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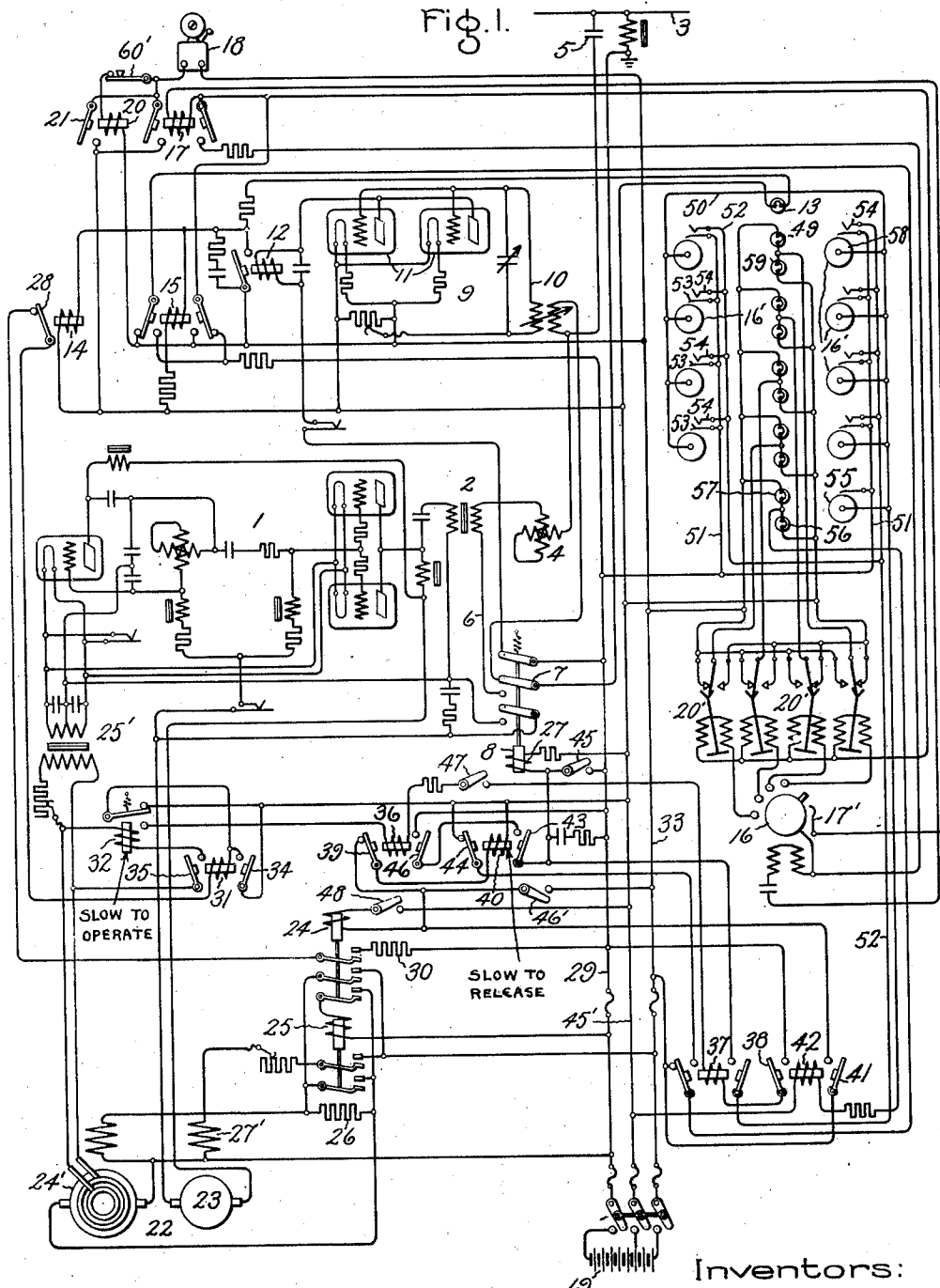
1,844,648

CARRIER CURRENT SUPERVISORY SYSTEM

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2 Sheets-Sheet 1

Fig. 1.



