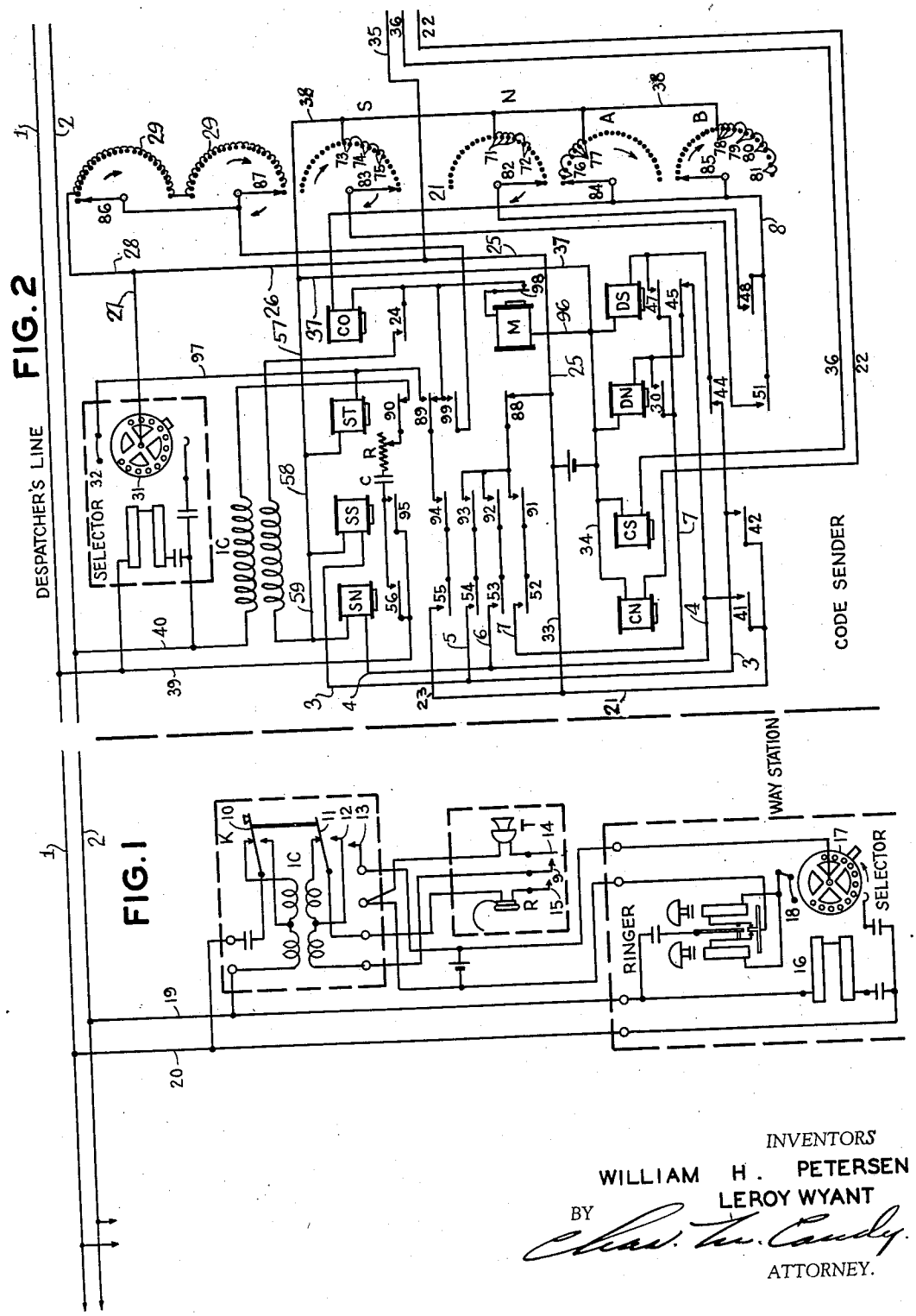
Aug. 24, 1937. W. H. PETERSEN ET AL 2,091,104

RAILWAY SIGNALING SYSTEM

Filed April 25, 1935 4 Sheets-Sheet 1




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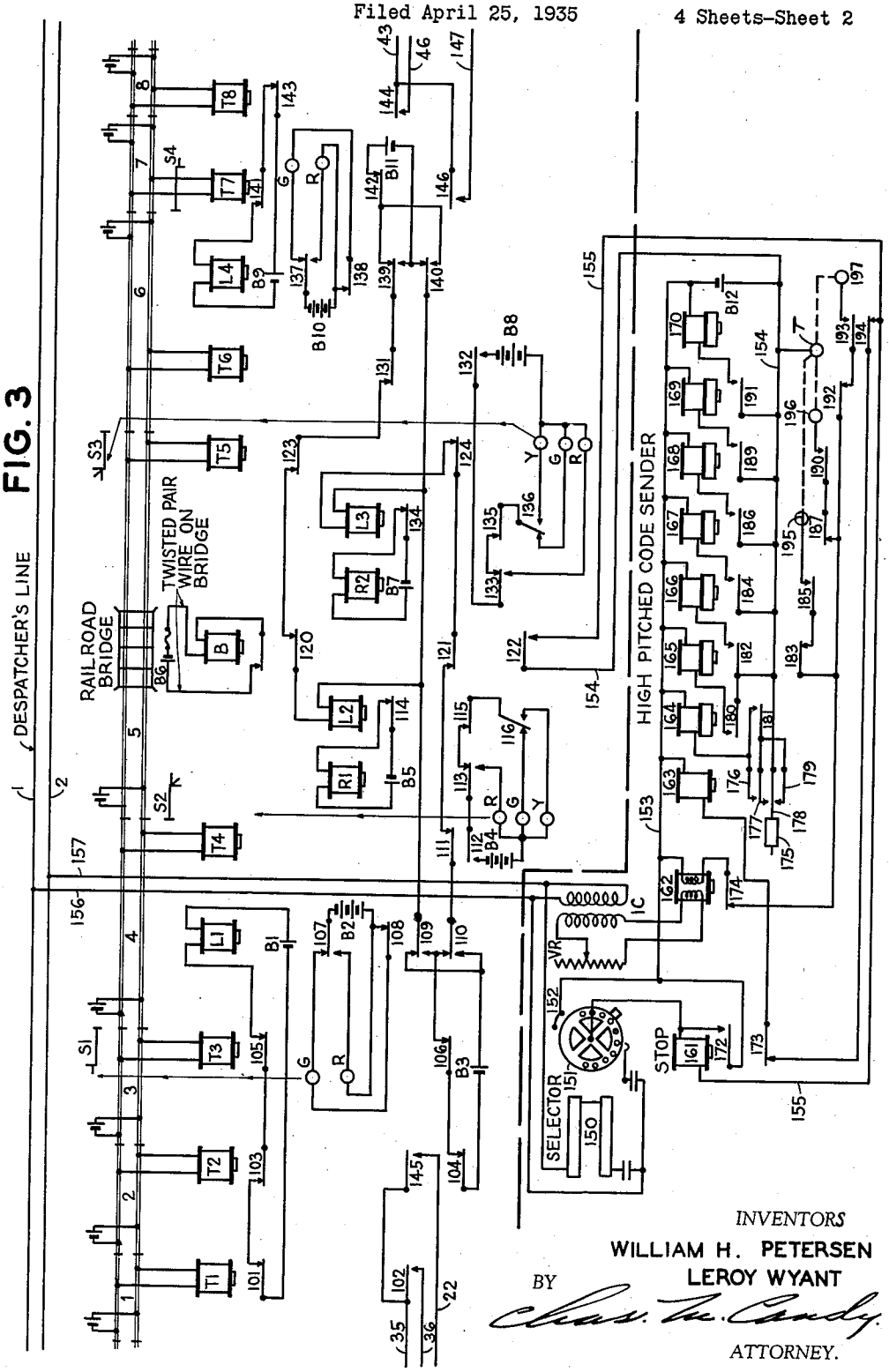
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RAILWAY SIGNALING SYSTEM

