

Nov. 13, 1934.

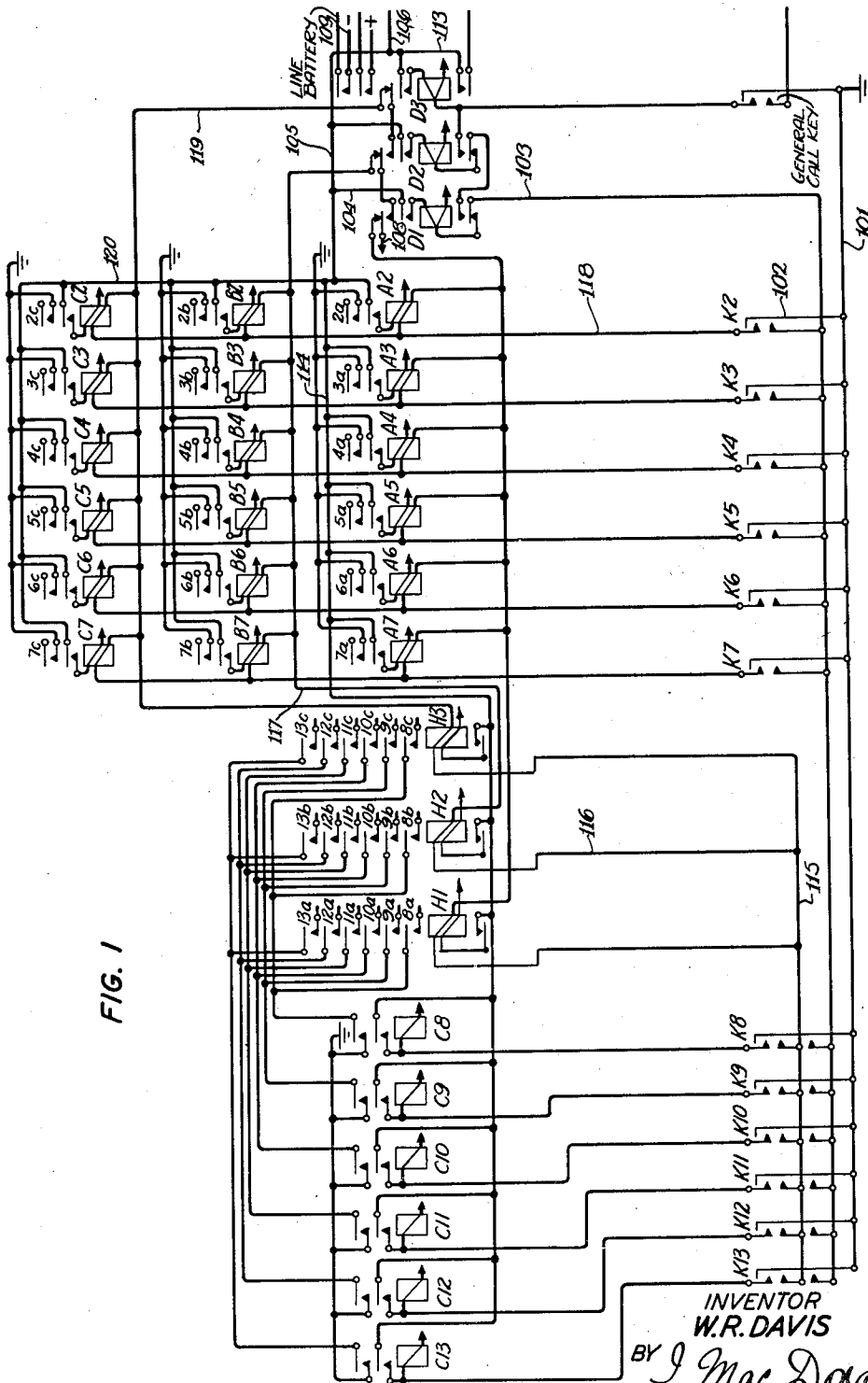
W. R. DAVIS

1,980,190

IMPULSE TRANSMITTER

Filed March 4, 1932

2 Sheets-Sheet 1



Nov. 13, 1934.