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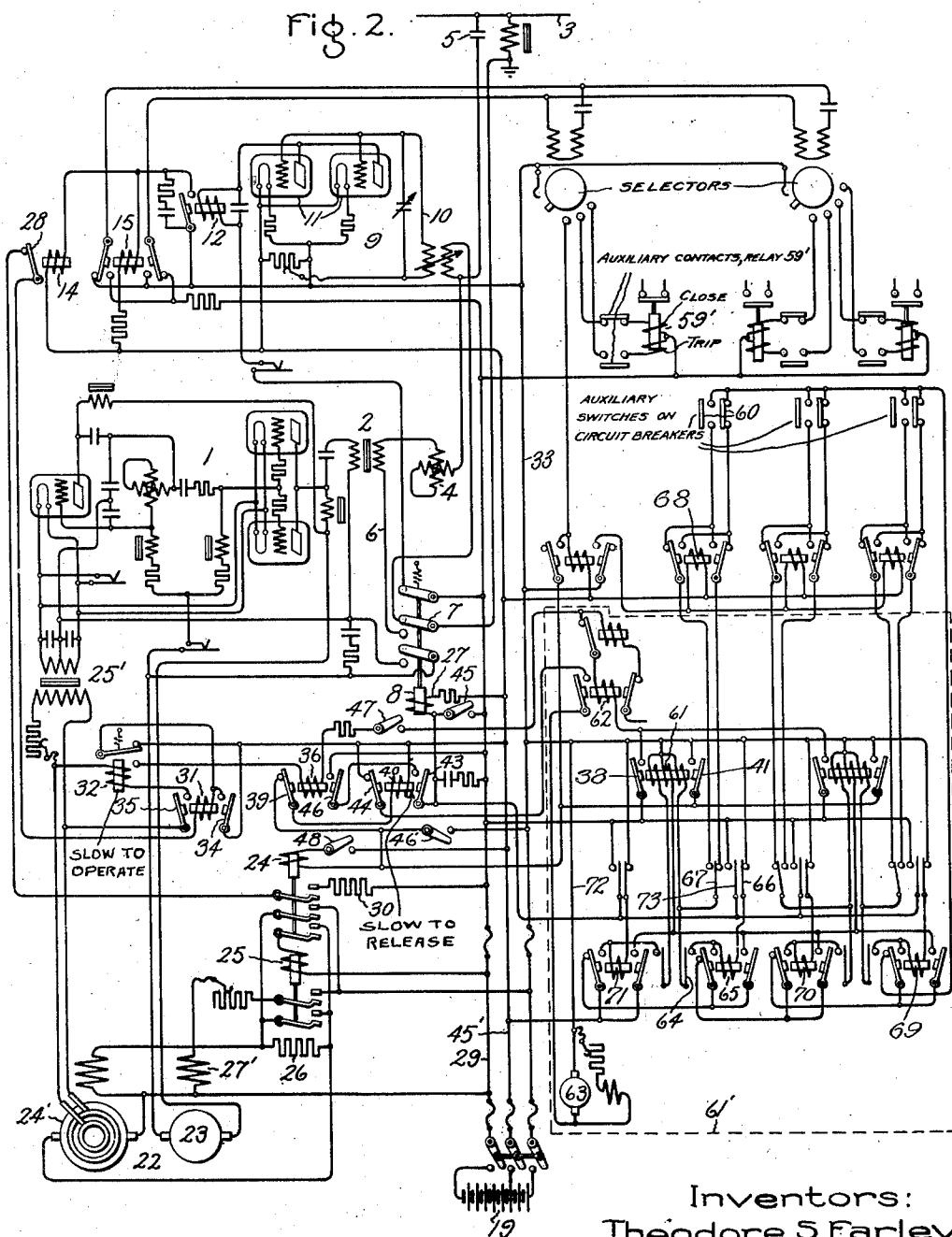
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UNITED STATES PATENT OFFICE

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CARRIER CURRENT SUPERVISORY SYSTEM

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The present invention relates to supervisory systems for the control of remote switching apparatus, and more particularly to the application of carrier current to such systems.

