

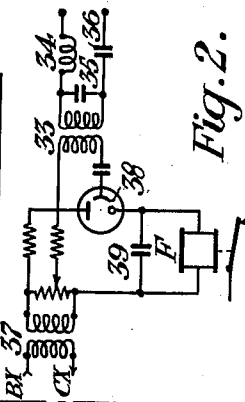
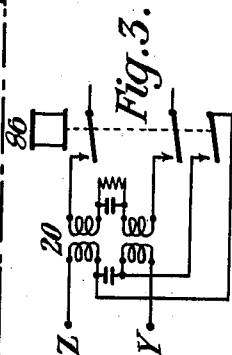
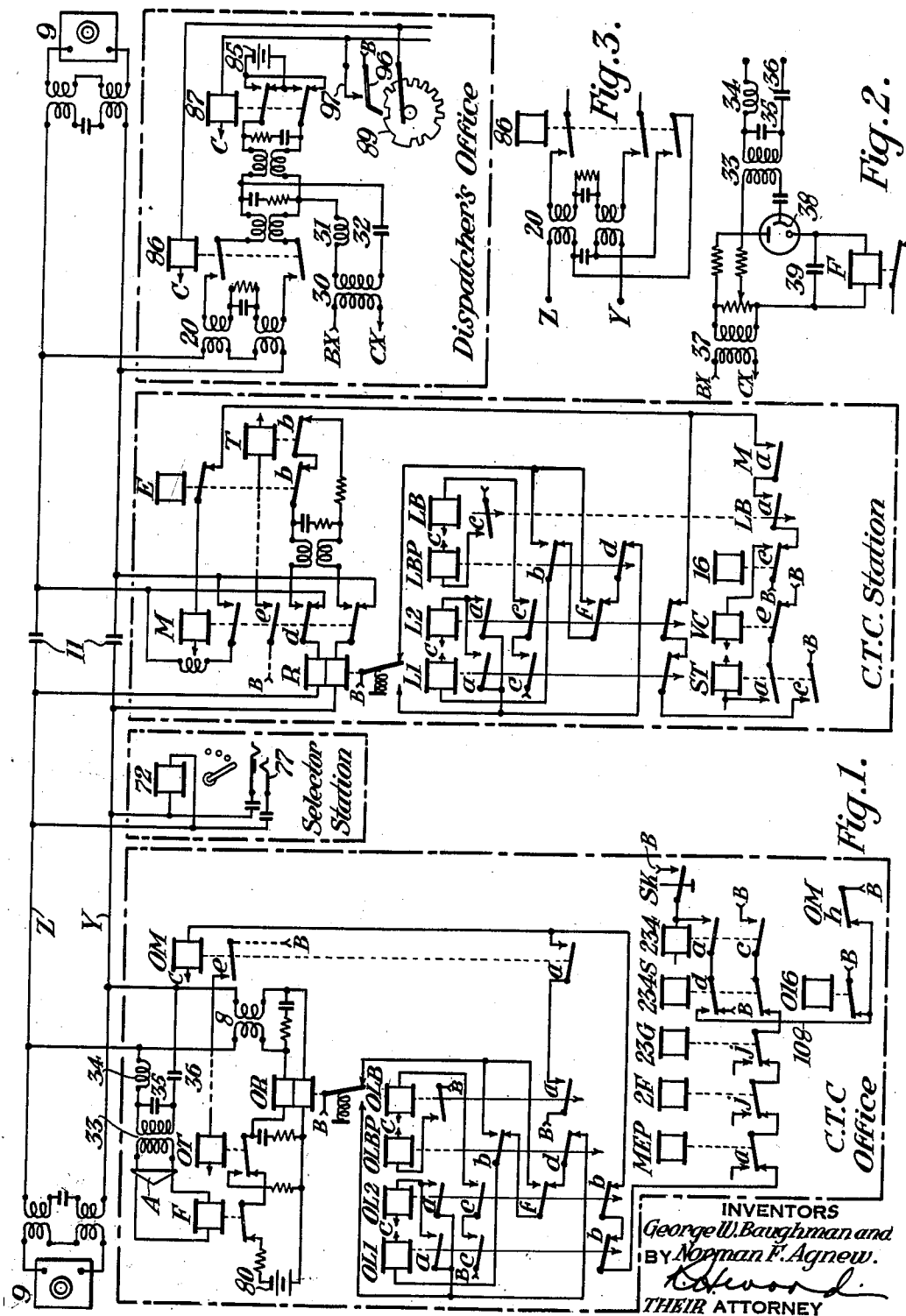
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REMOTE CONTROL SYSTEM