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FIG. 3




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RAILWAY SIGNALING SYSTEM

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FIG. 5

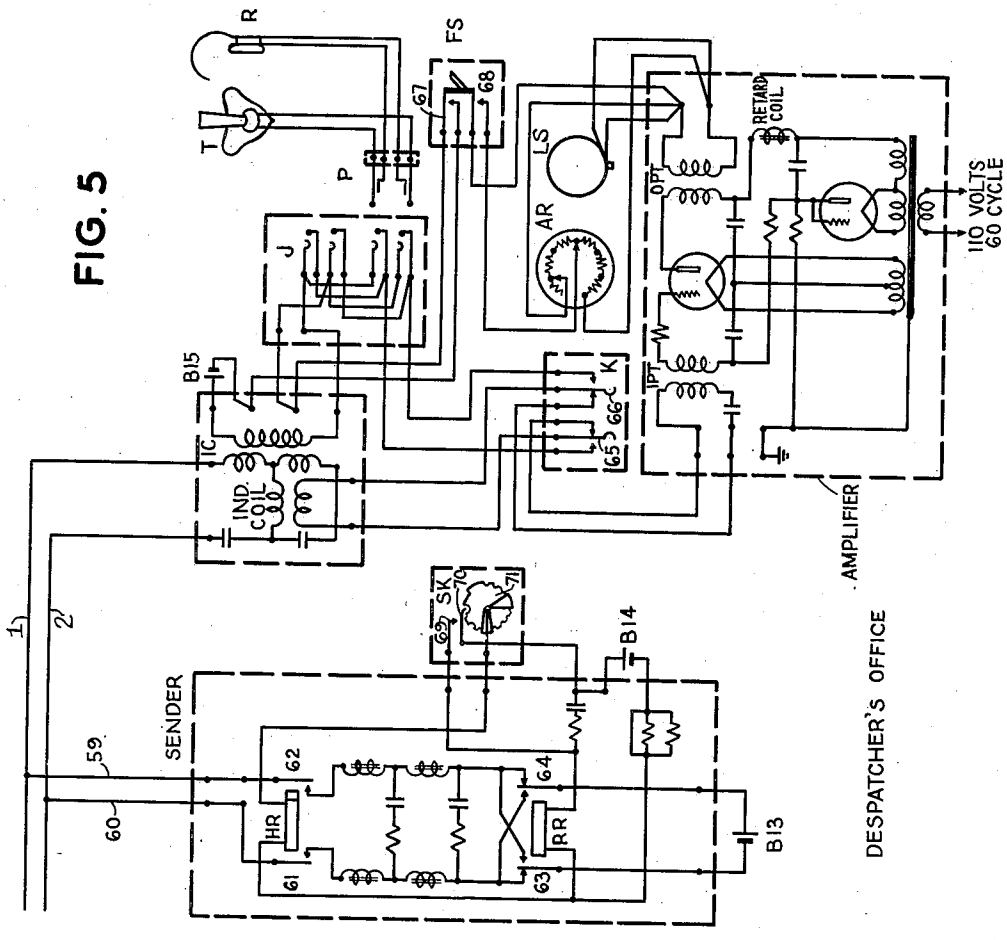
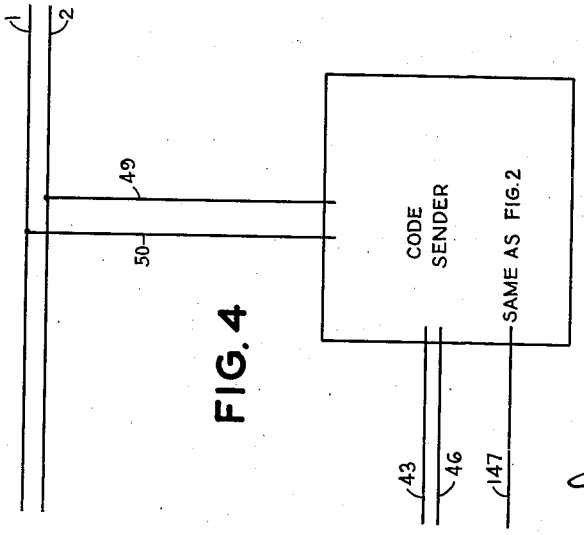



FIG. 4




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RAILWAY SIGNALING SYSTEM

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FIG. 8.

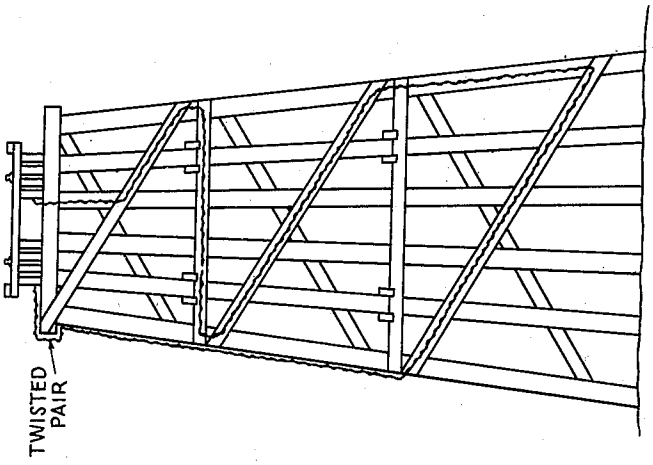



FIG. 6.

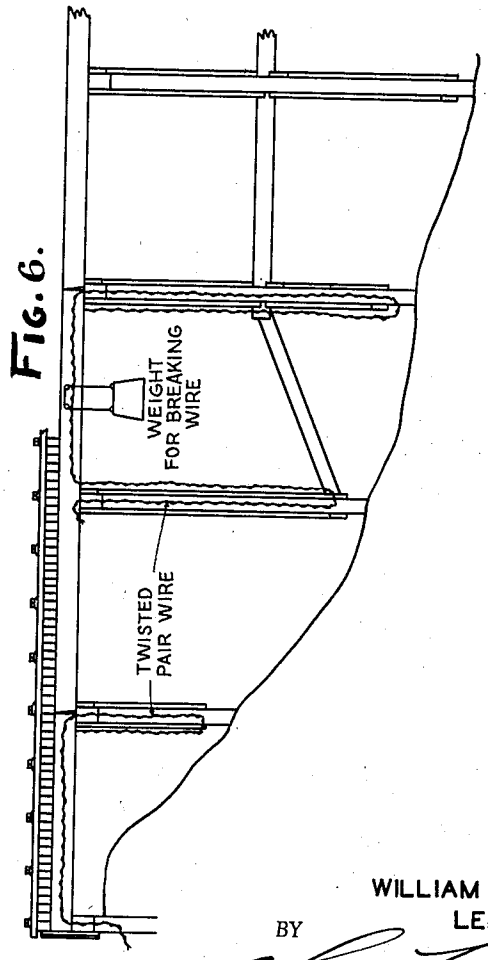
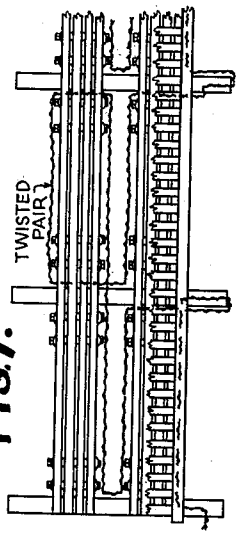



FIG. 7.