Heretofore supervisory systems have been provided for the remote control of switching apparatus, such systems providing means for indicating at the dispatcher's station the condition of the remote apparatus and also means for preventing operation of more than one transmitter at a time. To perform these functions, however, it has been necessary to employ at least three metallic conductors between the dispatcher's station and the remote station. By the use of a carrier current system two metallic conductors, or one metallic conductor and a ground connection are required to accomplish these objects, and these conductors may be employed for other purposes if desired, such as the transmission of power at commercial frequencies and voltages.

According to the present invention a single frequency is employed for the transmission of all signals in the system. Only one transmitter and one receiver are, therefore, required at each station in addition to the usual selector apparatus, and the transmitter and receiver of each set are so interlocked that but one transmitter in the entire system is operative to transmit signals at one time. Any confusion of signals is, therefore, prevented.

In order to assist in preventing operation of more than one transmitter at a time, means are provided for transmitting a locking impulse of radio frequency to all stations on the system prior to the transmission of the actual code impulses. This radio frequency impulse operates the selectors at each station, other than the sending station, and causes the lock-out relays in those stations to operate, thereby preventing any interference from all other transmitters while the transmitter at the originating station is in operation. The same channel is employed for the transmission of the locking impulse and the signaling impulses, the single channel controlling the remote apparatus and the timing of the im-

pulses determining the lock-out of transmitters at remote stations.

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, will best be understood from reference to the following specification when considered in connection with the accompanying drawings in which Fig. 1 shows diagrammatically one of the stations of the supervisory system, the station chosen being the dispatcher station, while Fig. 2 shows diagrammatically one of the several outlying or remote stations of the system. The equipment of the dispatcher's station is similar to that in the outlying stations with certain minor exceptions which will hereinafter be pointed out. Similar parts in the two stations shown are indicated by like reference characters.

Referring to the drawings, we have indicated as a whole at 1 an oscillation transmitter comprising the usual high frequency oscillation generator and amplifiers whereby radio frequency signals may be supplied through a transformer 2 to a transmission line 3. One secondary terminal of transformer 2 is connected to line 3 through a variometer 4 and coupling condenser 5. The other terminal of the secondary winding of the transformer 2 is adapted to be connected to ground through a wire 6 and a contact 7 on an impulsing relay 8.

A receiver, designated as a whole by the reference numeral 9, is associated with each transmitter 1 and comprises a tuned circuit 10 connected to line wire 3 and to a pair of parallel connected detector tubes 11. A relay 12 is connected in the output circuit of the detectors and is adapted to close a circuit for a pilot lamp 13 as well as to control circuits for the lock-out relay 14 and a pole changing relay 15, the latter relay being adapted to control the operation of the selector apparatus 16.

A relay 17, operated by the holding spring 17' of selector 16, closes a circuit to an alarm bell 18 when the selector receives the proper code. It also connects the entire battery 19 to polarized relays 20' in such a manner as

to prevent their improper operation due to slight passing contact on the selector apparatus. Relay 20 is operated by a contact of relay 17 and is provided with a contact 21 which maintains the circuit through relay 20 when relay 17 is deenergized. Relay 20 will keep bell 18 ringing until stopped by an attendant by opening switch 60', even though the selector has returned to normal position.

The source of current 19, which in the present instance is a storage battery, provides the filament current and plate voltage for the detector tubes 11. But in order to supply the filament current and the high plate voltage necessary for the transmitter 1, a motor generator set 22 is employed. This set comprises a direct current generator 23 and what is, in effect, a rotary converter 24' comprising a direct current motor and an alternating current generator. Current for the filaments of the transmitter tubes is supplied from the alternating side of the converter through a step down transformer 25' while the plate voltage of the tubes comprising the transmitter is supplied by generator 23.