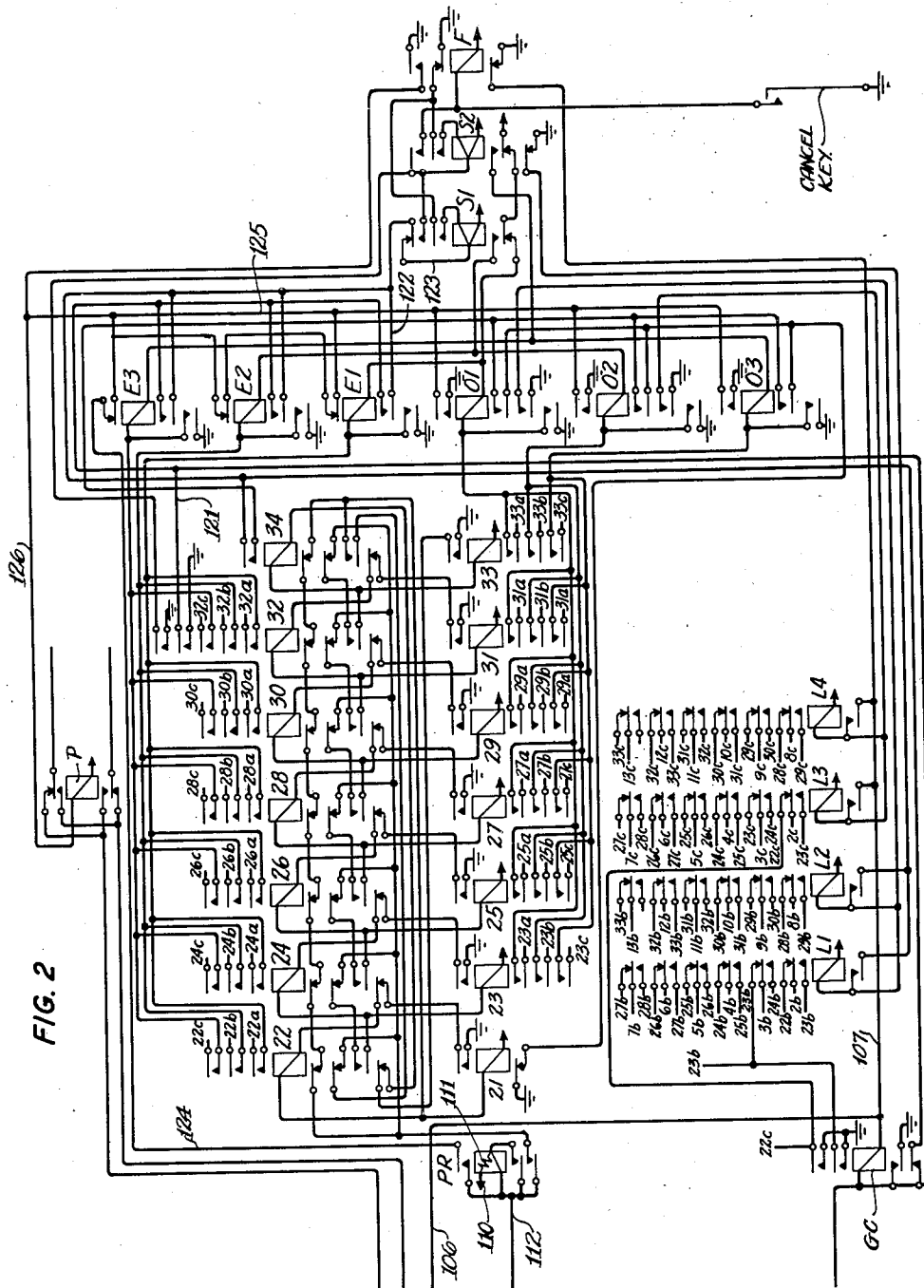
W. R. DAVIS

1,980,190

IMPULSE TRANSMITTER

Filed March 4, 1932

2 Sheets-Sheet 2



INVENTOR
W. R. DAVIS
BY *J. Mac Donald*
ATTORNEY

UNITED STATES PATENT OFFICE

1,980,190

IMPULSE TRANSMITTER

William R. Davis, Aldwych, London, England, assignor to Western Electric Company, Incorporated, New York, N. Y., a corporation of New York

Application March 4, 1932, Serial No. 596,758
In Great Britain March 19, 1931

3 Claims. (Cl. 177—380)

This invention relates to electric signaling or selective systems and more particularly to registering and controlling mechanisms for use in such systems.

The present invention has been devised in connection with so-called train dispatching systems, but is applicable to any other electric signaling or selective system in which similar conditions are met.

Train dispatching systems are telephone party lines comprising usually one control station and a number of way-stations. Selection of a particular station is usually performed by transmitting a code comprising seventeen impulses divided into three trains in a manner characteristic to the station.

The code is usually transmitted by mechanical senders or "keys" each individual to a way-station, which are comparatively expensive.

The object of the invention is to provide register controlling means, preferably of the all relay type, to replace the mechanical code senders, one per code, previously used in such systems.

Such register controlling means is cheaper than the mechanical senders, and the operators' key-set or the like takes up much less room than the previous arrangements.

In such systems the codes are transmitted by alternate impulses of opposite polarity caused by the alternate operation and release of a relay.

If one train of impulses of a code ends with the relay operated, the next train must begin by an impulse caused by deenergization of the relay.

