thereto to operate selecting apparatus.

An arrangement is provided for switching the line at the substation following the completion of the selection operation, from the control receiver to a polar relay, which is thereafter operated over said line to either complete the selection or release the selecting apparatus without operation. This same arrangement provides line circuits, cleared of selecting apparatus for metering.

Referring now to the drawing,

Fig. 1 discloses the circuits of the control transmitter and supervisory receiver at the office, while

Fig. 2 discloses the circuits of the supervisory transmitter and control receiver at the substation.

In practicing my invention, I provide a plurality of electron tubes 101 to 105 at the office arranged to generate alternating current voltages. Electron discharge tubes 201 to 205 are in circuits tuned to these frequencies. These tubes thus respond to the transmitted frequencies to control apparatus units, such as a circuit breaker C. A simi-

lar arrangement for supervisory apparatus is provided whereby a signal lamp such as 1 is made responsive to the operation of said circuit breaker.

Referring more particularly to Fig. 1, triodes 101 to 105 are placed in oscillating circuits, each generating voltages of different frequencies. These circuits are controlled by keys such as 9 for impressing their respective alternating currents voltages upon the conductors 114 and 115. Lamps 1 and 10 are illustrative of the supervisory lamps responsive to the operation of an apparatus unit at the remote point for indicating the condition of said unit. Electron discharge tubes 121 to 125 are responsive to supervisory codes received from the remote station to operate the selecting apparatus 141 to 145 through the relays 126 to 130 for selecting a lamp individual to the code receiver.

Referring more particularly to Fig. 2, three element tubes 201 to 205 are located in circuits tuned to be responsive to the frequencies generated by the oscillators 101 to 105, for operating selecting apparatus 241 to 245 through relays 226 to 230 which, in turn, prepare for operation, a circuit breaker such as C individual to the code received.

The switches 256 to 258 function responsive to the operation of an apparatus unit as finders and start into operation the code transmitter individual to the operated unit. Relays 254 and 255 are code relays operated responsive to the operation of a circuit breaker for closing various combinations of the oscillating circuits of electron tubes 221 to 225. It should be noted that the voltages generated at the office and station are of the same frequencies. Relay 211 is responsive to a completion of a selection or operation of an apparatus unit to switch the conductors 114 and 115 from control to supervision.

Briefly, the operation is as follows:

The dispatcher, in order to perform any desired operation at the remote station, will close an individual key, such as 5. The operation of the key energizes the relay 111, thereby switching the lines 114 and 115 from the supervisory receiver 121 to 125 to the control transmitter 101 to 105. At the same time, predetermined combinations of the alternating current voltages generated by the oscillators 101 to 105 are impressed on the conductors 114, 115 connecting the office with the station.

At the station, these alternating currents are selectively applied to control the grid voltage of the electron tubes 201 to 205, in circuits tuned to these respective frequencies.

The grid voltages of these tubes are such that normally no current flows in the plate circuits. Upon receiving an alternating current which changes this grid voltage, current flows in the plate circuit. Selector relays are operated as a result to select an apparatus unit for operation.

Simultaneously, with this selection, the conductors 114 and 115 which are normally connected to the receiving tubes 201 to 205 are switched to a polar relay 214.

An impulse of a predetermined polarity is now transmitted from the office to either release or complete the selection.

Following the operation of the apparatus unit, these selector relays are restored to normal and the conductors 114 and 115 are switched to their normal position.

The operation of a circuit breaker whether automatic, or manual, as a result of the selection described above, operates the relay 211 to again switch the conductors 114 and 115 from the control receiver to the supervisory transmitter. Simultaneously, a predetermined combination of voltages of alternating current frequencies individual to the operated unit are impressed on the conductor. These operate receiver tubes at the office. In the same manner, as described in connection with the control operation, a signalling device, such as 1 or 10 is thus operated.

In order to better understand the invention, a detailed description of the operations which take place when the dispatcher closes the contacts of a key to select an apparatus unit such as C, for operation, will now be described.