A relay 24 controls the starting of the motor side of the rotary converter. A relay 25, controlled by the counter-electromotive force of the motor, short circuits a starting resistor 26 after the motor has come up to speed and at the same time closes a circuit for the field winding 27' of the generator 23.

The receiver 9 is normally connected to line 3 through contacts on the impulsing relay 8. When the operating coil 27 of this relay is energized, however, the receiver is disconnected from line 3 and the transmitter connected thereto. Energization of winding 27 is normally controlled by the operation of keys in a key cabinet which control notched wheels 16' in a manner which will hereinafter be pointed out. It is desirable, however, before normal transmission of code signals to provide means for locking out all other transmitters associated with the signaling system for a predetermined period of time. This is accomplished by energizing the winding 27 of the keying relay for about .2 of a second. This momentarily connects the transmitter to line 3 and a radio frequency impulse is transmitted to all the remote receivers of the system. The relay 12 in each remote station controls the energization of relays 14 and 15 at those stations and thereby prevents energization of the operating coil 27 at that station for a predetermined period of time after the reception of a signal which time will usually be from four to five seconds.

The circuit controlled by the lockout relay 14 includes a contact 28. This circuit extends from line 29 through a resistor 30 and the upper contact on relay 24, through the contact 28, the winding of relay 31, the back contact of relay 32 to line 45'. Energization of relay 31 actuates a maintaining contact

34 for this relay and a contact 35 whereby relay 32 is energized. The latter relay is of the time delay type and may require about four seconds to close its lower contact after opening its upper or back contact. Closure of the lower contact of relay 32 completes a circuit for relay 36 from line 45' through contact 34, the lower contact of relay 32, winding of relay 36, winding of relay 37 and contact 38 to line 29. One of the contacts 39 of relay 36 normally closes a circuit for relay 40 from the line 45' through contact 41 of relay 42 so that contact 43 is normally closed and contact 44 is normally opened. Relay 40 is of the "slug" type and requires a certain interval of time as, for example, .2 of a second to release its armature after its winding is deenergized.

Energization of relay 42 closes a circuit for relay 40 and starting relay 24 of the motor generator 22. Operation of relay 24 closes a circuit for relay 31. Energization of relay 31 closes a circuit for relay 32 and at the end of about four seconds the lower contact of relay 32 is closed energizing relay 36 which closes a circuit for the winding 27 of the keying relay 8, this circuit extending from line 45' through contact 43 and contact 46 to line 29. Actuation of relay 8 closes a circuit for transmitter 1 and thereby supplies a locking impulse of radio frequency current to all receivers on the system. Since energization of relay 36 opens contact 39, relay 40 is deenergized and releases or opens its contact 43 about .2 of a second after it has been deenergized. In this period of time the locking impulse is supplied to all remote receivers, energizing the remote relays 14 and operating their associated contacts 28, which will release or deenergize their associated relay 31, provided the relay 31 at the remote station has in the meantime been energized to transmit a signal. Deenergization of relay 31 releases relay 32 at the remote stations thereby making it impossible for any other station to send a signal over the system for at least 4 or 5 seconds depending on the setting of the relay 32.

The equipment of the remote stations is substantially identical with that of the dispatcher station, so far as it concerns the features of the present invention. The difference in station equipment consists mainly in the substitution of a motor operated key at the remote or outlying station for the manual operated keys at the dispatcher's station and in the omission of relays at the remote stations corresponding to the relays 37, 42, 17 and 20 at the dispatcher station. The two latter relays may be omitted at the remote stations because there is ordinarily no need for an alarm bell at the outlying stations. Relays 37 and 42 are omitted because relays on a motor key at the remote stations ful-

fill the function which these relays perform at the dispatcher station.