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REMOTE CONTROL SYSTEM

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Our invention relates to remote control systems, and more particularly to centralized traffic control systems for railroads and to the line circuits employed by such systems.

It is usually the case that a dispatcher's telephone line equipped with call selectors extends throughout the length of any railroad territory which is to be controlled by a centralized traffic control system, and marked economy may be effected by the use of the same line wires jointly by the telephones, the dispatcher's call selectors and the centralized traffic control system. Our invention relates to improved arrangements by which this may be accomplished and is an improvement upon that disclosed in a prior application, Serial No. 261,241, filed March 11, 1939, for Remote control systems, by Lloyd V. Lewis, now Patent No. 2,259,573, issued October 21, 1941, and upon that disclosed in our prior application Serial No. 326,440, filed March 28, 1940, for Remote control systems, now Patent No. 2,303,875, issued December 1, 1942. The systems of both these applications are of the impulse code type, and as illustrated, employ coding apparatus of the type shown in the Lewis Patent No. 2,229,249, granted January 21, 1941. In the system of Serial No. 261,241, the coding apparatus is adapted to operate over a normally open bridged line circuit with local sources of line energy at the office and at each station, while that of Serial No. 326,440 employs a normally closed line circuit with a source of line current at the control office only. In both of these systems there are code transmitters at the C. T. C. stations at spaced points along the track as well as one at the control office, and in addition there is also a transmitter at the office for transmitting telephone call selector codes over the same line circuit. All of these transmitters have access to the line circuit, but only when it is free, and the initiation of a code by any one locks out all the others, the arrangement being such that if two or more initiate their codes at the same time the codes are transmitted one at a time in order without interference. Furthermore, these systems employ manually releasable code wheels for sending selector codes, as in the Field Patent No. 1,343,256, of June 15, 1920, but over the same line wires as used for transmission of C. T. C. codes. Since devices of that kind must send their codes immediately when released, or not at all, the systems are so arranged that the selector codes have priority over C. T. C. codes in the event two or more codes are initiated at the same time, and a guard lamp is provided to warn the selector operator against releasing a

code wheel when the line is in use by the C. T. C. system and the selector transmitter consequently does not have access to the line.

The system disclosed herein functions in a somewhat similar manner, but in accordance with the present invention no such restriction upon the release of a code wheel is necessary, and the operator of the call selector system may gain access to the line at any time wholly without regard to whether or not it is then in use by the C. T. C. system. The release of the code wheel temporarily disconnects the source of the C. T. C. signals from the line, thereby freeing the line and preventing any interference with the selector code by the C. T. C. system. If it happens that a code wheel is released during the transmission of a C. T. C. code, the latter of course is interrupted, but each C. T. C. transmitter is provided with arrangements for storing a code interrupted at any step of its transmission so that such code will be retransmitted from the beginning as soon as the line becomes free.

In accordance with a feature of our invention, the arrangements for interrupting the operation of the C. T. C. system are adapted to be controlled from a remote point, and this may be effected, for example, over a distinctive frequency channel employing the same line wires but without interference either with the transmission of voice frequencies or of selector codes, with the advantage that the C. T. C. system may be controlled from any desired point on the line without regard to the location of the selector transmitter. The latter is usually located in a train dispatcher's office which, may, for example, be at a division headquarters a considerable distance from any point in the territory controlled by the C. T. C. system.