One feature of the invention comprises a register controller or relay counting chain so constructed and arranged that it is adapted to control the transmission or reception of a train of impulses beginning with either of two different kinds of impulse.

Further it is advisable to retain the same code arrangement since if this is done the standard selectors can be used at the way-stations or the like.

Generally in such systems one only of three impulse trains in any code ever exceeds seven in number, the possible maximum being thirteen.

Another feature of the invention comprises a plurality of relay registers, adapted to register a digit of a code, and an additional relay register adapted to be individually associated with, or to replace, any one of said plurality of registers, to register a digital value above the capacity of each of said plurality of registers. One embodiment of the invention will be described below with reference to the drawings wherein:

Fig. 1 shows a set of thirteen keys and a relay register,

Fig. 2 shows the impulse sending and counting devices.

The system will first be described in brief.

The system provides a means whereby with the use of numbered keys, step-by-step relays and a pendulum relay, a three-digit code of impulses is originated and transmitted over lines, the number of impulses per digit depending upon the keys depressed and the total number of impulses remaining constant for each code.

This system is designed primarily for use in train dispatching systems such for instance as shown in Fig. 7 of J. C. Field Patent 1,343,256 and replaces the selector keys and selector key case normally used.

Since the impulse receiver at way-stations is the standard selector, the total number of impulses per code in this case is 17 and means are provided for the transmission of any of the 47 codes available for such selectors.

Keys numbered consecutively from 2 to 13 are provided and these are used for setting up the code it is desired to transmit. Three keys corresponding to the digit values of the code are depressed in rotation causing the code to be set up on marking relays. On the release of the third key a pendulum relay is operated to transmit impulses to line. The outgoing impulses are counted on relays and when the number transmitted equals the number marked further impulses are prevented from going to line. The second and third digits are similarly transmitted, a pause in impulsing being provided at the end of each digit, and at the conclusion of the third digit the apparatus is restored to normal.

In addition to the numbered keys, a "general call" key is provided which will cause 17 impulses to be transmitted to operate all the selectors on the lines to their ringing terminals. Further, in case an error in setting up the code is made, a "cancel" key may be operated to restore the apparatus to normal before the impulses are transmitted.

Referring to the drawings, K2, K3, K4, etc., are the sending keys which are of the non-locking type, and A2, A3, A4, etc., B2, B3, B4, etc. and C2, C3, C4 etc. are the marking relays for the first seven impulses for the first, second and third digits respectively. Relays C8, C9, C10 etc., are used for marking higher digit values and an economy in relays is effected by using one set only for this purpose since any of these high values can only appear once in each code, by employing

relays H1, H2 and H3 to determine the digit in which the marking shall apply. Relays D1, D2 and D3 are operated in succession by the first, second and third depressions of the keys. Relays D1 and D2 insure that the marking relays appropriate to the proper digit are operated in their correct sequence. Since relays D1 and D2 serve to transfer a source of current supply from one set of marking relays to another they will, for the purpose of identification, be hereafter referred to as marking transfer relays. Relay D3, which is operated after the release of the third key, connects the line battery to the line relay contacts and starts the pendulum relay PR impulsing. Relay D3 will hereafter be referred to as line battery relay D3. The numbered relays 21, 22, 23, 24 etc., are counting relays which are operated in rotation by the outgoing impulses and, since these relays have to count half cycles, because for selector impulses the "make" and the "break" each count as one impulse, it is necessary to employ relays L1, L2, L3 and L4 to change the marking in the case of digits following digits with an odd number of impulses. Relays L1, L2, L3 and L4 will be hereafter referred to as marking change relays. To prevent impulses being transmitted to line after the correct number in the digit has been counted relays O1, O2 and O3 are provided in the case of first, second and third digits respectively with an odd number of impulses in the digit. Since the odd numbered impulses are made on the making of contacts, relays O1, O2 and O3 will be referred to hereafter as make impulse holding relays. Relays E1, E2 and E3 are provided in the case of first, second and third digits respectively with an even number of impulses in the digit. Since the even numbered impulses are made on the breaking of contacts, relays E1, E2 and E3 will be referred to hereafter as break impulse holding relays. Relay P is a line relay the contacts of which are capable of placing battery reversals over the lines. Relays S1 and S2 operate at the end of the first and second digits to remove the first and second and to apply the second and third markings respectively for the digits to the counting relays. Relays S1 and S2 will be hereafter referred to as counting transfer relays. Relay F is the final cut-off relay which restores the apparatus to normal after the complete transmission of the code.

