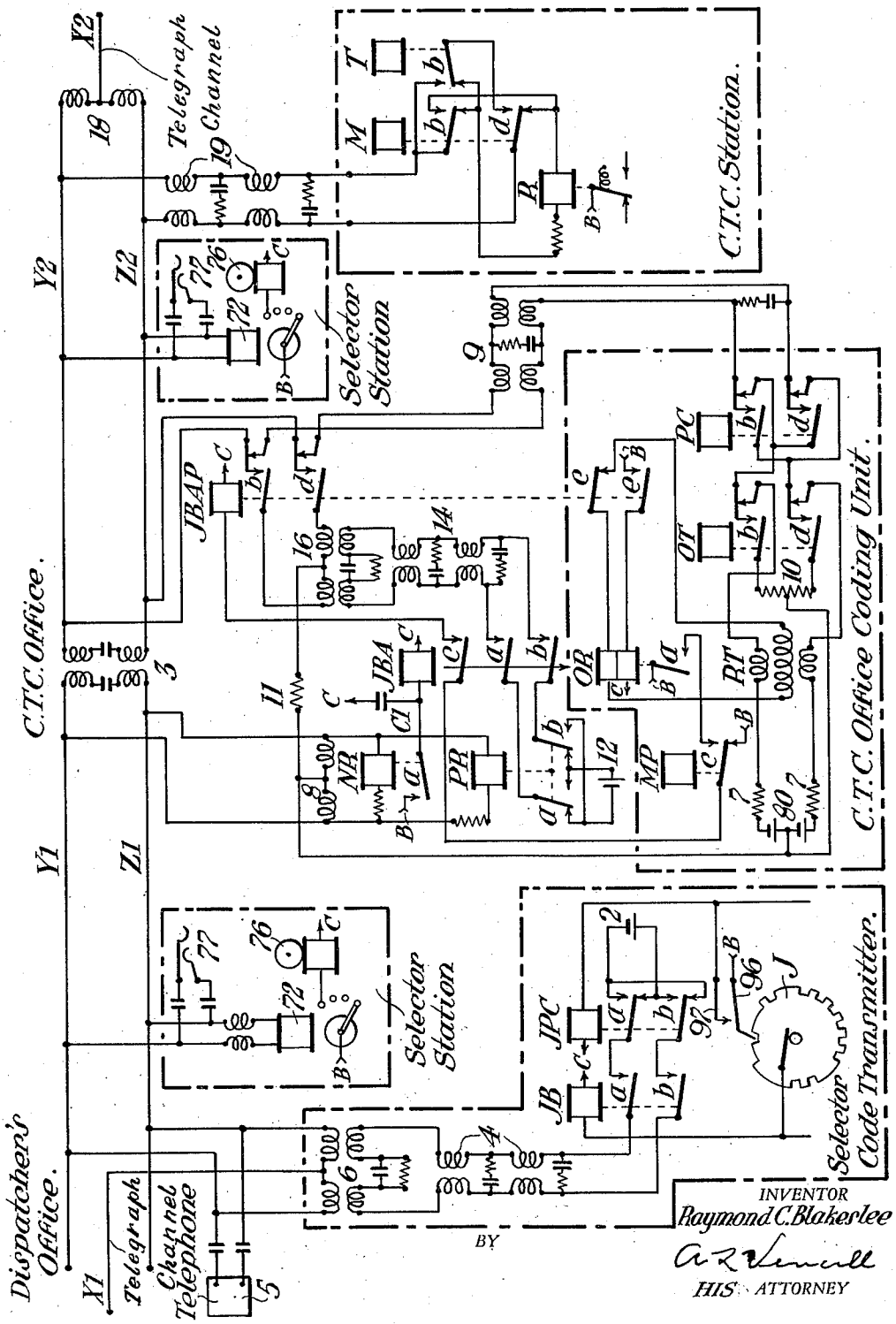
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REMOTE CONTROL SYSTEM

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REMOTE CONTROL SYSTEM

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

Centralized traffic control systems are now arranged to use the line wires of existing telephone circuits, a suitable system of this type being shown, for example, in Letters Patent of the United States No. 2,303,875, issued December 1, 1942, to George W. Baughman and Norman F. Agnew, for Remote control systems. In some cases the centralized traffic control system is superimposed upon a train dispatcher's telephone line equipped with selective calling apparatus for calling the operators at various telephone way stations, the selector system being usually of the type disclosed in Letters Patent of the United States No. 1,343,256, issued June 15, 1920, to J. C. Field.