It will be assumed that the dispatcher desires to close the circuit breaker C. The circuit breaker being assumed open, the relay 153 will have been previously energized by an operation similar to that which will be hereinafter described and is locked over a circuit from ground, through battery, winding of relay 153, front contact of armature 157 and back contact of armature 155 to ground. As a result of the operation of relay 153, an energizing circuit is completed for the green lamp 10 over a circuit to ground over armature 156 and its front contact, the lamp 10 and battery to ground. This lamp is thus illuminated to indicate that the circuit breaker C is opened.

The dispatcher will now close the key 5. As a result, the oscillating circuits of the electron tubes 101 to 105 are all closed to impress voltages of their frequencies upon the signalling conductors. Simultaneously, the relay 111 is energized over a circuit from ground through battery, winding of relay 111, contact 8 of the key 5, to ground. The energization of the relay 111 switches the conductors 114 and 115 from the normal connection to the supervisory receiver at the back contacts of armatures 112 and 113 to the control transmitter at the front contact of these armatures.

As a result of the closing of the secondary of the transformer 106, the tuned oscillator 101 impresses a voltage of predetermined fre-

quency upon the conductor 114, over a circuit from conductor 115, armature 113 and its front contact, the secondary winding of transformer 106, contact 2 of the switch 5, front contact and armature 112 to conductor 114. In a similar manner, the voltages of alternating current generated by the oscillating currents of electron tubes 102 to 105 are impressed upon the conductors 114 and 115. At the receiving end, the circuits of the secondaries of the transformers 206 to 210 are tuned to the frequencies generated by oscillators 101 to 105, respectively.

Since in this particular instance, voltages of all the frequencies are impressed upon the conductors, currents will flow in the secondaries of each of the transformers 206 to 210 to operate the relays 226 to 230 through the amplifiers 201 to 205.

The circuits of these tubes, as in the case of the oscillators, 101 to 105, being standard and well-known, need not be described in detail. All of the relays 226 to 230 will be energized to, in turn, complete energizing circuits for the relays 236 to 240, respectively. The energization of the relay 236 is completed over a circuit from ground, battery, winding of relay 236, front contact and armature 231 to ground. Similarly, relays 237 to 240 will be energized over the armatures 232 to 235, respectively.

As a result of the energization of relay 236, a locking circuit is completed for itself from ground, through battery and the winding of relay 236, front contact and armature 264 and back contact and armature 265 to ground. Similarly, relays 237 to 240 will be locked over their armature contacts and armature 265. The energization of the relay 236 completes an obvious energizing circuit for the relay 245. Similarly, the energization of relays 237 to 240 completes energizing circuits for the relays 244 to 241, respectively.

Attention is called at this time to the fact that the relay 247 is normally maintained energized during a non-operating condition over a circuit from ground, battery winding of relay 247, back contact and armature 248, back contact and armature 249, back contact and armature 250, back contact and armature 251 and back contact and armature 252, to ground. The energization of relay 247 maintains the operating circuit of the apparatus unit that has been selected, open at armature 266.

The function of this is to prevent a false operation, should one of the selecting relays close its armature contacts before any of the others that are energized. However upon the energization of any one of these selecting relays, which is indicative of a code having been received, the energizing circuit for the relay 247 is opened at any one of the armatures 252 to 248 and relay 247 is deenergized after an interval of time. This interval, however, is arranged to be sufficiently long to permit all of the selecting relays which have been energized to operate their armature contacts.

A circuit is then completed from ground through armature 266 and its back contact, back contact and armature 295, armature 285 and its first contact, armature 286 and its front contact, armature 287 and its front contact, armature 270 and its front contact, armature 271 and its front contact, winding of relay 267, and battery to ground.

As a result of the energization of the relay 267, an energizing circuit is completed for the relay 211 from ground over front contact and armature 272, winding of relay 211 and battery to ground. The energization of the relay 211 operates its armatures 212 and 213 to switch the line from the selecting apparatus to the operating circuit.

No further selection can now be made, since the selecting apparatus is disconnected from the conductor. The dispatcher may now either complete the operation which has been prepared by closing the contacts of the key 11 or may release the selection without an operation by the key 15.

It has been assumed, however, that the dispatcher desires to operate the apparatus unit C. He will therefore operate the key 11 to close a circuit which extends from ground, through battery, contact 12, front contact and armature 113, conductor 115, armature 213 and its front contact, the winding of the relay 214, front contact and armature 212, conductor 114, armature 112 and its front contact and contact 16 to ground.