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# UNITED STATES PATENT OFFICE

2,091,104

## RAILWAY SIGNALING SYSTEM

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Application April 25, 1935, Serial No. 18,150

4 Claims. (Cl. 246—121)

This invention relates to railway signaling systems. The main object of the present invention is to provide a combined signaling system wherein the train through the medium of track circuits and defective railroad structures control track-side signals and transmit codes over the dispatcher's line to inform the dispatcher of the train locations and of a particular defect in the permanent way if such defect should occur.

In accordance with the present invention a bridge or wooden trestle has a twisted pair of wires passing promiscuously throughout the structure so that in case of fire the insulation will burn off and short the pair. In addition falling weights or the collapse of the framework may open one or both wires. In case the twisted pair of wires should be shorted or opened a relay which is normally energized over the twisted pair falls back and causes the transmission of a special code over the dispatcher's line, identifying this particular bridge. This same relay, in addition to the above, alters the signal control circuits so that the signals associated with this bridge section of track will automatically indicate danger to a train approaching this bridge section.

Another feature relates to the use of the dispatcher's line adjacent the railway track sections for the transmission of a special distinctive bridge code signal in case of fire or other damage to a bridge in one of the track sections in combination with the standard practice of using the dispatcher's line for conversation between the dispatcher and a number of way stations and for the transmission of different code signals by the code senders at the several O-S'ing positions along the track. The bridge code signal and the O-S'ing code signals being sufficiently different so as to readily distinguish a bridge signal from an O-S'ing signal even if the two were transmitted simultaneously over the dispatcher's line.

The accompanying drawings diagrammatically show the apparatus and connections of a railway signaling system embodying this invention.

Fig. 1 shows a well-known type of way station connected to the dispatcher's line. The way station comprises an induction coil IC, a key K for connecting the operator's telephone set to the dispatcher's line, and the well-known Western Electric type of ringer and selector.

Fig. 2 shows a similar type of selector and a code sender for transmitting a code over the dispatcher's line, indicative of this position and the direction of train travel. The code sender comprises start, stop, code, and directional relays and a motor magnet for stepping the wipers over the switch banks of the sender. The contacts in the switch banks are wired in a certain manner to send a predetermined code indicating the location and the direction of train travel.

Fig. 3 shows in its upper portion eight sections of track, signals S1 to S4, and the usual associated relays in a block system. A bridge is shown in section 5 and such bridge is wired with a twisted pair of wires which normally hold relay B in energized position over its front contacts after being placed in energized position by hand. Relays B, L1 to L4, and R1 and R2 in combination with the track relays control the lamps associated with their respective signals.

A high pitched code sender and a selector is shown in the lower portion of Fig. 3. The sender comprises a group of slow acting relays, a vibrating relay having a weighted armature spring such as disclosed in British Patent No. 289,602, an inductively wound code transmitting relay, and a stop relay controlled by the selector. This sender is started in operation when relay B falls back and may be wired to send one of three different codes dependent upon the number of dotted connections connected to the battery terminal T.

In Fig. 4 is shown a square which diagrammatically represents the same type of selector and code sender as shown in Fig. 2. The bank contacts of this sender, however, are wired to transmit a different code.

Fig. 5 shows a dispatcher's office having the well-known type of Western Electric sender for controlling the way station selectors and a dispatcher's loud speaking telephone equipment. The sender comprises a hold relay HR, a reversing relay RR and selector keys, such as SK, for transmitting reverse battery pulses over the dispatcher's line to operate the selectors associated with this line. The dispatcher's telephone equipment comprises two induction coils and plug and jack connections for connecting the dispatcher's transmitter T and receiver R to the dispatcher's line. An amplifier comprising in-put and out-put transformers and two vacuum tubes is normally connected to the dispatcher's line by way of the key K and induction coil IND. COIL for controlling the loud speaking telephone LS. The adjusting resistance AR is for use in producing an adjustment for the loud speaker volume. A foot switch FS is provided to cut in the dispatcher's transmitter and to partially short circuit the out-put transformer, thereby making the loud speaker partially inoperative.

Fig. 6 shows a side view of a bridge having a

twisted pair of wires passing promiscuously over and around the structure comprising the framework of the bridge as shown. This twisted pair of wires is normally provided with an insulation which in case of fire causes the pair to be shorted. The wire is placed on the bridge so that if any portion of the framework should be weakened by fire or other causes to an extent where it is no longer safe for a train to proceed over the bridge, such wire is either shorted or opened. The wire may be opened by the collapse of a portion of the framework or by a weight falling on the wire and breaking it. An iron weight, as shown in the side view, is suspended on wooden pegs in the bridge timber and a fire on this portion of the bridge will cause the weight to fall on taut wires between the timbers to break the same.

Fig. 7 shows a top view and Fig. 8 an end view of this bridge.

The dispatcher may selectively call and converse with operators at the various way stations over the dispatcher's line in the well known manner by operating a selector key at his sender to send the code of the desired way station, while the operators may at any time converse with the dispatcher by simply removing the receiver from the switchhook springs. For example, it will be assumed that the dispatcher wishes to talk to the way station operator at the way station shown in Fig. 1. The dispatcher operates a selector key, such as SK to transmit reverse battery pulses in accordance with the code of this way station over the dispatcher's line. Assuming that the selector key SK is the key operated, holding relay HR is operated from one pole of battery B14, contact spring 70, impulse wheel 71, winding of relay HR, to the other pole of battery B14. Relay HR operates and closes contacts 61 and 62 thereby connecting battery B13 to the dispatcher's line conductors 1 and 2 by way of armatures 63 and 64 and their back contacts, the retard coils, contacts 61 and 62, and conductors 60 and 59 to the dispatcher's line. When springs 69 and 70 close a circuit is completed for operating reversing relay RR as follows: from one pole of battery B14, springs 70 and 69, through the winding of relay RR to the other pole of battery. Relay RR operates its armatures 63 and 74 to reverse the battery connections from battery B13 to the dispatcher's line in accordance with the code of selector key SK in the well-known manner. All of the selectors on the dispatcher's line are operated by these reverse battery pulses but only one of these selectors, for instance the selector in Fig. 1, has its code pins set to complete a circuit in response to this particular transmitted code. The code pins on the selector are located so that after the first set of impulses the code wheel will be in position for the holding spring to engage with the first code pin. The second code pin is located so that after the second set of impulses the code wheel will be in position for the holding spring to engage with the second code pin. The third set of impulses then advances the code wheel so that the permanent code pin is in position to engage with the holding spring and at the same time the contact spring is directly over and makes contact with the ringing terminal to complete the circuit for operating the ringer. In the present instance it is assumed that the code wheel 17 (Fig. 1) has been set in accordance with the transmitted code so as to complete the circuit through ringing terminal 18 to cause the operation of the ringer at this station. The circuit for operating this ringer extends from one pole of battery through the code wheel 17, ringing terminal 18, and ringer to the other pole of battery. The bell at the station will ring for about two seconds after which an impulse from the calling key will release the selector and open the ringer circuit. While the bell is ringing a tone or answer-back will be heard in the loud speaker or receiver thereby notifying the dispatcher that the ringer is operating.

The operator at the called way station removes his receiver from the switchhook thereby completing a circuit for his receiver R as follows: from the lower left-hand terminal of the induction coil IC, switchhook springs 9 and 15, receiver R, spring 11 and its resting contact to the lower right-hand terminal of induction coil IC. In case the operator at the way station desires to talk to the dispatcher the key K is actuated to bridge the transmitter T and a local battery across the lower left half of the induction coil IC by way of key springs 12 and 13 and springs 9 and 14.