Considering the keys 2, 3, 4, 5, 6 and 7, it will be seen that the depression of one of these for the first digit will operate momentarily a corresponding "A" relay over a back contact of marking transfer relay D1, and the relay so operated will lock up over a second winding, its own make contacts and a contact of relay F. The depression of any of these keys also provides a circuit for energizing the lower winding of marking transfer relay D1. For instance if key K2 is depressed relay D1 will be energized over the following circuit: ground, conductor 101, conductor 102, lower contact of key K2, conductor 103, lower armature and back contact of relay D1, lower winding of relay D1 to battery. Relay D1 operates fully through its lower and upper windings, innermost upper armature and front contact, conductor 104, conductor 105, conductor 106, conductor 107, lower armature and back contact of relay F to ground on the release of the key and transfers the negative feed 108 from the common side of the A relays to the common side of the B relays so that no further A relays can be operated. The depression of another key in the group K2 to K7 will operate a relay in the B group which will lock

up over a locking winding and its own contacts as did the A relay for the first digit. The lowermost armature of D1 has also changed over to a front contact so that the depression of the second key energizes the lower winding of marking transfer relay D2 which relay will operate fully on its lower end and upper windings on the release of the second key to transfer the negative battery lead 108 to the C group to enable marking to be made for the third digit. Contacts on marking transfer relay D2 provide that the depression of the third key operates line battery relay D3 and the release of the third key enables line battery relay D3 to operate fully through its lower and upper windings to complete a circuit for the pendulum relay PR and to connect the line battery 109 to the contacts of line relay P which transmits the impulses to line. The circuit for the pendulum relay PR may be traced as follows: battery connection 110 of the pendulum relay PR, resistance 111, winding of the pendulum relay PR, conductor 112, lower armature and front contact of relay D3, conductor 113, conductor 106, conductor 107, lower armature and back contact of relay F to ground. The pendulum relay closes its contacts and shorts out its own winding and releases. This alternate energization and deenergization of the pendulum relay continues as long as the system is in operation which is terminated by energization of relay F.

Considering the keys 8, 9, 10 etc., it will be seen that the depression of one of these operates a corresponding marking relay C8, C9, C10 etc., and that associated with these are digit determining relays H1, H2 and H3 which can operate only on the first, second or third digit respectively. The C relay applies the marking to the first, second or third digit according to whether digit determining relay H1, H2 or H3 is operated.

It has been shown that after the third key has been released the pendulum relay PR which is so constructed that it successively closes and opens its contacts while its circuit is maintained through contacts of relay D3 and relay F begins to impulse line relay P through back contacts on break impulse holding relays E1, E2 and E3. At the same time these impulses are counted by the counting relays 21, 22, 23, etc., in the following manner. The first make period is conducted through back contacts on counting relays 22, 24, 26, 28, 30, 32 and 34 to the common point of the windings of counting relays 21, and 22. Relay 21 operates and provides an earth through its upper contacts and lowermost armature and back contact of relay 24 for the winding of relay 22. Relay 22 is temporarily short-circuited by having a ground from the lower armature and back contact of relay F but, on the second impulse which is a break period, the removal of the earth by the pendulum relay PR from the common point of the windings of counting relays 21 and 22 will enable these two relays to operate in series. The next make period passes through break contacts on counting relay 24 and make contacts on counting relay 22 to the common point of the windings of counting relays 23 and 24. Relay 23 operates and prepares a circuit for relay 24 which operates in series with relay 23 on the succeeding break impulse. Relay 24 in operating breaks the circuit for relays 21 and 22 which deenergize. This operation of the counting relays in succession is carried on until, in the end, counting relays 33 and 34 are operated in series, when the next impulse will be diverted to relays 21 and 22 again to begin a new operation

of the counting relays. It is thus apparent that the counting relays operate in succession and are deenergized in pairs so long as impulses emanate from the pendulum relay PR and, since there are 14 counting relays, one complete operation of the counting group is sufficient to take care of the maximum number of impulses it is possible to obtain per digit. Counting relays 21, 23, 25, 27, 29, 31 and 33 count the "make" periods or odd impulses, the others count the "breaks" or even impulses.

Each pair of uppermost marking contacts on the marking relays is connected to a corresponding contact on the counting relays and through them an earth is applied for the O or E relays for each digit according to the marking.