The relay 214 will be energized and will operate its armature to close its right hand contact 292. A circuit will now be completed for the relay 253 over a circuit from ground, contact 292, winding of relay 253 and battery to ground. The energization of relay 253 completes an energizing circuit for the operating magnet of the selected circuit breaker; in this case, magnet 269.

This circuit is completed from ground by way of armature 296 and its front contact, the armature 289 and its front contact, winding of solenoid 269 and battery to ground. The energization of the operating magnet 269 will operate to close the circuit breaker C in accordance with the operation of the key at the dispatcher's office.

A further result of the energization of relay 253 is to complete an energizing circuit for the release relay 246. This relay is of the slow-to-energize type and after an interval of time sufficient to permit the circuit breaker to operate, the armature 265 will be attracted to open the locking circuits of the relays 236 to 240.

The armatures, such as 290 of relays 236 to 240, are so constructed that normally they rest between their front and back contacts

without touching either. Upon the deenergization of their respective relays, these armatures swing beyond their normal position and momentarily close an energizing circuit for the relay 298. Since the relay 298 is energized over multiple circuits, including all the armatures of relays 236 to 240, the release of any one of these relays will complete an energizing circuit for this relay. Relay 298 is energized to open the selecting circuit at its armature and contact 295, thereby preventing any false selecting operation, should any one of the selecting relays release before the others.

A further result of the deenergization of relays 236 to 240 is to deenergize the selecting relays 241 to 245.

During this period, the relay 298 is energized, as described above, and holds the selecting circuit open at the contact of armature 295. Should any one of the relays 241 to 245 cause its armature to close its back contact before any one of the other selecting relays releases its armature, no false selection can occur, since, as noted above, the selecting circuit is opened at armature 295.

As soon as the relays 241 to 245 are deenergized, the circuit for the relay 247, previously traced, is again completed. This relay energizes to open another point in the selecting circuits at the contact of armature 266. The circuit of the slow-release relay 298 being only momentarily closed, the relay is deenergized after a short interval of time to again close the contact of its armature 295.

As a result of the opening of the selecting circuits upon energization of relay 298, the intermediate relay 267 is deenergized to open the energizing circuit of the operating relay 269 at armature 289 and to open the energizing circuit of the relay 211 at armature 272. Relay 211 is deenergized to reconnect the line to the control receiver and the relay 214 is deenergized to restore its armature to its non-operating condition.

As the circuit breaker moves from its open to its closed position, the pallet switch moves to its upper contacts and in so doing will complete a circuit at the contacts 273 and 274 from ground over these contacts for the relay 263. Energization of the relay 263 operates to complete a locking circuit for itself over armature 276 and armature 275 and to prepare an energizing circuit for the relay 262 at armature 277. As a further result of the energization of the relay 263, an energizing circuit is completed for the relay 261 over a circuit from ground, battery, winding of relay 261, back contact and armature 278, and front contact and armature 277 to ground.

The energization of relay 261 completes an energizing circuit for the relay 259 over a circuit from ground, through armature 288 and its front contact, the closed contacts of the stepping magnet 260, winding of relay 259 and battery to ground.

The energization of relay 259 completes an energizing circuit for the stepping magnet 260 at armature 279. The stepping magnet 260 is energized to prepare its pawl to step the wipers 256 to 258 from their first to their second contacts and to open the energizing circuit of the slow-release relay 259. After an interval of time, the slow-release relay 259 is deenergized and opens the circuit of the stepping magnet 260.

The deenergization of the stepping magnet operates the pawl to step the wipers from their first to their second contacts. The deenergization of the stepping magnet again closes an energizing circuit for the relay 259, which, upon energization, again prepares to step the wipers for a further step and opens the energizing circuit for the relay 259. In this manner, the wipers are stepped from contact to contact. Upon reaching the second contact, in this particular instance, an energizing circuit is completed for the slow-release relay 262 including a circuit from ground over armature 277 and its front contact, winding of relay 262, the second contact of the switch 258 and its wiper and battery to ground.