The centralized traffic control system and the selector system are non-interfering by reason of the use of different codes, that is, the selecting apparatus of each system is non-responsive to the codes transmitted by the other, but since both systems employ codes of low frequency impulses transmitted over the same line channel through low pass filters, it is necessary to allot the use of the line to only one system at a time.

The selector system usually employs manually releasable code wheels which are adapted to transmit their codes immediately when released, or not at all, while the centralized traffic control system, on the other hand, may be arranged to store an interrupted code for retransmission in its entirety, as soon as the line is free.

One object of my invention is to provide improved means for interlocking two dissimilar code systems, such as those mentioned, in such a manner that the operator of one system, namely, the call selector system, may gain access to the line to transmit a code at any time irrespective of whether or not it is in use at the time by the other system, the operation of a code wheel being effective to temporarily suspend the operation of the centralized traffic control system and to disconnect it from the line circuit for the duration of the selector code.

A further object of my invention is to provide improved arrangements of this character suitable for use when the control office of the centralized traffic control system is at an intermediate point on the dispatcher's line, that is to say, at a point remote from the location of the selector transmitter.

It is also the practice to superimpose an additional communication channel upon the dispatcher's line, employing the two line wires in parallel as one side of a simplex telegraph or phantom telephone circuit, or both. As illustrated, for example, in Fig. 1 of the above-mentioned Patent No. 2,303,875, it has been the practice heretofore to employ the bridged type of simplex circuit in which the telegraph leg is connected to the line wires by a mid point connection to two relatively high resistances connected across the line wires in series. This added resistance is somewhat detrimental to the operation of the telegraph circuit, particularly when four such connections are required, as is the case when the control office of the centralized traffic control system is at an intermediate point on the line. This difficulty is avoided by a novel arrangement of the apparatus as disclosed herein, which provides a low resistance path for the telegraph channel through the line connections of the centralized traffic control and selector systems.

One form of apparatus employing my invention will now be described, and the novel features thereof will then be pointed out in claims.

Referring to the accompanying drawing, the reference characters Y1, Z1 and Y2, Z2 designate a pair of line wires which extend from the dispatcher's office shown at the left, through the territory controlled by the centralized control system. The physical line circuit is sectionalized at an intermediate point, at which the C. T. C. office is located, by interposing a telephone transformer or band pass filter 3 arranged to pass currents in the voice frequency range only.

The line wires provide a voice frequency communication channel extending from a telephone set 5 at the dispatcher's office over the line wires Y1 and Z1 to a plurality of jacks 11, such as the one at the selector station shown at the left of the drawing, to which way station telephone sets may be connected. The voice frequency channel also extends through the transformer or band pass filter 3 to the line wires Y2 and Z2, and thence to similar jacks 11 at other selector stations, one of which is shown at the right in the drawing.

The dispatcher's office is equipped with a selector code transmitter, which as shown, is that of the Field Patent No. 1,343,256, hereinbefore referred to, comprising a code wheel J for each station to be selected, a connector relay JB arranged to be energized during the rotation of any code wheel, and a pole changer relay JPC controlled by the code wheels. The periodic operation of relay JPC by any of the code wheels

J supplies impulses of alternately opposite polarity from battery 2 with interposed pauses through a low pass filter 4 and an impulse transformer 6 to the line wires. The selector impulses normally have a frequency of 3.5 cycles per second, and they serve to operate polarized selectors 72 so as to ring a call bell 76 at the selected station.

The territory controlled by the C. T. C. system is to be understood to be that adjacent line wires Y2 and Z2 only. These line wires are supplied with current from a line battery 80 to provide a normally closed line circuit connecting the C. T. C. office and a plurality of C. T. C. stations such as the one shown on the drawing, the C. T. C. system corresponding to that shown in the Baughman and Agnew Patent No. 2,303,875, hereinbefore referred to, except for certain minor modifications as described herein.

The C. T. C. line circuit as shown extends from battery 80 through the current limiting resistors 7 and primary coils of an impulse transformer RT, contacts *b* and *d* of relays OT and PC, a low pass filter 9, contacts *b* and *d* of relay JBAP to the line wires Y2 and Z2, and thence through the low pass filter 19, back contacts *b* and *d* of relay M, and the line relay R at each C. T. C. station, the line relays R being normally energized in parallel.

For an understanding of my invention it is deemed sufficient to point out that the C. T. C. coding units require the line circuit to be steadily energized in order to place them in condition to initiate the transmission of a code, or to selectively receive a code, and that the station transmitters are maintained in operation by the responce of the associated line relays to the code elements, becoming disabled if the line remains open for a period materially longer than any element of a code. The C. T. C. office coding unit is adapted to transmit control codes in which the line circuit is periodically interrupted by the repeated energization of a transmitter relay OT, to operate the station line relays R, which are of a high resistance biased polar type. The C. T. C. codes consist of combinations of long and short code elements having a base frequency of about 6 cycles per second.