Voice currents are induced through windings of the induction coil IC and thence over the dispatcher's line.

At the dispatcher's office (Fig. 5) the voice currents are induced through the left-hand induction coil, through key springs 65 and 66 and their resting contacts to the in-put transformer IPT of the amplifier, through the upper vacuum tube, out-put transformer OPT to the loud speaker LS. The amplifier in the well known manner amplifies the voice currents received and causes the loud speaker to audibly reproduce the voice currents in such a manner that the dispatcher need not wear a head-phone. In case the dispatcher desires to disconnect the loud speaker and use the head set, the plug P is inserted in either set of jacks and the key K is operated. Incoming voice currents through the left induction coil extend by way of key springs 65 and 66 and their working contacts, sleeves of jacks J and the sleeve contacts of plug P through the receiver R. In case the dispatcher desires to talk to the distant way station operator, the foot switch FS is operated to close springs 67 to bridge the transmitter T and battery B15 across the right-hand winding of the right induction coil IC by way of the tip conductors of plug P and the tip springs of jack J. Since dispatching systems of this type are old and well known it is believed that the above brief description will suffice. In order to describe the operation of the "OS" sender equipment shown in Fig. 2 it will be assumed that a train proceeding in a northerly direction has entered track section 1 and follows through the track blocks shown in Fig. 3 thereby causing the de-energization of track relay T1. A circuit for energizing relay CS of the sender may now be traced as follows: from one pole of battery, conductors 33, 25, and 35, contacts 102 of the operated track relay T1, conductor 36, relay CS, and conductor 34 to the other pole of battery. Relay CS thereupon energizes and at its armature 42 closes its front contact to complete a circuit for energizing directional relay DS as follows: from one pole of battery, conductor 33, conductor 21, armature 42, armature 44 and back contact, and through the winding of relay DS to conductor 34 and the other pole of battery. At armature 45 relay DS opens the circuit to directional relay DN to prevent its energization and at armature 47 and front contact prepares a locking or stick circuit for itself. At armature 48 and front con-

tact relay DS connects wiper 82 by way of conductor 8 to code relay CO. Armature 42 also completes a circuit for energizing start relay SS as follows: from one pole of battery conductors 33 and 21, armature 42, conductor 3, through the winding of start relay SS to conductors 58, 57, 37, and 34 and battery. At armatures 91 to 94, inclusive, start relay SS, upon energizing, prepares certain circuits and at armature 95 and front contact bridges the secondary winding of induction coil IC across the dispatcher's line; this bridge including armature 95 and front contact, condenser C, variable resistance R and armature 93 and back contact.

As the train proceeds north and enters section 2 track relay T2 deenergizes and at armature 145 and back contact completes a circuit for energizing relay CN as follows: from one pole of battery, conductors 33, 25, and 35, armature 145 and back contact, conductor 22, winding of relay CN, conductor 34 to the other pole of battery. At armature 41 and front contact relay CN completes a circuit for energizing start relay SN from one pole of battery, conductors 33 and 21, armature 41, conductor 4, winding of relay SN to conductors 59, 58, 57, 37, and 34 and the other pole of battery. The circuit to directional relay DN is not completed at this time because its circuit is open at armature 45. Relay SN, upon energizing, at armature 52 completes the stick circuit of the energized directional relay, in this case relay DS as follows: from one pole of battery, conductor 33, back contact and armature 88 of stop relay ST, front contact and armature 91, armature 52 and front contact, conductor 7, armature 47 and front contact, through the winding of relay DS to conductor 34 and the other pole of battery. At armatures 92 and 53 a stick circuit for relay SN is completed from one pole of battery, conductor 33, armatures 88, 92, and 53, conductors 6 and 4, through the winding of relay SN to conductors 59, 58, 57, 37, and 34 and the other pole of battery. A similar stick circuit is completed for relay SS by way of conductor 33, armatures 88, 93, and 54, conductors 5 and 3, relay SS, and conductors 58, 57, 37, and 34. At armature 56 relay SN shunts armature 95 and at armature 55 completes a circuit for operating the motor magnet M of the code sender as follows: from one pole of battery, conductors 33 and 23, front contacts and armatures 55 and 94, armature 89 and back contact, interrupter springs 98, winding of motor magnet M, conductor 96 to conductor 34 and the other pole of battery. The motor magnet M energizes over this circuit and at its interrupter contacts 98 interrupts its own circuit.

The code switch comprises a number of wipers 82 to 87, inclusive, which are adapted to be rotated in the direction indicated by the arrows over their associated switch banks under control of the motor magnet M by means of a well known pawl and ratchet arrangement in which the pawl is positioned preparatory to the stepping of the wipers on the energization of the motor magnet M. When the magnet M is deenergized the pawl operates the ratchet and wipers one step. The wipers are the well-known bridging wipers which make contact with a succeeding contact before disengaging from the preceding bank contact. Motor magnet M by interrupting its own circuit at interrupter springs 98 operates in the manner of a buzzer to advance the wipers step by step as long as such circuit is closed. It will be observed that wipers 87, 83, and 82 are resting on their last set of bank contacts while wipers 86, 84, and 85 are resting on their first set. When wiper 84 engages the first one of the two bank contacts 76, a circuit is completed for energizing the code relay CO as follows: from one pole of battery, conductors 33 and 23, armatures 55 and 94 and their front contacts, armature 89 and back contact, winding of code relay CO, wiper 84, 1st contact 76 connected to conductor 38, conductor 37, conductor 34 and the other pole of battery. At armature 24 and front contact relay CO completes the circuit through the lower or primary winding of induction coil IC from battery as follows: conductors 33 and 23, armatures 55 and 94, armature 89 and back contact, armature 24 and front contact, lower winding of induction coil IC, conductors 59, 58, 57, and 37, to conductor 34 and battery. The current flowing through this circuit induces a current flow in the upper secondary winding of the induction coil IC. This induced current is transmitted over the dispatcher's line by way of conductor 39, contacts 56 and 95 in multiple, condenser C, variable resistance R, contacts 90, upper winding of induction coil IC, and conductor 40. This induced current produces an audible "click" in the loud speaker LS at the dispatcher's station in the well known manner. The resistance in the above traced circuit may be adjusted to modify the loudness of the "click" in the loud speaker LS.

The code relay CO is maintained energized over the second bank contact 76 and deenergizes when wiper 84 steps into engagement with its third or dead bank contact. The code relay CO is therefore held energized during the time it takes the wipers to take two steps and this interval of time corresponds to a "dot" in the Morse code. When the code relay deenergizes in response to wiper 84 reaching its third bank contact the circuit through the lower winding of the induction coil IC is broken at contacts 24. When wiper 84 is next stepped into engagement with its fourth bank contact the code relay is again energized for a time interval corresponding to a "dash" in the Morse code since four bank contacts, the fourth, fifth, sixth, and seventh contacts, are multipled as indicated at 77. The code relay is therefore energized for four successive steps of the wipers for a "dash" and two successive steps of the wipers for a "dot". By referring to the drawings it will be seen that wiper 84 sends only one dot and one dash for the first letter or figure of the code in this code letter A. Wiper 85 is next effective to send one dash and three dots corresponding to the code of letter B as indicated at 78, 79, 80, and 81. Since directional relay DS is energized wiper 82 is next effective to send a dash and a dot corresponding to letter N or the direction of train travel. It will be seen that the code transmitted is dependent upon the battery connections to the bank contacts and that such connections may be altered to transmit any desired code. This code sender continues to send the code as long as the start relays are energized. Since the start relays are held energized by the deenergized condition of stop relay ST, the code will be continuously transmitted until the stop relay ST is energized.