In the operation of the system, testing switches 45 and 46' are normally open and switches 47 and 48 normally closed. If the dispatcher now wishes to open breaker No. 1, for example, at sub-station X the red lamp 49 corresponding to this breaker will be lighted. If the white or pilot light 13 is not flashing no signals are being transmitted from other stations on the line. The dispatcher now turns a master key on his selector through 90° in a clockwise direction and releases the key. A spring which is wound up by this turn revolves a notched wheel 55 through a chain of gears. While revolving, the wheel completes a circuit between the lines 50 and 51 and thereby closes the circuit for the relay 42. Contact 38 associated with relay 42 prepares a circuit to relay 37 and contact 41 completes a circuit to the motor starting relay 24. Relay 24 closes a circuit to the field winding and armature of the rotary converter 24'. As the motor speed increases, relay 25 operates putting full voltage on the armature of the motor and energizing the field of the generator 23. The motor now revolves at full speed and power is supplied to the filaments of the transmitter tubes through the transformer 25'.

Since the circuit to relay 31 is complete, it is energized and closes a circuit to relay 32 which starts to close its lower contact, at the same time opening its upper contact. Since relay 31 has in the meantime actuated its maintaining contact 34 no effect is produced by the opening of the upper contact of relay 32. After about four seconds, relay 32 closes its lower contact completing the circuit to relay 36 and relay 37 and causing them to operate.

When relay 36 operates, it completes a circuit to the impulsing relay 8 and at the same time opens the circuit for relay 40. The circuit to relay 8 being complete, its contacts close, starting the transmitter 1 and putting radio frequency energy into the line 3. About .2 of a second after the circuit for relay 8 is closed, however, it is opened by the movement of the contact 43 of relay 40 to open position, the delay in the opening of contact 43 being due to the fact that this relay is of the slow release type. An impulse of radio frequency is sent out on the line 3 during the interval that relay 8 has been energized. This impulse is detected by the receiver tubes in all stations other than the dispatching station and the receiving relay 12 in each outlying station is closed for .2 of a second. When the relays 12 close they operate relays 14 in their respective stations and thereby prevent operation of any other transmitter for a period of at least 4 seconds. The radio frequency impulse also causes operation of the pole changing relays 15 in

the remote stations which relays in turn give their associated selectors one impulse, but since one impulse is insufficient to operate any selector to a selecting position they will return to the normal position after actuation in response to the single impulse.

Relay 40 at the dispatcher's station having opened, a circuit to a green pilot lamp 57 associated with the master key is completed. This circuit extends from the intermediate point on the battery through conductor 45', armature 44, left-hand armature of relay 37 and its right-hand contact, and lamp 57 to the negative side of the battery. A circuit to line 52 also is completed by relay 37 which operated at the same time as relay 36 operated. A red lamp 56 associated with the master key was put out when relay 37 operated. Since the lower terminal of this lamp is connected to the intermediate point on the battery it is short circuited through the above traced circuit. The green pilot lamp 57 being lighted now indicates to the dispatcher that the equipment is ready for the transmission of the code signals. He, therefore, turns that control key corresponding to the operation he desires to perform. In the present case the particular key would be labeled "open breaker No. 1 sub-station X". The spring which is wound up by turning the key revolves the code wheel 58, associated with the key, through a chain of gears and completes the circuit between lines 51 and 50 which was first completed by similar contacts on the master key wheel. As the code wheel revolves the contacts 53 and 54 close and open according to the code for which the key is set. The opening and closing of these contacts operates relay 8 in accordance with the code and causes impulses of radio frequency energy to be sent over line 3. The detector tubes 11 in all receivers in outlying stations rectify these radio frequency impulses and the contacts on their associated relays 12 open and close according to the code being received. Relay 14 in each outlying station is alternately energized and deenergized at this time. The pole changing relays 15 in the remote stations also operate and actuate the associated selectors. Only the one selector in sub-station X controlling breaker No. 1 will make contact, however, because all other selectors on the system are set for a different code. Since the time between the code impulses is usually less than four seconds, the intermittent operation of relays 14 during the transmission of a signal prevents the operation of any transmitter, other than that at the dispatcher's or originating station while a signal is being transmitted.