The energization of the relay 262 operates to open the energizing circuit for the relay 261 at armature 278, thereby preventing further operation of the stepping magnet and at armature 276 to complete an energizing circuit for the code relay 254 over a circuit from ground by way of armature 276 and its front contact, the wiper of switch 256 and its second contact, the upper contacts of the pallet switch of the circuit breaker C, winding of relay 254, the second contact of the switch 257 and battery to ground.

The relay 254 is energized to complete an energizing circuit for the relay 211 over a circuit from ground through armature 280 and its front contact, winding of relay 211 and battery to ground.

The operation of armature 276 also interrupts at its back contact the locking circuit for relay 263, which opens armature 277 to interrupt the energizing circuit and maintains the energizing circuit for the code relay 254 at its armature 276 for a sufficient length of time to effect the sending of the supervisory code.

The energization of the relay 211 switches the line circuit from the control receiver to the supervisory sender. Closing of the contacts of the armatures 281 to 284 closes the circuits of the oscillators 222 to 225, one of said circuits, by illustration, being from the armature 213 and its front contact, through secondary of the transformer 216, the front contact and armature 281, and the front contact and armature 212 over the line connecting the stations.

In a similar manner, the circuits of the oscillators 223 to 225 are completed by the contacts 282 to 284. At the receiving end, electron tubes 121 to 125 are arranged in circuits tuned to respond to these frequencies, respectively, and operate to energize the relays 126 to 130. Electron tube 121, however, is not energized since the electron tubes 221 at the substation is not rendered effective by the operation of relay 254.

Relay 127 energizes to complete an obvious energizing circuit for the relay 137 over armature 131. In a similar manner, relays 128 to 130 energize relays 138 to 140. Relay 137 locks itself up over armature and contact 158, and armature 159. It is understood, of course, that normally, the relay 146 is energized over a circuit from ground, through battery, winding of relay 146, the armature 148 and its back contact, armature 149 and its back contact, armature 150 and its back contact, armature 151 and its back contact, and back contact and armature 152 to ground. Energization of relay 146 completes an energizing circuit for the relay 147 at armature 161 and its front contact.

The energization of the relay 137 completes an energizing circuit for the relay 144 over armature 160. In a similar manner, relays 138 to 140 close energizing circuits for the relays 143 to 141, respectively.

As previously pointed out, the relay 146 is energized over a circuit including the back contacts of all the selecting relays 141 to 145 in series. The energization of relay 146 holds the selecting circuit open at armature contact 161. Upon the energization of any one of these relays, this slow-release relay 146 deenergizes to close the selecting circuit. This arrangement prevents a false operating circuit, should one of the selecting relays energize to close its contact before any of the others.

By this means, all of the selecting relays are given sufficient time to completely operate before the selecting circuit is completed. Upon complete deenergization of relay 146, a circuit is completed from ground, over armature 161 and its back contact, back contact and armature 195 of relay 196 armature 162 and its front contact, armature 163 and its front contact, armature 164 and its front contact, armature 165 and its front contact, armature 166 and its back contact, winding of relay 154 and battery to ground. The energization of the relay 154 opens the locking circuit for the relay 153 at armature 155 and completes a locking circuit for itself over armature 167 and its front contact and armature 156 and its back contact.

A further result of the energization of relay 154 is to complete an energizing circuit for the red lamp 1 over armature 155 and its front contact. Due to de-energization of relay 153, the energizing circuit for the green lamp 10 is opened at armature 156.

When the relay 146 opens to complete the selecting circuit at its armature 161 and back contact, the locking circuit for the relay 147 is interrupted. Relay 147 then opens to interrupt the locking circuits of all the relays 136 to 140 which have been energized. Relays 136 to 140 then open to effect the de-energization of the selecting relays 141 to 145.

The armatures of the relays 136 to 140, such as armature 160 of relay 137, are so constructed that normally they rest between their front and back contacts without touching either. Upon the de-energization of the relays these armatures swing beyond their normal position and momentarily close the energizing circuit for the relay 196. Since the relay 196 is disposed to be energized over multiple circuits including all the armatures of the relays 136 to 140 which have been operated, the release of any one of the relays will complete an energizing circuit for relay 196 which opens the selecting circuit at its armature 195, thereby preventing any fake selection of the signal lamps, in the same manner as relay 298 at the substation functions to prevent a false selection of the apparatus units.