In order to minimize code distortion when the line wires are in a cable, a resistor 10 is connected across the line wires Y2 and Z2 to provide a discharge path when relay OT picks up to disconnect battery 80 from the line.

Each C. T. C. station is adapted to transmit indication codes by energizing a master relay M and then periodically connecting the line wires together by the repeated operation of contact *b* of a transmitter relay T, the resulting variations in the line current causing transformer RT to supply impulses of alternately opposite polarity to the office line relay OR, which is of the stick polar type, so that relay OR repeats the code operation of relay T at the transmitting station.

The first impulse of an indication code operates the pole changer relay PC at the office by means not shown, and relay PC reverses the polarity of the current supplied to the line by battery 80, while relay M reverses the connections for relay R at the transmitting station to render it responsive to the current of reverse polarity. This reversal of the line polarity releases the line relays R at the other C. T. C. stations, at which the relays M are deenergized, so that these stations are held in an inactive condition until the transmission of the indication code is completed and the line circuit is again energized by current of normal polarity.

The telephone transformer 3, which is provided to isolate the C. T. C. line circuit from the remainder of the dispatcher's line, is also arranged to block the transmission of selector codes from one section of that line to the other, and accordingly, a selector code repeater is provided to repeat the selector codes delivered to line wires Y1 and Z1 into the circuit comprising the line wires Y2 and Z2, in order to operate the selectors 72 at stations to the right of the C. T. C. office. The selector code repeater furthermore compensates for the impairment of the selector line circuit due to the connection of the line relays R in parallel with the selectors 72 across the line wires Y2 and Z2.

The simplex telegraph channel extends from wire X1 through transformer 6 to the line wires Y1 and Z1 in parallel, and thence to the simplex coil 8 from the center terminal of which it extends over one or another of a plurality of low resistance circuit portions provided in accordance with a feature of my invention, to line wires Y2 and Z2, thereby by-passing transformer 3, and over the line wires Y2 and Z2 in parallel to the simplex coil 18, and thence to wire X2. In order to provide a circuit path of uniformly low resistance for the telegraph circuit under all conditions of operation of the C. T. C. and selector systems, the various relay contacts in the C. T. C. line circuit have been made of the continuity transfer type, as shown, and the center terminal of coil 8 is connected respectively to the center terminals of resistor 10, of battery 80, and of transformer 16, the last named connection including a resistor 11. The values of resistors 7, 10 and 11 are made relatively low, and chosen so as to present substantially the same resistance to the telegraph currents flowing from coil 8 to the line wires Y2 and Z2, irrespective of the positions of relays OT and JBAP. It will be readily apparent that the telegraph channel is not disturbed by the operation of the pole changer relay PC, since this merely interchanges wires Y2 and Z2 in the circuit, nor when wires Y2 and Z2 are connected together during the operation of a transmitter at a C. T. C. station, and further, that the resistance of the by-pass circuit may be made materially lower than that of the usual simplex connection comprising resistors bridged across the line wires, thereby permitting a reduction in the voltage impressed upon the telegraph circuit and correspondingly decreasing the detrimental effects of line leakage.

Considering now the mode of operation of the selector system, and assuming for the present that the C. T. C. system remains in its normal at rest condition, when a code wheel J is released by the operator at the dispatcher's office, its initial movement completes a circuit from one terminal B of a suitable local source of current over contact 96 to wheel J and thence through relay JB to the other terminal C of the source, this circuit remaining closed until the wheel J completes its rotation and again occupies its normal position as shown. Relay JB therefore picks up, and its contacts *a* and *b* by connecting battery 2 to transformer 6 cause the delivery of a preliminary impulse to the line wires Y1 and Z1 to pick up relay NR, and to energize relay PR in the normal direction as shown. Relay NR energizes relay JBA, contacts *a* and *b* of which connect battery 12 over the pole changer contacts *a* and *b* of relay PR through a low pass filter 14 to transformer

16, and contact c of relay JBA completes a circuit from terminal B at the back contact c of relay MP, through relay JBAP to terminal C so that relay JBAP picks up to connect transformer 16 to the line wires Y2 and Z2. This preliminary impulse is not repeated into the line Y2—Z2 because it is delivered to transformer 16 before relay JBAP picks up.