Our invention is particularly advantageous for use with C. T. C. systems of the central battery type having a single source of line current located at the C. T. C. office, either of the bridged line circuit type as shown in our prior application, or of the series type as in Patent No. 2,229,249, for the reason that by interrupting the supply of current to the line at its source, the operation of the C. T. C. system may be temporarily suspended whenever this is required, in a very simple manner, without regard to the location of the transmitter in operation at the time.

One form of our invention and several modifications thereof will now be described, and the novel features thereof will then be pointed out in claims.

Referring to the accompanying drawing, Fig. 1 illustrates diagrammatically one form of our invention, Fig. 2 shows the internal circuits for an amplifier suitable for use as the device A in Fig. 1, while Fig. 3 illustrates modification of the circuits for the transformer 20 of Fig. 1.

Similar reference characters refer to similar parts in each of the views.

Referring to the drawing, the reference characters Y and Z designate the two line wires extending along the track which provide a normally closed line circuit for the transmission of impulse codes in either direction between the office and stations of the C. T. C. system. This is shown as a series circuit, as in Fig. 10 of Patent 2,229,249, but modified to permit voice communication over the same line wires in the manner pointed out in the Baughman Patent No. 2,208,446, issued July 16, 1940, and to also include a back contact of a normally deenergized relay F at the C. T. C. office. For simplicity but one C. T. C. field station is shown, but it will be understood that in general the C. T. C. system will include a plurality of such stations each arranged like the one shown.

To facilitate an understanding of our invention, we have designated those relays shown herein which function like corresponding relays of Patent No. 2,229,249, by reference characters similar to those of the patent, and it is to be understood that all of the C. T. C. apparatus, the operation of which is not specifically described herein, functions in the manner described in this patent. The circuits for certain of these relays are reproduced herein merely for convenience although identical with corresponding circuits of the patent, while the circuits for others are modified, as will be pointed out hereinafter.

As shown herein, the C. T. C. line circuit is normally closed and extends from the central battery 80 at the C. T. C. office over back contacts of relay F and of the office transmitter relay OT through the windings of the office line relay OR and of a low pass filter 8 to the line wires Y and Z, and thence through each C. T. C. station in turn, passing through the windings of the line relay R and over back contacts of the master relay M at each station, the line circuit being completed by a low resistance reactive connection between line wires Y and Z, which in the particular arrangement shown comprises the secondary of a transformer 20 at the train dispatcher's office. It will be clear that none of these modifications of the line circuit change the normal mode of operation of the system of Patent No. 2,229,249 in any way, and that as long as relay F is in its released position, C. T. C. control codes may be transmitted by the operation of relay OT, and indication codes may be transmitted by the operation of relay T at any C. T. C. station, precisely as described in this patent.

The line wires Y and Z also provide a telephone channel suitable for train dispatching or message transmission, extending between the terminal telephones 9 at the opposite ends of the line as shown, or from the dispatcher's office to any one of a plurality of intermediate points such as the one designated "selector station" on the drawing, at which a telephone may be connected to the line through a jack 77, to answer a call resulting from the operation of an associated telephone call selector 72.

It is to be understood that the selector station shown is but one of a plurality of similar stations having access to line wires Y and Z, and

that each selector 72 is responsive to a different code transmitted from the dispatcher's office. The selector code transmitting apparatus includes a connector relay 86, which is picked up for the duration of the operation of a code wheel 89, together with a pole-changer or transmitter relay 87 for delivering a code of impulses of current of alternately opposite polarity from battery 85, according to the arrangement of the teeth on the operated code wheel, there being a different code wheel for each selector 72. The reference characters for these parts are the same as those of corresponding parts shown in Patent No. 1,343,256 hereinbefore referred to, and their detailed mode of operation may be ascertained from this patent.

The transformer 20 is interposed between the selector transmitter and the line wires to isolate the two line batteries 80 and 85, and to prevent current from battery 85 from passing through the selector windings, serving the same purpose as condensers 74 of Patent No. 1,343,256 in permitting the selector to assume a neutral position during the pauses in a selector code, and these condensers are accordingly omitted.