In the meanwhile, when the switch wipers have reached their second contact at the substation, it will be recalled that relay 262 was energized over switch 258 and opened the locking circuit of the relay 263 at armature 276 and the circuit of the relay 261 at armature 278. The relay 263 is deenergized and opens the energizing circuit of the relay 262 at armature 277. The relay 262 being a slow-to-release relay, does not act immediately.

After an interval of time, sufficiently long to permit the complete transmission of the code just described, the relay 262 is deenergized and opens the energizing circuit of the relay 254 at the armature 276. The deenergization of the relay 254 opens the energizing circuit of the relay 211 and the line connecting the station is again connected to the control receiver at the substation preparatory to the receipt of the next code.

Had the dispatcher, in the case just described, been desirous of releasing the apparatus without the operation, it was only necessary to operate the key 15 in the office with the result that an impulse of the opposite polarity would have been impressed upon the line 114, 115 and the polar relay 214 would have been energized to close its left-hand contact to complete an energizing circuit for the relay 246.

The energization of the relay 246 would have opened the locking circuits of the relays 236 to 240 which in turn, would have deenergized any of the selecting relays 241 to 245, thereby again completing an energiz-

ing circuit for the relay 247. The energization of relay 247 would have opened the operating circuit at armature 266 without performing an operation.

Should a circuit breaker automatically operate, as for example, circuit breaker C, the operations will be the same as that described in connection with the operation of the circuit breaker by the dispatcher. As the pallet switch moves from its lower to its upper contacts, it will complete a circuit for the relay 263, which, in turn, will prepare an energizing circuit for the relay 262 at armature 277, lock itself up at armature 275, and complete an energizing circuit for the relay 261 at armature 277.

The energization of the relay 261 completes an energizing circuit for the relay 259 which functions to periodically energize and deenergize the stepping magnet 260. The wipers of switches 256 to 258 are stepped until the second contact is reached, when the relay 254 is energized over the contacts of the pallet switch. This results in the energization of relay 211 at armature 280, thereby connecting the signalling line to the supervisory transmitter.

It will be noted from the above that the switches 256 to 258 have no normal position, remaining at rest at their last operating position.

In the event that the circuit breaker C is closed and it is desired to open the breaker, the operator may actuate the key 9 to effect this operation. When the key 9 is closed, the oscillating circuits of the electron tubes 102 to 105, only, are closed. Simultaneously the relay 111 is energized and operated to transfer the connection of conductors 114 and 115 from the supervisory receiver to the control transmitter and voltages of predetermined frequencies are transmitted to the control receiver at the substation.

Since the oscillating circuit for the tube 101 is not closed for this operation, relays 226, 236 and 245 are not operated; however, relays 227 to 230 respond to the control frequencies and effect the operation of the selecting relays 241 to 244, as hereinbefore described. In this instance, the selecting circuit, which is established when armature 266 of relay 247 closes, extends from ground through armature 266 and its back contact, armature 295, armatures 285 to 270 and their front contacts, armature 271 and its back contact, winding of relay 267′ and the battery to ground.

As a result of the energization of relay 267′, relay 211 is energized as before and the dispatcher may then effect the opening of the breaker by operating the key 11, or release the selection by operating the key 15, in exactly the same manner as described hereinbefore for effecting a closing operation of the breaker.

If the dispatcher desires to read a certain meter at the substation, he operates a particular key which causes a selection to be made at the substation in exactly the same manner as an apparatus unit is selected for operation and the relay 211 is energized to shift the conductors 114 and 115 to the meter circuit as shown in Fig. 2.

Since the connections of the conductors 114 and 115 are always shifted in response to a selecting operation, it is evident that the line is clear for use in whatever capacity required. Therefore, when a meter connection is selected, it is immediately connected through conductors 114 and 115 to the metering apparatus at the dispatcher's office.

Although I have described my invention in connection with a supervisory control system, it is understood, of course, that I do not intend to limit myself to this specific application, but only in so far as indicated in the appended claims.