Since the impulses begin with a "make" period, the odd impulses are "makes" in each case so that at the termination of a digit of an odd number of impulses, it is necessary, to prevent further impulses being transmitted to line, to keep the line relay P energized during the interdigital pause and the first impulse of the next digit will begin with a "break" period. For this reason, it will be seen that the make impulse holding O relays, when operated through marking contacts, provide an earth for the line relay P to maintain it in operation. The even impulses are "break" periods and in this case the line relay P is deenergized for each even impulse. Accordingly, the break impulse holding E relays when operated at the end of a digit break the impulsing circuit from the pendulum relay PR to the line relay P so that the latter remains deenergized during the interdigital pause. Relays O1 and E1 are associated with the first digit and they can be operated through marking contacts on the marking relays and corresponding contacts on the counting relays and through lower back contacts on the counting transfer relays S1 and S2 to terminate impulses comprising the first digit. 12 is the maximum even number of impulses it is possible to have in one digit and counting relay 32, which is operated on the 12th impulse, is provided with make contacts to supply earth through make contacts on the break impulse holding E relays to the lower winding of counting transfer relay S1. Since one of the break impulse holding E relays will be operated at that time, this circuit is complete. In the case of the odd number of impulses, the earth is supplied through break contacts on counting relay 21, make contacts on the make impulse holding O relays and a make pair on relay 34. Counting transfer relay S1 will operate fully only when the earth is removed from the mid-point of its winding. For an even number of impulses this earth is removed on the operation of counting relay 34 since this relay breaks the circuit for counting relay 32. As has been explained, for an even number of impulses, the line relay P is held unoperated so that the first make impulse in the new digit is counted on relay 21 and received on the line relay P for transmission to line since counting transfer relay S1 breaks the circuit for the break impulse holding E relay to reconnect line relay P to the pendulum relay contacts. In the case of an odd number of impulses in the digit it is necessary to operate counting transfer relay S1 completely at a time when the line relay P would normally be operated by the pendulum relay PR, since the line relay P is being held operated during the interdigital pause by the operation of one of the make impulse holding O relays. This is done by maintaining the earth on

the mid-point of the windings of relay S1 through the back contacts on relay 21, and when relay 21 operates on what should be the first impulse of the second digit, the line relay P will remain operated when it is transferred to the pendulum relay circuit. In this way the first impulse is lost and in order that the markings and countings shall not be affected by this lost impulse, marking change relays L1, L2, L3 and L4 are operated to advance the markings one impulse. The marking change L relays are operated by the corresponding make impulse holding O relays, that is L1 and L2 are operated by O1 in the case of an odd number of impulses in the first digit, L3 and L4 are operated by relay O2 in the case of an odd number of impulses in the second digit.

As relay S1 was operated at the termination of the first digit, so relay S2 is operated at the termination of the second digit and at the conclusion of the third digit when the code has been transmitted relay F is operated to break the locking circuits for all relays.

As an example, and in order that the circuit may be more clearly understood, consider the transmission of the code 6—9—2. Key 6 will first be depressed which will complete a circuit for relay A6 from earth, conductor 101, upper key contacts of key K6 lower, winding of relay A6, back contact and uppermost armature of relay D1 to negative battery 108. Relay A6 will operate and a circuit for its locking winding will be complete from negative battery, upper winding of relay A6, contacts of relay A6, conductor 114, conductor 105, conductor 106, conductor 107, lower armature and back contact of relay F to earth. The depression of the key K6 also applied earth through the back contact and lowermost lever spring of the change-over contacts of marking transfer relay D1 to the lower winding of that relay and the release of the key K6 enables relay D1 to operate fully through its lower and upper windings, removing the negative battery from the A group of relays and transferring it through the uppermost lever spring and front contact of relay D1 and uppermost lever spring and back contact of relay D2 to the B group. Key K9 will now be depressed which will energize relay C9 over the circuit—earth, conductor 101, uppermost key contacts of key K9, winding C9 to negative battery. Relay C9 will lock up over its own make contacts and the lower armature and back contact of relay F. The depression of the key K9 also energized digit determining relay H2 over the circuit—earth, conductor 101, key contacts, conductor 115, conductor 116, winding H2, conductor 117, back contact and uppermost lever spring of marking transfer relay D2, front contact and uppermost lever spring of marking transfer relay D1 to negative battery. Relay H2 has two windings similar to those shown in the relays A2 to A7 and will lock up over its own contacts and the back contact and lower armature of relay F. With marking transfer relay D1 operated by the first key, the depression of the second key completes a circuit through earth, conductor 101, lower key contacts, conductor 103, lower lever spring and front contact of D1, lower lever spring and back contact of relay D2 for the lower winding of marking transfer relay D2 and the release of key 9 enables marking transfer relay D2 to operate fully, transferring the negative battery for the B group of relays to the C group. Depression of key 2 operates relay C2 over the circuit—earth, conductor 101, upper key contacts, conductor 118, lower winding C2 conductor 119 back contact and

lever spring of line battery relay D3, front contact and lever spring of marking transfer relay D2, front contact and lever spring of marking transfer relay D1 to negative battery 108. Relay C2 locks up over its own contacts and the back contacts of relay F by way of conductor 120, conductor 105, conductor 106 and conductor 107. The release of K2 also operates line battery relay D3 fully and contacts on this relay complete a circuit for the pendulum relay PR and apply line battery 109 to the contacts of the line impulsing relay P. The condition now is that relays H2, A6, C9 and C2 are operated and locked up over back contacts of relay F, relays D1, D2 and D3 are similarly locked and the pendulum relay PR is ready to impulse. The impulses have the following effect:

Impulse 1. (make)

Completes a circuit from earth, through back contacts on relay F, lower contacts on D3, lowermost pendulum relay contacts, back contacts on relays 22, 24, 26, 28, 30, 32, 34 to common side of the windings of counting relays 21 and 22. Relay 21 operates. Relay P operated (1 impulse to line). Relay P is operated over the following circuit: ground, back contact and lower armature of relay F, conductor 107, conductor 106, conductor 113, lower armature and front contact of relay D3, conductor 112, upper armature and front contact of pendulum relay PR, conductor 124, break contacts of relays E3, E2 and E1 which are in series, conductor 125, conductor 126, winding of relay P to battery.

Impulse 2. (break)

Relays 21 and 22 operate in series over the circuit from earth, front contact and lever spring of relay 21, break contacts on relay 24, winding of relay 22, winding of relay 21 to negative battery. Relay P unoperated (2 impulses to line).

Impulse 3. (make)

Relay 23 operates over the circuit from pendulum relay contacts, impulse wire, back contacts on relay 24, make contacts on relay 22, winding of relay 23, to negative battery. Relay P operated (3 impulses to line).

Impulse 4. (break)

Relays 23 and 24 operate in series over the circuit from earth, make contacts on relay 23, break contacts on relay 26, winding of relay 24, winding of relay 23, to negative battery. Relays 21 and 22 deenergize since their circuit is broken by the break contacts on relay 24. Relay P unoperated (4 impulses to line).

Impulse 5. (make)

Relay 25 operates in the same manner as relay 23 operated on the third impulse. Relay P operated (5 impulses to line).

Impulse 6. (break)

Relays 25 and 26 operate in series. Relays 23 and 24 deenergize. Relay P unoperated (6 impulses to line). The contact 6a of relay A6 connects earth to contact 26a of relay 26 and the operation of this latter relay completes the circuit for break impulse holding relay E1 through the back contact and lever spring of the change-over contacts of counting transfer relay S1, back contact and lever spring of the change-over contacts of counting transfer relay S2 to negative battery. Relay E1 operates and locks up over its

own make contacts. Its break contacts prevent further impulses from reaching the line relay P.

Impulse 7. (make)

Relay 27 operates. Relay P remains unoperated (inter-digital pause).

Impulse 8. (break)

Relays 27 and 28 operate in series. Relays 25 and 26 deenergize. Relay P remains unoperated (inter-digital pause).

Impulse 9. (make)

Relay 29 operates. Relay P remains unoperated (inter-digital pause).

Impulse 10. (break)

Relays 29 and 30 operate in series. Relays 27 and 28 deenergize. Relay P remains unoperated (inter-digital pause).

Impulse 11. (make)

Relay 31 operates. Relay P remains unoperated (inter-digital pause).

Impulse 12. (break)

Relays 31 and 32 operate in series. Relays 29 and 30 deenergize. Relay P remains unoperated (inter-digital pause). Make contacts on relay 32 complete a circuit for the lower winding of relay S1 from earth, make contacts of relay 32, conductor 121, make contacts of relay E1, conductor 122, lever spring and upper back contact of relay S1, conductor 123, lower winding of relay S1 to negative battery.

Impulse 13. (make)

Relay 33 operates. Relay P remains unoperated (inter-digital pause).

Impulse 14. (break)

Relays 33 and 34 operate in series. Relays 31 and 32 are deenergized. Relay P remains unoperated (inter-digital pause). Removing the earth from the midpoint of the windings of counting transfer relay S1 by the deenergizing of relay 32 enables counting transfer relay S1 to operate fully with its two windings in series over break contacts on relay F. Relay E1 deenergizes enabling further impulses to reach the line relay from the pendulum relay and this occurs during a break impulse so that relay P is ready to receive the next impulse which will be a "make".

14 impulses have now been counted and the next impulse will be the first of the second digit.

2ND DIGIT

Impulse 1. (make)

Relays 33 and 34 are operated in series and this first impulse operates relay 21 over the circuit—earth, impulse wire, break contacts on relay 22, make contacts on relay 34, winding of relay 21 to negative battery. Relay P operates (1 impulse to line).

Impulse 2. (break)

Relays 21 and 22 operate in series. Relays 33 and 34 deenergize. Relay P is unoperated (2 impulses to line).

Impulse 3. (make)

Relay 23 operates. Relay P operates (3 impulses to line).

Impulse 4. (break)

Relays 23 and 24 operate in series. Relays 21

and 22 are deenergized. Relay P is unoperated (4 impulses to line).