Relay F, at the C. T. C. office, is a repeater of relay 86 at the dispatcher's office, and it disconnects battery 80 from the line whenever a selector code is being transmitted. When these offices are located at different points on the line, as shown, relay F is controlled over a non-interfering line channel including the line wires Y and Z by means of alternating current of a particular frequency, preferably of low value and outside the voice frequency range.

As already mentioned, the operator at the dispatcher's office may release a code wheel at any time, regardless of whether or not a C. T. C. code is being transmitted. As soon as the code wheel rotation starts a circuit is completed from one terminal B of a local source of current over contact spring 96 to wheel 89 and thence through relay 86 to the other terminal C of the local source. As shown in the drawing, the code wheel teeth are so disposed that relay 86 picks up before the transmission of the selector code by relay 87 begins, and releases just after it is completed. A transformer 30 having its primary connected to terminals BX and CX of a suitable source of alternating current has its secondary connected through a tuned circuit including coil 31 and condenser 32, the contacts of relay 86 and the windings of transformer 20, across line wires Y and Z, so that alternating current is delivered to the line as long as relay 86 is picked up. This current passes through relay R and the back contacts of relay M at each intervening C. T. C. station (or through the by-pass condenser 11 if relay M is picked up) to the C. T. C. office, where it is effective to pick up relay F by reason of a connection to wires Y and Z including an amplifier A, and a tuned filter circuit comprising the transformer 33, coil 34 and condensers 35 and 36, as shown.

Relay F, when picked up, opens the C. T. C. line circuit by disconnecting battery 80 from the line, which suspends the operation of the C. T. C. system for the duration of the selector code, and at the same time conditions the line circuit as required for the proper operation of the selectors 72, since these have windings of relatively high resistance bridged across the line and otherwise would be shunted by the low resistance connection between wires Y and Z through battery 80. It is clear therefore that the C. T. C. system

is rendered incapable of interfering with the selector system. The suspension of the operation of the C. T. C. system by the selector system is but temporary, and does not prevent the subsequent retransmission of an interrupted C. T. C. code.

Assume that relay F picks up during the transmission of an indication code, due to the release of a code wheel; relay R at the C. T. C. station which is transmitting the code will release, and being of the biased polar type will respond to alternate impulses only of the selector code, which follows the interrupted C. T. C. code, and hence will be released most of the time during the transmission of the selector code. More particularly, relay R will be released for a relatively long period at the beginning of the selector code, sufficient to release relays LB and M. The starting relay ST which initiated the interrupted C. T. C. code will remain picked up, however, and also relay L2, and only when the line becomes steadily energized from battery 80 at the end of the selector code will relays L1 and L2 assume their released positions at the same time so as to permit relay ST to complete a pick-up circuit for relay M to initiate a new code.

The office starting relays as described in Patent No. 2,229,249 are so controlled that each is released upon the completion of the transmission of the station code call governed by such relay, for the selection of the corresponding station, and an interrupted code will be repeated, provided the interruption occurs prior to the completion of the station code call, that is if it occurs during steps 1 to 8 of the sixteen step code. It is of advantage in the practice of our invention to modify the office transmitting apparatus so as to also insure repetition of a code interrupted on one of the later steps, or in other words, to have the office starting relays function like the field station relays ST. Accordingly, each office starting relay such as relay 234, shown in Fig. 5 of the patent, has its holding circuit modified by the connection from terminal B over a back contact of relay 016 to wire 108, as shown herein, so as to hold the starting relay picked up until the final step of the corresponding code is transmitted. In addition, a back contact of the associated selector relay 234S, as shown herein, is included in the station code call circuit which includes contact c of relay 234 (Fig. 2 of the patent), in order to interrupt that circuit at the proper time as described in the patent.