The code switch continues to operate and repeatedly sends the code letter AB indicating the location or track sections and the letter N indicating the direction of the movement of the train until stopped by the dispatcher.

Before describing the manner in which code transmission is stopped a brief description of the

code sender will be given when a train enters section 2 traveling in a southerly direction.

Assume now that a train proceeding along the railroad track in the opposite or southerly direction enters track section 2 thereby causing the deenergization of track relay T2. At contacts 145 track relay T2 completes a circuit for energizing relay CN from one pole of battery, conductors 33, 25, and 35, contacts 145, conductor 22, winding of relay CN to conductor 34 and the other pole of battery. At armature 41 relay CN completes a circuit for energizing start relay SN from one pole of battery, conductors 33 and 21, armature 41 and front contact, conductor 4, winding of start relay SN, conductors 59, 58, 57, and 37, to conductor 34 and the other pole of battery. At armature 56 relay SN bridges the secondary winding of induction coil IC in series with condenser C and variable resistance R across the dispatcher's line and at armatures 52 to 55, inclusive, prepares locking circuit for relays DN, SN, and SS. Relay CN at armature 41 also completes the circuit for energizing directional relay DN as follows: from one pole of battery, conductors 33 and 21, armature 41 and front contact, back contact and armature 45, through the winding of relay DN to conductor 34 and the other pole of battery. At armature 30 relay DN prepares a locking or stick circuit for itself; at armature 44 opens a point in the energizing circuit to directional relay DS to prevent its energization at this time; and at armature 51 connects wiper 83 by way of conductor 3 to code relay CO so that the sender will send the code for letter S to indicate the direction of travel of the train. When the train enters section 1 track relay T1 deenergizes and completes the previously traced circuit for energizing relay CS. At armature 42 and front contact relay CS completes the circuit for energizing start relay SS as follows: from one pole of battery, conductors 33 and 21, armature 42 and front contact, conductor 3, winding of relay SS, conductors 58, 57, and 37 to conductor 34 and the other pole of battery. Since both start relays SN and SS are now energized the previously traced locking circuits of the start relays are again completed. Relay DN locks energized over contacts 88, 91, 52 and 30 and the previously traced self interrupting circuit of motor magnet M is again completed to continuously step the wipers of the switch as previously described. Code relay CO is again operated to transmit the code AB encountered by wipers 84 and 85 after which, since relay DN alone is energized, wiper 83 is effective to operate code relay CO in accordance with the code of letter S to transmit code letter S over the dispatcher's line to indicate that the train is traveling in a southerly direction. The code in this case comprises AB, indicating location, and S, indicating direction. The code is continuously sent until stopped by the dispatcher.

The dispatcher may stop the transmission of this code by operating the selector in Fig. 2 to complete a circuit for the stop relay ST. The stop relay ST is energized over the following circuit: from one pole of battery, conductors 33, 25, 26, and 27, code wheel 31, terminal 32, conductor 97, through winding of the stop relay ST, and conductors 57, 37, and 34 to the other pole of battery. At contacts 90 the stop relay ST opens the circuit through the upper winding of the induction coil IC to stop further code transmission. At the back contact of armature 89 the stop relay ST opens the circuit to the code relay CO and the motor magnet M. At armature 89 and its front contact stop relay ST completes a locking circuit for itself by way of one pole of battery, conductors 33 and 23, front contacts of armatures 55, 94 and 89, through stop relay ST, conductors 57 and 37, to conductor 34 to the other pole of battery. At armature 99 and its front contacts stop relay ST completes a circuit for automatically restoring the wipers of the code switch to their normal positions or the positions shown in the drawings. It will be assumed that at the time stop relay ST is energized wiper 86 or wiper 87 is on one of the multipled bank contacts 29 connected to conductor 28. In this case a self interrupted circuit for operating motor magnet M is completed from one pole of battery, conductors 33, 25, 26, and 28, any one of the multipled bank contacts 29, wiper 86 or wiper 87, armature 99 and front contact, interrupter springs 93, winding of motor magnet M, conductor 96 to conductor 34 and the other pole of battery. Motor magnet M continues to interrupt its own circuit and step the wipers of the switch until such time as both wipers 86 and 87 come into engagement with their normal position bank contacts in which case no circuit is completed for the motor magnet since these contacts are not connected to conductor 28. The wipers, therefore, remain in this position until another train arrives at this location.

At armature 88 and back contact relay ST, upon energizing, opens the locking circuit of the energized directional relay DN or DS and also opens the circuits of start relays SN and SS which accordingly deenergize. The deenergization of start relays SN and SS opens the locking circuit of stop relay ST at armatures 55 or 94 thereby causing the deenergization of stop relay ST since the selector is released by this time by an automatic impulse over the dispatcher's line. Since relays CN and CS deenergized when the train proceeded through these track sections all of the relays and wipers of the code switch are now restored to normal.

The code sender shown by the square in Fig. 4 is somewhat similar to that shown in Fig. 2 and is operated in the same manner when track relays T7 and T8 are deenergized to close contacts 144 and 146. The code from this sender, however, is different since the code transmitted corresponds to track sections 7 and 8.

Referring now to Fig. 3 the block signal control system will now be described. For this purpose it will be assumed that a train enters section 1 from the left and causes the deenergization of track relay T1. At armature 101 track relay T1 opens the normally closed circuit to relay L1 to cause the latter relay to deenergize. At armature 102 track relay T1 causes the operation of relay CS shown in Fig. 2 as previously described. Relay L1, upon deenergizing, at armatures 107 and 108 opens the normally closed circuit through the green lamp G of signal S1, and at the back contact of armature 107 completes the circuit for illuminating the red lamp R of signal S1 over an obvious circuit. At armatures 109 and 110 relay L1 reverses the current flow over the subsequently traced circuit through signal relay L3 whereupon signal relay L3, being a polar neutral relay, operates its armature 136 to the right to prepare a circuit for the yellow lamp Y on signal S3. If a train is in section 6 at this time the yellow lamp of signal S3 will be illuminated.

As the train proceeds and enters section 2 track relay T2 as deenergized and at armature 103

maintains the circuit of relay L1 open. At armature 145 relay T2 operates relay CN to cause the code sender of Fig. 2 to transmit a code as previously described. At armature 104 relay T2 opens the circuit of polar neutral relay L3 which has previously been energized over the following circuit: from one pole of battery B3, contacts 104 and 106, over the back contact of armature 109, through the winding of relay L3, contacts 124, 121, 111, armature 110 and its back contact to the other pole of battery B3. Relay L3, upon deenergizing, at armature 134 opens the circuit of relay R2 and at armature 135 opens the prepared circuit to the yellow lamp of signal S3. Relay R2, upon deenergizing, at armature 133 prepares the circuit for the red lamp R of signal S3 so that this lamp will be illuminated in case a train enters section 6.

When the rear of the train leaves section 1 track relay T1 again energizes and at armature 101 prepares a point in the circuit of relay L1, while at armature 102 the circuit to relay CS is opened to cause the deenergization of relay CS.

When the train enters section 3 track relay T3 deenergizes and at armature 105 opens a further point in the circuit of relay L1, and at armature 106 opens a further point in the circuit of signal relay L3.

When the rear of the train leaves section 2 track relay T2 energizes and at armature 103 prepares a point in the circuit of relay L1 and at armature 104 prepares a point in the circuit of signal relay L3. At armature 145 relay T2 opens the circuit of relay CN thereby causing its deenergization.