The final impulse of the code having been received the selector at the remote station makes the proper contact to an auxiliary relay 59' and the latter opens the particular breaker. With the completion of the code,

the code wheel at the dispatcher station is returned to normal and opens the circuit through lines 50 and 51 thereby deenergizing the relay 42. Deenergization of relay 42 opens the circuit for the motor starting relay 24 and relay 25. All power is now removed from the transmitter tubes and relay 31 is deenergized. At the same time that relay 42 deenergizes the motor starting relay 24 it also deenergizes relays 36 and 37. As the contacts of relay 37 open, the pilot lamp associated with the master key changes from green to red and the circuit to the operating keys through line 52 is opened. The dispatcher's station equipment is now in normal position. At the outlying station, when the code is completed, relay 12 opens thereby deenergizing relays 14 and 15 and the selector apparatus returns to normal position.

If the system is in normal position, and a breaker opens in an outlying or remote station, the following operations will take place at the remote station whether the breaker has been opened automatically or by the dispatcher. When the breaker opens, an auxiliary contact 60 on it closes and completes a circuit for a relay 61 on the motor key 61'. This circuit extends from the negative side of battery 19 through the right-hand winding of relay 61, armature and contact 67, armature and right-hand contact of relay 68, right-hand interlock 60, left-hand armatures of relays 69, 70, 65 and 71 which are in the position shown in the drawings, and which are connected in series, and conductor 45' to the intermediate point on battery 19. Relay 61 corresponds to relay 42 at the dispatcher station, and by means of its contact 41 it closes a circuit to relay 40 and to motor starting relay 24 in the same manner as is done by relay 42. The motor generator 22 at the remote station starts and comes up to speed and supplies heating current to the filaments, and the plate voltage to the tubes of its transmitter 1. Relay 31 is energized by the operation of relay 24 and the former relay causes energization of relay 32 which four seconds later completes a circuit to relay 36 and relay 62 on the motor key, the latter corresponding to relay 37 at the dispatcher's station.

Relay 36 completes the circuit to relay 8. Energization of the latter relay sends out a locking impulse to all transmitters on the system and releases relay 40 which stops the locking impulse and completes a circuit to the motor 63 on the motor key. This circuit extends from the negative side of source 19 through conductors 33 and 72, motor 63, left-hand armature of relay 62, armature 44 of relay 40 and conductor 45' to the intermediate point on the source 19. Motor 63 starts and through a contact 64 on the commutator spring assembly operates a release magnet 65. This circuit extends from the intermediate point on source 19 through conduc-

tor 45', left-hand armature of relays 71, 65, 70 and 69 which are in the position shown in the drawings, in series, right-hand interlock 60, contacts 67 and 64, winding 65, contact 66 and conductor 33 to the negative side of the battery. Energization of magnet 65 releases a code wheel corresponding to the breaker open, and the code wheel by means of contacts 73 operates keying relay 8 which sends out the code impulses in a similar manner to that in which the code was sent from the dispatcher's station. The receiving relay 12 in all stations on the line is closed for a short interval of time by the locking impulse. This impulse operates all the relays 14 in the other stations and prevents any other transmitter from sending.

At the dispatcher station the white pilot lamp 13 is alternately energized and deenergized by the operation of relay 12 indicating to the dispatcher that an outlying station is transmitting a signal and that his transmitter is inoperative.

Relays 12, in stations other than the sending station, are operated in accordance with the code as sent by the code wheel on the motor key and they operate pole changer relays 15 which in turn actuate the selectors. The dispatcher's station selector having the same code as that of the sending code wheel makes contact. The selector contact at the dispatcher station when made energizes relay 17 which rings bell 18 and at the same time closes a circuit for relay 20. Relay 20 closes a maintaining circuit for its operating coil and keeps the bell 18 ringing even after the selector has been released. The relay 17 at the same time completes the circuit to the proper polarized relay 20' on the indicating panel of the selector apparatus by means of the selector contact, and this relay is operated lighting the green lamp 59 in the dispatcher's cabinet corresponding to breaker No. 1 in sub-station X. The dispatcher, therefore, knows that the breaker in the remote station is open and by pressing the key 60' he releases the alarm bell 18.