With these changes a control code interrupted on any one of its sixteen steps by the removal of battery 80 will be reinitiated when battery 80 is restored. Under these circumstances the only effect of the joint use of the line as far as the C. T. C. operator is concerned will be to cause a temporary brief delay in the transmission of controls and the receipt of indications under a condition which in practice occurs but rarely.

It will also be apparent that the codes produced by varying the current from battery 80 do not operatively effect the selectors 72 since the latter respond only to particular codes of impulses of alternately opposite polarity.

It may be that the dispatcher's office is to be located at a point different from that shown, as for example, at the left of the C. T. C. office in Fig. 1. In this case a second relay F, similar to that shown, would be required at the right-hand end of the C. T. C. line circuit, which circuit would then be completed by a reactive connection between wires Y and Z over a back contact of the

second relay F, in place of the permanent connection through transformer 20, in order to open the low resistance connection between line wires Y and Z during the transmission of selector codes. In case the dispatcher's office and C. T. C. office are at the same point, the connection of battery 80 to the line wires Y and Z may be controlled directly over a back contact of relay 26, as shown in our prior application, Serial No. 326,440, for example.

Our invention is also readily applicable to the system of our prior application, in which the C. T. C. station line relays are bridged across the line wires. In this case the connection between line wires Y and Z provided by transformer 20 should be normally open, as shown in Fig. 3. It will be apparent that in this view the connection of the secondary of transformer 20 across line wires Y and Z is closed only when required to complete a path for the selector codes and for the current for controlling relay F, by including therein the lower contact of relay 26 as shown. It will also be apparent that our invention is applicable to systems having sources of line current at each transmitting station as in the system of Serial No. 261,241 hereinbefore referred to, by the provision of a relay F at each station for disconnecting the associated current source.

In a specific embodiment of our invention, current for the control of relay F is obtained by connecting the terminals BX and CX at the dispatcher's office to the local 60 cycle A. C. power source, and transformer 30 is adjusted so that the 60 cycle current in the line, which is substantially free of harmonics due to the circuit arrangements, is of such a low value as to be practically inaudible in the telephones 9, this value being far below the minimum current to which the selectors 72 or the line relays R are responsive, and it consequently has no direct effect upon code transmission. Relay F, at the C. T. C. office, is rendered responsive to the presence of this 60 cycle current in the line by interposing an amplifier comprising an electron tube of the controlled ionization, or "cold cathode" type, with its circuits including elements selective as to frequency and arranged as in Fig. 2. Relay F, which is a direct current neutral relay, is connected in series with the secondary of a transformer 37 across the anode and the cathode of the tube. The primary of transformer 37 is energized by a connection to terminals BX and CX of the local 60 cycle source, at the C. T. C. office, but the voltage supplied is normally not sufficient to start ionization to render the tube conductive. The control element 38 of the tube is supplied with a 60 cycle potential from transformer 33, which is so connected to the line through a filter circuit as to be selectively responsive to the 60 cycle current supplied to line wires Y and Z when relay 26 is picked up. The potential thus supplied, when of the proper polarity, is sufficient to start ionization of the tube so as to cause its anode-cathode circuit to become conductive, thereby charging condenser 39 and after several cycles, energizing relay F.

It is to be understood that the ionization is started anew on each half cycle of the same polarity, relay F being maintained energized by the discharge of condenser 39 during the intervening half cycles when the potential is of the opposite polarity, and the tube becoming deionized, and relay F releasing when the energization of the control element by transformer 33 ceases.

The circuits are so proportioned that relay F picks up only in response to sustained oscillations

in transformer 33, and is non-responsive to impulse excitation due to the codes or to switching, and is also non-responsive to the voice frequency currents.

Although we have herein shown and described but one form of apparatus embodying our invention, and several modifications thereof, it is understood that various changes and modifications may be made therein within the scope of the appended claims without departing from the spirit and scope of our invention.