When the train enters section 4 track relay T4 deenergizes and at armature 111 opens a further point in the circuit of signal relay L3 to maintain this relay in deenergized position. At armature 112 track relay T4 completes a circuit for lighting the green, red, or yellow lamp of signal S2, dependent upon the operated condition of signal relay L2, which is controlled from the track sections beyond or track sections 5, 6, 7, and 8 and bridge relay B. In case there are no trains in sections 5, 6, 7, and 8, and the bridge is not defective signal relay L2 will be in the position shown in the drawings with the result that a circuit for the green lamp G of signal S2 is completed from one pole of battery B4 through the filament of the green lamp G of signal S2, left contact and armature 116, contacts 115, front contact and armature 113, and through contact 112 to the other pole of battery B4. If a train is in either section 5, 6, or 7 or the bridge is destroyed, signal relay L2 and relay R1 are deenergized to complete a circuit for the red lamp R of signal S2 by way of armature 113 and its back contact. In case there is a train in section 8 relays L2 and R1 are in energized position, but armature 116 of the polar neutral relay L3 is in its right-hand operated position with the result that a circuit is completed to the yellow lamp Y of signal S2.

As the train leaves section 3 track relay T3 is energized to prepare a point in the circuit for energizing signal relay L3 at armature 106, and at armature 105 completes the circuit for energizing relay L1 over contacts 101 and 103 and battery B1. At armatures 107 and 108 and their front contacts the circuit for the green lamp G of signal S1 is again completed, while at armatures 139 and 140 and their front contacts a circuit is prepared for operating the polar neutral signal relay L3 so as to operate armature 136 to its left-hand position or the position shown in the drawings.

When the train enters the bridge section, or section 5 track relay T5 deenergizes and at armature 123 opens the circuit of polar neutral signal relay L2 which heretofore has been energized over the following circuit: from one pole of battery B11, front contact and armature 142, front contact and armature 139, contacts 131, 123, and 120, through the winding of signal relay L2, armature 140 and front contact to the other pole of battery B11. At armature 124 track relay T5 opens a further point in the circuit of signal relay L3 so as to maintain this relay in deenergized position. Signal relay L2, upon deenergizing, at armature 114 opens the circuit of relay R1, and at armature 115 opens the circuit of the green lamp G of signal S2. Relay R1, upon deenergizing, at armature 113 and back contact completes a circuit for illuminating the red lamp R of signal S2.

When the rear of the train leaves section 4 track relay T4 energizes to prepare a point in the circuit of signal relay L3 at armature 111 and at armature 112 opens the circuit to the red lamp R of signal S2. The signal S2 is now dark and will not be illuminated until another train enters section 4.

When the train enters section 6 track relay T6 deenergizes to maintain the circuit of signal relay L2 open at armature 131 and at armature 132 completes the circuit for illuminating the red lamp R of signal S3 as follows: from one pole of battery B8, filament of the red lamp R of signal S3, back contact and armature 133, armature 132 to the other pole of battery B8.

When the train leaves section 5 track relay T5 energizes to prepare a point in the circuit of signal relay L2 at armature 123, and at armature 124 completes the circuit for energizing signal relay L3 over its normally closed circuit previously traced. At armature 134 signal relay L3 completes the circuit for energizing relay R2 and at armatures 135 and 136 completes the circuit for illuminating the green lamp G of signal S3 when relay R2 closes its front contact at armature 133. This circuit may be traced from battery B8 through the filament of the green lamp G of signal S3, left-hand contact and armature 136, armature 135, front contact and armature 133, armature 132, to battery B8.

When the train enters section 7 track relay T7 deenergizes to open the circuit of relay L4 at armature 141 and at armature 142 opens another point in the circuit for signal relay L2. At armature 146 relay T7 completes the circuit for energizing a relay in the sender of Fig. 4 corresponding to relay CS. Relay L4, upon deenergizing, at armatures 137 and 138 and their front contacts, opens the circuit to the green lamp G of signal S4, and at the resting contact of armature 137 completes the circuit for illuminating the red lamp R of signal S4. At armatures 139 and 140 and their back contacts relay L4 prepares a point in the circuit for reversing the battery connections to signal relay L2.

When the rear of the train leaves section 6 track relay T6 energizes to prepare a circuit for signal relay L2 at armature 131 and at armature 132 opens the circuit to the green lamp G of signal S3. The signal S3 is now dark and remains in this condition until another train enters section 6.

When the train enters section 8 track relay T8 deenergizes to open a further point in the

circuit of relay L4 at armature 143 and at armature 144 causes the operation of the code sender in Fig. 4 to transmit a code over the dispatcher's line, as previously described for Fig. 2.

When the train leaves section 7 track relay T7 energizes to prepare a point in the circuit for relay L4 at armature 141, at armature 146 opens the circuit to the code sender relay in Fig. 4, and at armature 142 completes a circuit for energizing the polar neutral relay L2 as follows: from one pole of battery B11, armature 142, back contact and armature 140, through the winding of signal relay L2, contacts 129, 123, and 131, armature 139 and its back contact, to the other pole of battery B11. Signal relay L2 energizes over the above-traced circuit and at armature 114 completes the circuit for energizing relay R1. Relay L2, due to the reversal of battery through its winding, operates its armature 116 to the right to prepare a circuit for the yellow lamp Y of signal S2. Relay R1, upon energizing, at armature 113 and its front contact prepares a circuit for the yellow or green lamp of signal S2, dependent upon the operated position of armature 116. If a train should enter section 4 at this time the circuit for the yellow lamp Y on signal S2 would be completed.

When the rear of the train leaves section 8 track relay T8 energizes to complete the normally closed circuit of relay L4 at armature 143 and at armature 144 opens the circuit to the code sender relay of the code sender shown in Fig. 4. Relay L4, upon energizing, at armature 137 and back contact opens the circuit of the red lamp R of signal S4 and at the front contacts of armatures 137 and 138 completes the circuit for illuminating the green lamp G of signal S4. At armatures 139 and 140 and their front contacts, relay L4 reverses battery to signal relay L2 to cause relay L2 to operate its armature to the left as shown in the drawings to prepare the circuit for the green lamp G of signal S2. If a train should enter track section 4 at this time the green lamp G of signal S2 is illuminated in the same manner as previously described.

Since the track shown in Fig. 3 is used for traffic in both directions it will now be assumed that a train traveling from right to left over this track enters section 8. Track relay T8 thereupon deenergizes to open the circuit of relay L4 at 143, and at armature 144 causes the operation of the code sender relay in Fig. 4. Relay L4, upon deenergizing, at armatures 137 and 138 extinguishes the green lamp G and illuminates the red lamp R of signal S4, as previously described. At armatures 139 and 140 relay L4 reverses the current through the winding of signal relay L2 to cause this relay to operate its armature 116 to the right, so that if a train enters section 4 the yellow lamp Y of signal S2 is illuminated.

When the train enters section 7 track relay T7 deenergizes to maintain the circuit of relay L4 open at armature 141, at armature 146 causes the operation of the code sender in Fig. 4, and at armature 142 opens the circuit of signal relay L2 to cause the latter relay to deenergize. At armature 114 relay L2 opens the circuit of relay R1 and at armature 115 opens points in the circuit to the green and yellow lamps of signal S2. Relay R1, upon deenergizing, at armature 113 prepares a point in the circuit for the red lamp R of signal S2, so that the red lamp of signal S2 is illuminated if a train enters section 4.

When the train leaves section 8 track relay T8 is energized to prepare a point in the circuit of relay L4 at armature 143, and to open the circuit of the code sender relay in Fig. 4 at armature 144.