The more detailed structure and circuit arrangement of the equipment comprising the motor key 61' is set forth in British Patent No. 264,235 and in United States Patent No. 1,613,944 to Joseph C. Field.

At the sub-station X upon completion of the code the release magnet 65 is deenergized by the opening of a contact 66 on the code wheel. This, in turn, stops the code wheel and releases relay 61 corresponding to the relay 42 at the dispatcher station. Relay 61 breaks the circuit to relay 62, corresponding to relay 37 at the dispatcher station, and to the relay 36. At the same time deenergization of the relay 61 releases the motor starting relay 24. Relays 31 and 32 open and the apparatus is again in normal position.

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

1. In a signaling system, a plurality of stations each comprising a transmitter and a receiver, a relay associated with each station having contacts normally connecting its associated receiver to the system and arranged when actuated to connect its associated transmitter thereto, a second relay included in each receiver and arranged when actuated to prevent actuation of said first mentioned relay, means whereby one of said first mentioned relays may be momentarily actuated to connect its associated transmitter to the system to transmit a signal to each remote receiver and means whereby actuation of said one relay actuates each of said second relays included in the remote receivers and thereby prevents the connection of the remote transmitters to the system.

2. In a signaling system comprising a plurality of stations, a transmitter and a receiver in each station, impulsing means for each transmitter, means for normally operating said impulsing means thereby to cause said transmitter to supply signal current to the system, means for momentarily energizing said impulsing means prior to normal operation to cause said transmitter to supply signal current to the remote receivers, and timing means included in said remote receivers responsive to said initial flow of signal current for preventing operation of other transmitters for a predetermined interval of time after said signal current has been transmitted.

3. In combination, a radio frequency transmitter, impulsing means therefor, a normally inactive dynamo electric machine, means for starting said dynamo electric machine and for causing said machine to supply operating potential to said transmitter, means responsive to an operating condition of said machine for operating said impulsing means thereby to transmit an impulse from said transmitter, and additional means for operating said impulsing means to transmit desired signals.

4. In combination, a radio frequency transmitter, impulsing means therefor, a normally inactive dynamo electric machine, means for starting said dynamo electric machine and for causing said machine to supply potential to said transmitter, means responsive to an operating condition of said machine for operating said impulsing means thereby to transmit an impulse from said transmitter, means for indicating when said impulsing means has been operated, and additional means for operating said impulsing means to transmit desired signals and for stopping said dynamo electric machine.

5. In combination, a radio frequency transmitter, impulsing means therefor, means for energizing said transmitter, time responsive means controlled by said energizing means for operating said impulsing means thereby

to transmit an impulse from said transmitter, additional means for operating said impulsing means in accordance with desired signals, a radio frequency receiver responsive to received signals and means controlled by the receiver for rendering both of said last means inoperative.

6. In combination, a radio frequency transmitter, impulsing means therefor, means for energizing said transmitter, time responsive means controlled by said energizing means for operating said impulsing means thereby to transmit an impulse from said transmitter, additional means for operating said impulsing means in accordance with desired signals, and means controlled by said last means for deenergizing said transmitter.

7. In a signalling system, a circuit, a receiver including a selector, a transmitter, a relay normally connecting said receiver to said circuit and adapted when operated to effect the disconnection of said receiver from said circuit and the connection of said transmitter to said circuit, means for effecting the operation of said relay, means for producing in said circuit current impulses of a character to effect the operation of said selector, and means responsive to said current impulses in said circuit for preventing the operation of said relay for a predetermined time after the termination of a current impulse through said circuit.

In witness whereof we have hereunto set our hands this 4th day of March, 1927.

THEODORE S. FARLEY.
CHANCY F. WHITNEY.