Impulse 5. (make)

5 Relay 25 operates. Relay P operates (5 impulses to line).

Impulse 6. (break)

10 Relays 25 and 26 operate in series. Relays 23 and 24 are deenergized. Relay P is unoperated (6 impulses to line).

Impulse 7. (make)

15 Relay 27 operates. Relay P operates (7 impulses to line).

Impulse 8. (break)

20 Relays 27 and 28 operate in series. Relays 25 and 26 are deenergized. Relay P is unoperated (8 impulses to line).

Impulse 9. (make)

25 Relay 29 is operated. Relay P is operated (9 impulses to line). The marking for the second digit is provided by relay C9 and make contacts on this relay provide an earth through contacts 9b on relay H2, through contacts on relay L2 to contact 29b of relay 29 for relay O2 which operates over the front contact and lever spring of the change-over contacts of relay S1, back contact and lever spring of the change-over contacts of relay S2 to negative battery. Contacts on relay O2 provide an earth for the winding of the line relay P which is already energized so that so long as O2 is operated "breaks" from the pendulum relay will not affect it and further impulses are prevented from going to line. When once operated make impulse holding relay O2 locks up over its own make contacts.

Impulse 10. (break)

40 Relays 29 and 30 operate in series. Relays 27 and 28 are deenergized. Relay P remains operated (inter-digital pause).

Impulse 11. (make)

45 Relay 31 operates. Relay P remains operated (inter-digital pause).

Impulse 12. (break)

50 Relays 31 and 32 operate in series. Relays 29 and 30 are deenergized. Relay P remains operated (inter-digital pause). It should be noted that since no E relay is operated the earth supplied by contacts on relay 32 to the S relays is not effective.

Impulse 13. (make)

60 Relay 33 operates. Relay P remains operated (inter-digital pause).

Impulse 14. (break)

65 Relays 33 and 34 operate in series. Relays 31 and 32 are deenergized. Relay P remains operated (inter-digital pause). Make contacts on relay 34 complete a circuit from earth, break contacts on relay 21, make contacts on relay O2, make contacts on relay 34, uppermost lever spring and front contact of the change-over contacts of relay S1 (operated) lower winding of relay S2 to negative battery.

Impulse 15. (make)

75 Relay 21 is operated and the earth provided by its break contacts to the lower winding of relay

S2 is removed so that relay S2 operates fully with its two windings in series and removes the negative battery feed from relay O2 which deenergizes and permits further impulses from the pendulum relay to reach the line relay P. Since this impulse is a "make" period and relay P has been held operated it is ineffective as regards line impulses and the first impulse of the third digit will be a "break" period.

When relay O2 operated on the 9th impulse of the second digit it completed a circuit for marking change relays L3 and L4 which locked up over their own contacts and the back contacts of relay F to earth. This advances the markings for the third digit one impulse and the marking imposed by relay C2 and its contacts 2c is advanced from contact 22c to 23c by change-over contacts on relay L3.

3RD DIGIT

Impulse 1. (break)

Relay 21 is already operated and this first impulse of this, the 3rd digit, operates relays 21 and 22 in series. Relays 33 and 34 deenergize. Relay P is unoperated (1 impulse to line).

Impulse 2. (make)

105 Relay 23 operates: Relay P operates (2 impulses to line). With relay 23 operated the marking from relay C2 transferred to contact 23c by marking change relay L3 operates relay O3 through front contact and lever spring of relay S2 to negative battery. Make contacts on this relay provide an earth for the winding of relay P which being operated remains operated so long as relay O3 is operated. Relay O3 locks up over its own contacts. The total number of 17 impulses has now been sent and the selector at the way-station coded 6—9—2 is now operated to its ringing terminal.

Impulse 3. (break)

120 Relays 23 and 24 operate in series. Relays 21 and 22 deenergize. Relay P remains operated (ringing period).

Impulse 4. (make)

125 Relay 25 operates. Relay P remains operated (ringing period).

Impulse 5. (break)

130 Relays 25 and 26 operate in series. Relays 23 and 24 deenergize. Relay P remains operated (ringing period).

Impulse 6. (make)

135 Relay 27 operates. Relay P remains operated (ringing period).

Impulse 7. (break)

140 Relays 27 and 28 operate in series. Relays 25 and 26 deenergize. Relay P remains operated (ringing period).

Impulse 8. (make)

145 Relay 29 is operated. Relay P remains operated (ringing period).

Impulse 9. (break)

150 Relays 29 and 30 operate in series. Relays 27 and 28 deenergize. Relay P remains operated (ringing period).

Impulse 10. (make)

Relay 31 operates. Relay P remains operated (ringing period).

5 *Impulse 11. (break)*

Relays 31 and 32 operate in series. Relays 29 and 30 deenergize. Relay P remains operated (ringing period).