Having thus described our invention, what we claim is:

1. In combination, an office and a station connected by a line circuit, a remote control system having a plurality of code transmitters including one at said office and one at said station each having a transmitting contact, means for initiating the operation of each code transmitter effective only when the line is free, means controlled by each code transmitter when initiated for operating its transmitting contact repeatedly to deliver an impulse code to said line circuit, a starting relay for each transmitter free to be actuated at any time for controlling the initiation of that transmitter, holding means for each starting relay effective to maintain it actuated only until one complete code initiated thereby is transmitted by the uninterrupted repeated operation of the associated transmitting contact, an additional code transmitter having access at times to said line circuit, means operable irrespective of whether or not the line circuit is in use for initiating the operation of said additional code transmitter to deliver other impulse codes to said line circuit, and means rendered effective when said additional transmitter is initiated for immediately interrupting the operation of the transmitting contact of any remote control system transmitter then in operation while retaining the starting relay associated therewith in its actuated condition and effective to initiate the transmission of a code in its entirety as soon as the code delivered by said additional transmitter is fully transmitted.

2. In combination with a line circuit, a remote control system transmitter having access to said line circuit to deliver an impulse code thereto, a starting relay free to be actuated at any time for initiating the operation of said transmitter, means preventing the initiation of said transmitter in response to the actuation of said starting relay except when the line is free, holding means for each starting relay effective to maintain it actuated only until one complete code initiated thereby is transmitted, an additional transmitter having access at times to said line circuit, means operable irrespective of whether or not said line circuit is in use for initiating the operation of said additional transmitter to deliver a different impulse code to said line circuit, and means rendered effective when said additional transmitter is initiated for immediately interrupting the operation of said remote control system transmitter if such transmitter is then in operation and for reinitiating the operation of the interrupted transmitter to transmit its code in its entirety as soon as the code delivered by said additional transmitter is fully transmitted.

3. In combination, an office and a station connected by a line circuit, a remote control system having a plurality of code transmitters including one at said office and one at said station each operable when the line is free, to deliver an im-

pulse code comprising a predetermined number of impulses each of determinable character to said line circuit, a manually releasable code wheel operable when released to deliver a different impulse code to said line circuit, interference preventing means responsive to the release of said code wheel and effective when a code is being transmitted by said office or station transmitter for stopping the operation thereof, thereby interrupting said code immediately upon the release of said code wheel, storing means associated with the transmitters of said remote control system for storing each such interrupted code for transmission in its entirety when the line becomes free, and means controlled by said interference preventing means for reinitiating the transmission of said stored code in its entirety after the transmission of said different code by said code wheel.

4. In combination, an office and a station connected by a normally closed line circuit, a source of current for energizing said line circuit, a remote control system having a plurality of code transmitters including one at said office and one at said station each adapted to be initiated only when the line circuit is steadily energized to periodically vary the current from said source in accordance with a code, a manually releasable code wheel operable when released to deliver a different impulse code to said line circuit, interference preventing means responsive to the release of said code wheel when a code is being transmitted by said office or station transmitter for disconnecting said source immediately upon the release of said code wheel and until said code wheel completes its operation, and means associated with the transmitters of said remote control system for storing each such interrupted code for transmission when the line circuit is again steadily energized.

5. In a communication system having a control office and one or more stations connected by a line circuit which is normally energized from a current source at said office, a remote control system having a plurality of code transmitters including one at the office and one at each station each operable when initiated to periodically vary the current delivered to said line circuit in accordance with a code, said remote control system having starting means for each transmitter free to be operated at any time to condition such transmitter to transmit its code but effective to initiate its operation only when the line circuit is steadily energized from said source and having storing means effective to maintain each actuated starting means in its actuated condition in the event a code is interrupted and until the corresponding code has been fully transmitted, said remote control system also including interference preventing means effective when two or more transmitters are initiated simultaneously to prevent further operation of all but one during the resulting code, an additional transmitter free to be operated at any time to deliver other impulse codes to said line circuit, and means controlled by said additional transmitter for disconnecting said source from said line circuit for the duration of each code transmitted by said additional transmitter to prevent interference therewith by any remote control system transmitter.