The code wheels J are arranged so that a period of at least one second elapses after the contact spring 96 makes contact with the code wheel, before it engages the first tooth to complete a circuit over contact spring 97 to pick up relay JPC. Relay JBA is made sufficiently slow release by the connection of a condenser C1 of large capacity across its winding to bridge this interval as well as the intervals between the successive impulses of the code. Relays NR and PR respond to the code impulses delivered to the line wires Y1 and Z1 by relay JPC, relay NR maintaining relays JBA and JBAP picked up until the code wheel completes its rotation, and relay PR repeating the operation of relay JPC to deliver the code to the line wires Y2 and Z2.

During the transmission of the selector code the C. T. C. line battery 80 is disconnected by the opening of back contacts b and d of relay JBAP, and the telegraph channel by-pass from coil 8 to the line wires Y2 and Z2 through battery 80 is replaced by the equivalent one from coil 8 through transformer 16 without interrupting its continuity. Since the C. T. C. coding units require the line circuit to be steadily energized to condition them to transmit and to receive codes, the C. T. C. system becomes disabled during the interval between the preliminary impulse and the first impulse of the selector code, remaining in that condition until after relay JBAP releases at the end of the selector code. The station line relays R being of the biased polar type, pick up momentarily in response to alternate impulses of the selector code, but since they were all released for a relatively long period when relay JBAP picked up, and since they do not become steadily energized as required to condition the station coding units to receive code, until relay JBAP releases, the C. T. C. station units are non-responsive to the selector codes, regardless of their code character.

The operation of contacts c and e of relay JBAP disconnects the office line relay OR from the impulse transformer RT and holds it reversed for the duration of the selector code, thereby holding the C. T. C. office receiver inactive.

Assuming next that a selector code is initiated while a C. T. C. indication is being transmitted, it will be clear that the energization of relay JBAP, by holding the C. T. C. line open, will disable the C. T. C. transmitter, interrupting its code before the selector code begins. It will be understood that the C. T. C. station units include storage means such that an interrupted code is retransmitted in its entirety as soon as the line becomes free so that in this case the selector code and the C. T. C. code will be transmitted successively.

Considering next the transmission of a control code by the C. T. C. office coding unit which code, as already mentioned, is generated by opening and closing the line circuit including battery 80 by the periodic operation of the office transmitter relay OT. Each time relay OT picks up, the simplex channel by-pass through battery 80 is replaced by one from coil 8 through resistor 10 by the operation of contacts b and d of relay OT without interrupting the continuity of the telegraph channel, and it follows that the telegraphic transmission over this channel is not interfered with by the C. T. C. transmission.

Relay MP is provided in accordance with a modification of the C. T. C. system disclosed in a pending application for Letters Patent of the United States, Serial No. 496,907, filed July 31, 1943, by Arthur P. Jackel for Remote control systems. In this modification the control elements of the code are each registered during the reception of the next succeeding element without storing them until the line is closed at the end of the code, as heretofore. Relay MP is energized for the duration of the control code and provides a circuit extending over its front contact c to terminal B at the reverse contact a of relay OR over which relay JBAP is energized in response to the energization of relay JBA as in the preceding examples, provided relay JBA picks up during the transmission of a line open code element, that is to say, while relay OR is reversed. On the other hand, if relay JBA picks up during the transmission of a long line closed element, the C. T. C. system retains control of the line long enough to complete the transmission of that element, relay JBAP becoming energized in response to the reversal of relay OR when the element is terminated. In this manner the conversion of a long element into a short one by the action of relay JBAP is prevented, thereby avoiding the improper response to that element as received at the field station. In either case, relay JBAP becomes energized to free the line prior to the transmission of the first impulse of the selector code.

It is also to be understood that the C. T. C. office coding unit is provided with arrangements such as are disclosed in the above-mentioned Jackel application, whereby an interrupted control code is retransmitted in its entirety following the restoration of the line circuit to its normal closed condition.

It will be evident that in general the operator of the selector system will have no knowledge of whether or not the line circuit is in use by the C. T. C. system. Such knowledge is unnecessary as he is free to gain access to the line at any time to interpose selector codes without causing any of the C. T. C. codes to fail to be transmitted, and without causing interference between these codes and the selector codes, the only effect being to suspend the operation of the C. T. C. system as long as he continues to use the line. Furthermore, this result is attained without the provision of any additional circuits between the dispatcher's office and the C. T. C. office, and without impairing the full efficiency of utilization of the line wires thereby enabling the C. T. C. system to be superimposed upon a portion of a simplexed dispatcher's telephone line without in any manner impairing its normal mode of operation.