I claim as my invention:

1. In a supervisory control system comprising a first station, a second station, a line connecting said stations, apparatus units at said second station, an operating circuit for each of said units, signalling devices at said first station, means for transmitting a code of impulses over said line to said second station, means at said second station responsive to said code for selecting an operating circuit of an apparatus unit individual to said code, means operated in response to said selection for switching said line to control said operating circuit, means for transmitting over said line an operating impulse from said first to said second station, means responsive to said impulse for completing the selected circuit to operate the apparatus unit individual to said selected circuit and means for transmitting a supervisory code over said switched line to operate a signalling device individual to said operated unit.

2. In a signalling system, a first station, a second station, apparatus units at said second station, a circuit individual to each of said apparatus units, means at said first station for simultaneously transmitting different combinations of a plurality of alternating currents of different frequencies, electromagnetic means responsive to said currents of different frequencies, means responsive to different combinations of said electromagnetic means for selecting one of said circuits, means for maintaining said individual circuits open during said selection, means operative following the selection of one of said circuits for closing the selected circuit, means responsive to the closing of said selected circuit for conditioning the associated apparatus unit for operation, means for transmitting an impulse from said first station to said second station, means responsive to said impulse for operating said conditioned appara-

tus unit, means for restoring said selecting means to normal and means operative during said restoring operation for maintaining all of said individual circuits open.

3. In a signalling system, a first station, a second station, a signalling line connecting said stations, a plurality of apparatus units at said second station, signalling devices individual thereto at said first station, means for generating a plurality of alternating currents of different frequencies at said second station, means individual to each of said apparatus units for conditioning various combinations of said alternating-current generating means for transmission, a finder switch having a plurality of positions, one for each of said apparatus units, means responsive to the operation of one of said apparatus units for starting said finder switch into operation, means for operating said finder switch to the position individual to said operated apparatus unit, means including said switch for operating the alternating-current conditioning means individual to said operated apparatus unit, means controlled by the alternating-current conditioning means for connecting said signalling line to said alternating-current generating means whereby said alternating currents are transmitted over said signalling line, and means at said first station responsive to said alternating currents for operating the signalling device individual to said operated apparatus unit.

4. 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, means at said first station for simultaneously transmitting over said line code combinations of impulses comprising alternating currents of different frequencies, electromagnetic means responsive to said code of alternating currents, means for locking the operated electromagnetic means, a plurality of selector magnets, means for variably operating said selector magnets in accordance with the operation of said first-mentioned electromagnetic means, selecting circuits for each of said apparatus units, means responsive to the operation of said selector magnets for conditioning one of selector circuits for operation, means for maintaining said selecting circuits open while one of said circuits is being selected, means controlled by said selectors for operating said last-mentioned means to close the selected circuit, an operating magnet, means responsive to the closing of said circuit for conditioning the associated apparatus unit for operation, said means also being operative to connect said signalling line to said operating magnet, means for transmitting a control impulse over said line from said first station and means controlled by said operating magnet for either operating said apparatus unit and restoring said locked electromagnetic means or restoring said electro-magnetic means without operating the unit depending upon the nature of the control impulse transmitted from said first station.

5. In a supervisory control system, in combination, a first and a second station, apparatus units at the second station, a control circuit connecting the stations, means at the first station for transmitting simultaneously over the control circuit different combinations of alternating currents of different frequencies, a plurality of selecting relays at the second station provided with selecting contact members connected in pyramidal relation and auxiliary contact members connected in chain circuit relation, said selecting relays being disposed when operated in different combinations to establish different selecting circuits for the apparatus units, means at the second station responsive to the different combinations of alternating currents of different frequencies transmitted over the control circuit for effecting the operation of the selecting relays in different combinations to establish selecting circuits, means controlled by the operation of the auxiliary contact members connected in chain circuit relation for controlling the selecting circuit, said means being effective after a predetermined time delay in response to the operation of any of the selecting relays to finally establish the selecting circuit, means responsive to the final establishment of the selecting circuit for conditioning the apparatus unit for operation, means for transmitting an impulse from the first to the second station, and means responsive to the impulse for operating the selected apparatus unit.

In testimony whereof I have hereunto subscribed my name this 9th day of August, 1925.

ROY J. WENSLEY.