When the train enters section 6 the track relay T6 deenergizes to maintain the circuit of signal relay L2 open at armature 131 and at armature 132 completes a circuit for illuminating the proper lamp of signal S3 in accordance with the occupied or unoccupied condition of the track sections beyond and the condition of the bridge section S. In case no train is in sections 5, 4, 3, or 2, and the bridge in section 5 is not damaged, the green lamp G of signal S3 is illuminated from one pole of battery B8 through the filament of green lamp G of signal S3, left-hand contact and armature 136, armature 135, front contact and armature 133, armature 132, to the other pole of battery B8. In case there is a train in section 1 relays L3 and R2 are in energized position, but armature 136 is in its right-hand operated position with the result that the circuit through the yellow lamp Y is completed instead of the green lamp. In case a train is in any one of the sections 2, 3, 4, or 5, or the bridge is defective relays L3 and R2 are in deenergized condition, and the red lamp is illuminated over armature 133 and back contact and armature 132.

When the train leaves section 7 track relay T7 energizes to prepare a circuit for signal relay L2 at armature 142, at armature 146 opens the circuit to a code sender relay in Fig. 4, and at armature 141 completes the circuit for energizing relay L4. Relay L4, upon energizing, at armatures 137 and 138 extinguishes the red lamp R and illuminates the green lamp G of signal S4. At armatures 139 and 140 relay L4 prepares a point in the circuit of relay L2 so as to operate its armature 116 to the left due to the reversal of battery connections thereto.

When the train enters section 5 track relay T5 deenergizes to maintain the circuit of signal relay L2 open at armature 123 and at armature 124 opens the circuit of signal relay L3. Relay L3, upon deenergizing, at armature 134, opens the circuit of relay R2 and at armature 135 opens a point in the circuit to the yellow or green lamps of signal S3. At armature 133 and its back contact relay R2 completes the circuit for lighting the red lamp R of signal S3.

When the train leaves section 6 track relay T6 energizes to prepare a circuit for the signal relay L2 at armature 131 and at armature 132 opens the circuit to the red lamp R of signal S3. The signal S3 is now dark and will not be illuminated until another train enters section 6.

When the train enters section 4 track relay T4 deenergizes to maintain the circuit of signal relay L3 open at armature 111 and at armature 112 completes the circuit for the red lamp R of signal S2.

When the train leaves section 5 track relay T5 energizes to prepare a point in the circuit of signal relay L3 at armature 124, and at armature 123 completes the normally closed circuit for signal relay L2 as previously traced. Relay L2, upon energizing, at armature 114 completes the circuit for energizing relay R1, closes contacts 115 and operates armature 116 to the left as shown in the drawings. Relay R1 at armature 113 lights the green lamp G of signal S2 if no train is in section 8, while if a train is in section 8 the yellow lamp Y of signal S2 is illuminated.

When the train enters section 3 track relay T3 deenergizes to maintain the circuit of signal

relay L3 open at armature 106 and to open the circuit of relay L1 at armature 105. Relay L1, upon deenergizing, at armatures 107 and 108 extinguishes the green lamp G and illuminates the red lamp R of signal S1. At armatures 109 and 110 and their resting contacts prepares a circuit for connecting reverse battery to signal relay L3.

When the train leaves section 4 track relay T4 energizes to prepare the circuit for signal relay L3 at armature 111, and at armature 112 opens the circuit to the signal lamps of signal S2.

When the train enters section 2 track relay T2 deenergizes to maintain the circuit of relay L1 open at armature 103 and to maintain the circuit of signal relay L3 open at armature 104. At armature 145 relay T2 completes the circuit for energizing code relay CN as previously described.

When the train leaves section 3 track relay T3 energizes to prepare a circuit for relay L1 at armature 105 and to prepare a circuit for signal relay L3 at armature 106.

When the train enters section 1 track relay T1 deenergizes to maintain the circuit of relay L1 open at armature 101 and at armature 102 causes the operation of relay CS and the code sender shown in Fig. 2 to transmit the predetermined code over the dispatcher's line, as previously described.

When the train leaves section 2 track relay T2 energizes to prepare a circuit for relay L1 at armature 103, at armature 145 causes the deenergization of relay CN, and at armature 104 completes the reverse battery connection to signal relay L3 to cause relay L3 to operate its armature 136 to its right-hand operated position. Signal relay L3, upon energizing, at armature 134 completes the circuit for relay R2 and at armature 135 prepares points in the circuits to the green or yellow lamps of signal S3. At armature 133 and its front contact, relay R2 prepares the circuit for the yellow lamp of signal S3.

When the train leaves section 1 track relay T1 energizes to close the circuit of relay L1 at armature 101, and to open the circuit of relay CS of the code sender in Fig. 2 at armature 102. Relay L1, upon energizing, at armatures 107 and 108 extinguishes the red lamp R and illuminates the green lamp G of signal S1. At armatures 109 and 110 and their front contacts relay L1 reverses the battery connection through the winding of signal relay L3 to cause armature 136 to be moved to the left to prepare the circuit for the green lamp G of singal S3. The circuits of the signaling system are now in their normal position or in the position shown in the drawings.

It will now be assumed that due to fire the twisted pair of wires crossing promiscuously over and around the frame work of the bridge are short circuited or are opened due to fire or other damage to the bridge. In either case the bridge relay B is deenergized. Bridge relay B, upon deenergizing, at contacts 120 opens the circuit to signal relay L2, at contacts 121 opens the circuit to signal relay L3, and at contacts 122 closes a circuit for operating the relay code sender shown in the bottom of this figure to transmit a high pitched bridge code over the dispatcher's line to the dispatcher, in a manner to be described hereinafter.. Signal relays L2 and L3 operate in the same manner as previously described to open the circuits of relays R1 and R2 so that a train approaching the bridge section, or section 5, will operate the red lamps of signals S2 and S3 regardless of the occupied or non-occupied condition of the track sections beyond. The circuit for the red lamp R of signal S2 is prepared at armature 113 and its back contact and completed by track relay armature 112 when a train enters section 4. In a similar manner the red lamp R of signal S3 is prepared at armature 133 and its back contact and completed at armature 132 when a train enters section 6. Signals S2 and S3 will therefore automatically indicate danger when a train approaches the bridge section at a time when bridge relay B is denergized as a result of fire or other damages to the bridge.

As previously stated, in case relay B falls back due to the twisted pair of wires being short circuited or opened said relay at contact 122 completes a circuit for energizing relay 163 as follows: from one pole of battery B12, conductor 154, contacts 122, conductor 155, back contact and armature 194, back contact and armature 173, through the winding of relay 163 to conductor 153 and the other pole of battery B12. Relay 163, as previously stated, is somewhat similar to the vibrating relay shown in British Patent No. 289,602 and upon energizing operates its weighted spring 175 so as to cause contacts 176, 177, and 178 to engage. At contacts 176, 177 and 178 relay 163 completes a circuit for energizing relay 164 from battery B12 by way of conductors 153 and 154. At armature 181 relay 164 prepares a holding circuit for itself and at armature 180 completes a circuit over conductors 153 and 154 for energizing relay 165. Relay 165 at armature 193 opens one point in the circuit to tone relay 162 and at armature 182 completes a circuit for relay 166. Relay 166 at 185 prepares one point in the circuit to tone relay 162 and at 184 completes a circuit for relay 167. In a similar manner relays 168, 169, and 170 are energized in succession over contacts 186, 189, and 191. Relays 166, 168, and 170 prepare points in the circuit for the tone relay 162 at contacts 185, 190, and 193, while relays 165, 167, and 169 open points in the tone relay circuits at contacts 183, 187, and 192. Armature 194 of relay 170 opens the circuit of start relay 163 which thereupon releases its weighted spring 175 which vibrates for a predetermined length of time to alternately close contacts 177 and 178, and 178 and 179. Slow acting relay 164, due to the circuit through contact 181 and its retarded action, is held in operated position by these alternate closures for a predetermined time. When the amplitude of the weighted spring is reduced to a point where springs 177 and 179 are no longer contacted, relay 164 deenergizes and at 180 opens the circuit to slow acting relay 165 which deenergizes after an interval. Relays 166 to 170, inclusive, deenergize in succession in response to the preceding relay opening its circuit. Due to the retarded action of these relays there is a slight interval of time between the deenergization each succeeding relay and this interval is used to transmit a tone to the dispatcher by operating tone relay 162. For example, it will be assumed that terminals 195, 196, and 197 are connected by jumpers represented by the dotted lines to the battery terminal T for transmitting a code comprising three high pitched buzzes. The first part of the code is transmitted in response to the deenergization of relay 165 when relay 166 is still energized at which time tone relay 162 is energized over the following circuit: from one pole of battery B12, conductor 154, terminal T, dotted jumper, terminal 195, contacts 185 and 183, interrupter contact 174 of relay 162, through the right-hand winding of relay 162 to conductor 153 and the other pole of battery. Due to its inter-