In the foregoing I have assumed that the dispatcher's office and C. T. C. office are at different locations. When they are at the same location, relay JB will replace relay JBA, and transformer 6 will replace transformer 16 in the circuits associated with the C. T. C. office coding unit, the arrangements for providing a low resistance telegraph channel being equally advantageous under this condition.

Although I have herein shown and described but one form of apparatus embodying my invention, 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 my invention.

Having thus described my invention, what I claim is:

1. In a remote control system, two line wires arranged to provide a line circuit equipped with call selectors and divided into two sections, a code transmitter for delivering codes of impulses to which such selectors are responsive to one of the sections, a repeater responsive to the codes delivered to said one section for repeating them to the second section, said repeater being normally disconnected from said second section, a code system having a normally energized line circuit including a source of current and the line wires of said second section, means controlled by the selector code transmitter when operated for delivering a preliminary impulse to said one section prior to the delivery of a code thereto, a slow acting relay, means comprising said preliminary impulse for operating said slow acting relay, means comprising said code impulses for maintaining said slow acting relay operated during the transmission of said selector code, and means controlled by said slow acting relay when operated for disconnecting said source of current from the second section and for connecting said repeater thereto.

2. In a remote control system, two line wires arranged to provide a telephone circuit equipped with call selectors responsive to low frequency impulses and divided into two sections by a selective filter adapted to pass alternating currents of voice frequency but not of said low frequency from one section to the other, a code transmitter for delivering codes of impulses to which such selectors are responsive to one of said sections, a connector relay, a code system having a normally energized line circuit including a source of current, back contacts of said connector relay and the line wires of said second section, a selector code repeater responsive to the codes delivered to said one section for repeating them into the other section over front contacts of said connector relay, means controlled by the selector code transmitter for delivering a preliminary impulse to said one section prior to the delivery of a selector code thereto, a slow release relay, means for operating said slow release relay in response to said preliminary impulse and for maintaining it operated during the delivery of the succeeding selector code, and means controlled by said slow release relay when operated for energizing said connector relay.

3. In combination with a pair of line wires arranged to form two sections in each of which the line wires are connected in parallel in a telegraph circuit and in series in a telephone circuit; call selectors responsive to low frequency impulses bridged across the line wires of both sections, a telephone transformer connecting said sections to extend the telephone circuit from one section to the second section, a code transmitter for delivering codes of impulses to which such selectors are responsive to said one section, a connector relay having front and back contacts of the continuity transfer type, a code system having a normally energized line circuit including a source of current, the back contacts of said connector relay, and the line wires of said second section, in series; a polar relay responsive to the selector code impulses delivered to said one section, means for repeating said impulses to said second section comprising an impulse transformer having a primary winding supplied with current of reversible polarity over contacts of said polar relay and a secondary winding connected across the line wires of said second section over front contacts of said connector relay, means responsive to the impulses delivered to said one section for energizing said connector relay for the duration of each selector code, and means for connecting said sections to extend said telegraph circuit from one section to the other comprising two balanced connections of relatively low resistance from a coil connected across the line wires of said one section, one extending through the secondary winding of said impulse transformer and the front contacts of said connector relay, the other through said source of current and the back contacts of said connector relay to the line wires of the second section.

4. In combination with a pair of line wires arranged to form two sections in each of which the line wires are connected in parallel in a telegraph circuit and in series in a telephone circuit, a telephone transformer connecting said sections to extend the telephone circuit from one section to the second section, a code system having a normally energized line circuit including a source of current and the line wires of said second section in series, a transmitter relay having contacts of the continuity transfer type included in said line circuit, said contacts in one position connecting said source of current to the line wires through current limiting resistors and in another position connecting the line wires together through a line discharge resistor, and means for connecting said sections to extend said telegraph circuit from one section to the other comprising two balanced connections from a coil connected across the line wires of said one section, one extending through said source of current and the other through said line discharge resistor, to the contacts of said transmitter relay and thence to the line wires of the other section.

5. In combination with a pair of line wires arranged to form two sections in each of which the line wires are connected in parallel in a telegraph circuit and in series in a telephone circuit, a telephone transformer connecting said sections to extend the telephone circuit from one section to the second section, a code system having a normally energized line circuit including a source of current and the line wires of said second section in series, a transmitter relay having contacts arranged to periodically interrupt the supply of current from said source to deliver impulse codes to the line wires of said second section, and means for connecting said sections to extend said telegraph circuit from one section to the other, comprising two balanced connections to the line wires of said one section, one extending through said source of current and the transmitter relay contacts by which such source is connected to the line wires of the second section, and the other extending to the line wires of said second section over other contacts of said transmitting relay which close when said first mentioned contacts are open.

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