6. In combination with a line circuit, a source of current for normally energizing said line circuit, a code transmitter effective when initiated to periodically interrupt the supply of current from said source to deliver an impulse code to said line circuit, starting means effective only

when the line circuit is steadily energized from said source for initiating its operation, means for stopping the operation of said transmitter in response to a prolonged deenergization of said line circuit and for reinitiating its operation when said line circuit is again steadily energized, an additional transmitter free to be operated at any time to transmit a different impulse code to said line circuit, and means controlled by said additional transmitter for disconnecting said source from said line circuit during the transmission of said different impulse code.

7. In a communication system, two stations connected by line wires, a connector relay at one station, a repeater relay at the other station, a code transmitter at each station, means for at times connecting the code transmitter at one station to said line wires over front contacts of said connector relay, means for connecting the code transmitter at the other station to said line wires over back contacts of said repeating relay, a transmitting contact included in each code transmitter, means for operating each transmitting contact repeatedly to deliver impulse codes to said line wires when the associated transmitter is connected thereto, means effective as long as the code transmitter at said one station is connected to said line wires over front contacts of said connector relay for supplying alternating current of a particular frequency to said line wires, and means selectively responsive to said alternating current but non-responsive to said impulse codes for energizing said repeating relay to disconnect the other code transmitter from said line wires.

8. In a communication system, a first and a second station connected by line wires, a code transmitter at each station, a transmitting contact included in each code transmitter, means for operating each transmitting contact repeatedly to deliver impulse codes to said line wires when the associated code transmitter is connected thereto, a connector relay at said first station, a repeating relay at the second station, selectors controlled over said line wires and selectively responsive to said impulse codes, means effective when said connector relay is energized for connecting the code transmitter at said first station to said line wires and at the same time energizing said line wires by current of a distinctive character to which said selectors are non-responsive, means responsive to said current of distinctive character in said line wires for energizing said repeating relay, and means for disconnecting the code transmitter at said second station from said line wires only as long as said repeater relay is energized.

9. In a communication system, a plurality of stations connected by line wires normally energized from a direct current source at one station, a code transmitter at each of a plurality of said stations, a transmitting contact included in each code transmitter, means for operating

each transmitting contact repeatedly to control the current supplied from said source to thereby deliver impulse codes to said line wires, a relay at said one station, selective circuit means for energizing said relay when current of a distinctive character is supplied to said line wires, means including said selective circuit means for rendering said relay non-responsive to the current from said source or to said impulse codes, means at another station for at times supplying current of said distinctive character to said line wires to energize said relay, and means controlled by said relay when energized for disconnecting said direct current source from said line wires.

10. In a communication system, a plurality of stations connected by line wires normally energized from a direct current source at one station, a code transmitter at each of a plurality of said stations, a transmitting contact included in each code transmitter, means for operating each transmitting contact repeatedly to control the current supplied from said source to thereby deliver impulse codes to said line wires, a relay at said one station, selective circuit means for energizing said relay when current of a distinctive character is supplied to said line wires, means including said selective circuit means for rendering said relay non-responsive to the current from said source or to said impulse codes, means at another station for at times supplying current of said distinctive character to said line wires to energize said relay, means controlled by said relay when energized for disconnecting said direct current source from said line wires, and means at said another station for delivering other impulse codes to said line wires when said current of distinctive character is being supplied to said line wires.

11. In a communication system, a first and a second station connected by line wires, a code transmitter at each station, a transmitting contact included in each code transmitter, means for operating each transmitting contact repeatedly when the associated code transmitter is connected to said line wires to thereby deliver an impulse code thereto, a repeating relay, means controlled by said repeating relay when energized to interrupt the delivery of impulse codes to said line wires by the transmitter at said first station, selective circuit means for energizing said repeating relay only when current of a distinctive character is supplied to said line wires, a connector relay at the second station free to be operated at any time, means controlled by said connector relay when operated for simultaneously connecting the code transmitter at said second station and a source of current of said distinctive character to said line wires, and storing means at said first station for storing each interrupted code for delivery in its entirety upon the release of said repeating relay.

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