rupter springs 174 tone relay 162 is rapidly energized and deenergized over this circuit during the time it takes relay 166 to completely fall back and open contacts 185. The rapid interruption in the energizing circuit of tone relay 162 induces a current in the left-hand winding which is transmitted through the induction coil IC and over wires 156 and 157 and the dispatcher's line in the well-known manner. After an interval relay 166 falls back and opens the circuit to tone relay 162 at 185 and at 184 opens the circuit to relay 167. When relay 167 falls back the tone relay is again operated, this time over a circuit extending from one pole of battery B12, conductor 154, terminal T, dotted jumper, terminal 196, contacts 190 and 187, interrupter springs 174, and right-hand winding of relay 162 to conductor 153, and the other pole of battery. Relay 162 vibrates as before and transmits the second part of the code over the dispatcher's line. When relay 168 falls back after an interval the circuit to tone relay 162 is opened at contacts 90 to stop the transmission. After an interval relay 169 falls back and again operates tone relay 162 over a circuit this time including terminal T, dotted jumper, terminal 197 and contacts 193 and 192. As before, relay 162 transmits the third part of the code to the dispatcher and when relay 170 finally falls back the tone is stopped. The deenergization of relay 170 at armature 194 again completes the circuit for relay 163 which again energizes to cause the successive energizations of relays 164 to 170, inclusive, as previously described. The reenergization of relay 170 again opens the circuit of relay 163 which again vibrates its weighted spring 175 to maintain relay 164 in energized position for a predetermined length of time. After an interval relays 164 to 170 fall back in the same manner as previously described to again transmit the code over the dispatcher's line. This tone continues until such time as relay B is manually energized to open contacts 122 or until the dispatcher stops the transmission by energizing and locking up relay 161. It can be readily understood that in order to change the code from three buzzes to one or two buzzes it is only necessary to cut one or two of the dotted jumpers connected to terminal T.

In the dispatcher's office this high pitched code transmitted over the dispatcher's line is audible in the loud speaker LS and immediately advises the dispatcher that the bridge at this particular section is no longer safe for traffic. In accordance with the usual procedure the dispatcher will immediately take whatever steps are necessary to again place the bridge in service.

If desired the dispatcher may stop the transmission of the bridge code by operating the selector in Fig. 3 to close the circuit for stop relay 161. The dispatcher, in order to stop the bridge code, transmits the impulsing code from the apparatus in Fig. 5 which affects the selector in Fig. 3 which completes the circuit for stop relay 161 as follows: from one pole of battery B12, conductor 154, contacts 122, conductor 155, winding of stop relay 161, code wheel 151, terminal 152, and conductor 153 to the other pole of battery. Stop relay 161 at armature 172 completes a stick circuit for maintaining itself energized as long as contacts 122 are closed. At armature 173 relay 161 opens the circuit to relay 163 so that this relay cannot again operate when relay 170 falls back at the end of the bridge code. When relay B is again energized the stick circuit to stop relay 161 is opened whereupon said relay deenergizes to allow the bridge code sender to function again.

Having described the invention and what is considered to be new and is desired to be protected by Letters Patent, will be set forth in the following claims.

What is claimed is:

1. In an audible railway signaling system, the combination of a common dispatcher's line adjacent a railway track divided into sections, a plurality of O-S'ing positions corresponding to certain of said sections, a code sender at each said position for transmitting a distinctive code indicative of such position over the common dispatcher's line in response to a train arriving at the corresponding track sections, a bridge supporting a portion of the track of one of said sections, a code sender individual to said bridge for transmitting a different kind of code indicative of this bridge over the common dispatcher's line, said bridge code being sufficiently different when simultaneously received with an O-S'ing code for enabling the dispatcher to identify both the bridge code and the particular O-S'ing code transmitted, means for operating the bridge code sender in case of fire or other damage to said bridge, and a dispatcher's receiving set audibly operated by said different transmitted codes to enable a dispatcher to identify a bridge code and an O-S'ing code in case both codes are simultaneously transmitted.

2. In an audible railway signaling system, the combination of a common dispatcher's line adjacent a railway track having several O-S'ing positions for transmitting distinctive codes indicative of such positions over the common dispatcher's line when a train arrives at the corresponding track sections, a bridge supporting a portion of the track in one of said sections, a bridge code sender operated in response to bridge trouble for transmitting a different pitched code over the common dispatcher's line indicative of this particular bridge to inform the dispatcher of the bridge trouble, the difference in the bridge code and the O-S'ing codes being sufficient in case a bridge code and an O-S'ing code were transmitted simultaneously to enable the dispatcher to identify each particular code transmitted, and a dispatcher's receiving set audibly operated by said different pitched codes to enable the dispatcher to identify an O-S'ing code and a bridge code in case both codes are simultaneously transmitted.

3. In an audible railway signaling system, the combination of a common dispatcher's line associated with a railway track divided into sections, a plurality of O-S'ing positions correspondng to certain of said sections, a code sender at each said position for transmitting a distinctive code over the common dispatcher's line indicative of both the position and the direction of train travel in response to a train arriving at the corresponding track sections, a bridge supporting a portion of the track of one of said sections, a code sender individual to said bridge for transmitting a different kind of distinctive code over the common dispatcher's line indicative of this particular bridge, said bridge code being sufficiently different when simultaneously received with an O-S'ing code to enable the dispatcher to identify both the bridge code and the particular O-S'ing code transmitted, means for operating said bridge code sender in case of fire or other damage to said bridge, and a dispatcher's receiving set audibly operated by said

different codes to enable the dispatcher to identify an O-S'ing code and a bridge code in case both codes are simultaneously transmitted.

4. In an audible railway signaling system comprising in combination a code sender at each of a plurality of O-S'ing positions along a railway for transmitting codes over a common dispatcher's line and a bridge code sender associated with a bridge supporting a portion of the railway track for transmitting a different type of code over the common dispatcher's line, means in each O-S'ing code sender for transmitting Morse codes over the dispatcher's line indicative of its location in response to a train arriving at the corresponding O-S'ing position, means in said bridge code sender for transmitting a high-pitched tone code over said common dispatcher's line indicative of said bridge in response to trouble at the bridge without interfering with a simultaneously transmitted O-S'ing code, and receiving apparatus at the dispatcher's station audibly operated by said different codes for enabling the dispatcher to identify both the bridge code and the particular O-S'ing code transmitted in case both said codes should be transmitted simultaneously.

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