10 *Impulse 12. (make)*

Relay 33 operates. Relay P remains operated (ringing period).

Impulse 13. (break)

15 Relays 33 and 34 operate in series. Relays 31 and 32 deenergize. Make contacts on relay 34 complete a circuit from earth, back contacts of relay 21, make contacts of relay O3, make con-
20 tacts of relay 34, lever spring and front contact of the change-over contacts of relay S1, lever spring and front contact of relay S2, to the wind-
25 ing of relay F which operates and breaks the earth locking circuits for all relays so that the system is restored to normal. Relay P in restoring to normal sends a final impulse to line to restore the selector at the distant station.

30 The "cancel" key can be operated if incorrect keys are depressed for either the first or second digits and it has the effect of operating relay F to break the locking circuit for the marking re-
lays operated by those keys.

35 The "general call" key when depressed operates relay GC which locks up over back contacts on relay F and marks contacts 23b and 22c. Also, when released, it operates relay D3 fully which connects line battery to contacts of relay P and also completes the circuit for the pendulum relay to impulse. The impulses are counted on
40 the relays as follows:—

45 Impulse 1 (make) on relay 21, Impulse 2 (break) on relay 22, Impulse 3 (make) on relay 23 and so on, the 14th impulse being counted on relay 34, the 15th on relay 21 again, the 16th on
50 relay 22 and the 17th on relay 23.

55 When relay 32 operated it completed the circuit for the lower winding of relay S1 from earth, contacts on relay 32, break contacts on relay GC, lever spring and back contact on relay S1, wind-
60 ing of S1 to negative battery. Relay S1 operates fully on the operation of relay 34, since at this point relay 32 is deenergized to remove the earth from the mid-point of the two windings of relay S1. Change-over contacts on relay S1 prepare
65 a circuit to pick up the marking on the "b" set of contacts and the marking, imposed by relay GC on contact 23b through contacts on relay L1, causes relay O2 to operate. Contacts on this latter relay maintain an earth to relay P which
70 remains operated until the end of this digit. As shown when describing the circuit for the 9-impulse digit in the above code example, relay P is not free to follow impulses again until relay 21 operates. The impulse operating relay 21 is a
75 "make" so that relay P is still operated. The next impulse, a "break", operates relays 21 and 22 in series and relay P is deenergized sending a final impulse to line to restore the selectors at the distant way stations to normal. A marking is imposed on contact 22c by contacts on relay GC so that when relay 22 is operated a circuit is completed for relay E3 which operates and locks up over contacts on relay S2 which operates fully by contacts on relays O2, and 34 when relay 21 operates. Relay E3 maintains relay P deener-

gized by breaking the impulse wire from the pendulum relay.

On the third count by the relays when relay 32 operates, a circuit is completed for relay F through contacts on relays GC, S1 and S2. In operating relay F breaks the locking circuit for all relays and the system is restored to normal.

What is claimed is:

1. A transmitter for a selective signal-system comprising two groups of manually operated keys, three groups of marking relays controlled by the first group of keys, a single group of marking relays controlled by the second group of keys, means whereby the first group of keys and the three groups of marking relays controlled there-
85 by operate to set up code signals having three digits of a predetermined low number of im-
90 pulses and the second group of keys and the single group of marking relays controlled thereby operate to set up code signals of one digit of a
95 higher number of impulses than is possible in the first group of keys and the three groups of marking relays, marking transfer relays operating in sequence and common to the groups of keys, a source of current supply for the marking relays,
100 means including contacts operated by said marking transfer relays upon operation of a key in either group to transfer the source of current supply from one group of marking relays to an-
105 other, digit determining relays connected to the second group of keys and to contacts of said marking transfer relays, means whereby said digit determining relays and said marking transfer relays operate to replace one of the groups of
110 marking relays controlled by the first group of keys by the single group of marking relays controlled by the second group of keys when a key in the second group is operated, marking con-
115 tacts controlled by the digit determining relays and connected to contacts controlled by the single group of marking relays for the second group of keys, a line battery, line contacts, a line battery relay operating in sequence with the last of said
120 marking transfer relays to connect the line battery to the line contacts, a pulsing pendulum type relay, said line battery relay having contacts to close a circuit to said pulsing pendulum type re-
125 lay, a line relay, reversible line contacts controlled by said line relay and means including a system of counting relays operating in sequence and hav-
ing contacts marked by said marking relays to control the operation of said line relay.

2. A transmitter for sending code signal im- pulses of three digits to operate selectors com-
130 prising two groups of manually operated keys, the first group to set up digit signals up to seven impulses, the second group to set up digit signals above seven impulses, three groups of marking relays controlled by the keys of the first group, a single group of marking relays controlled by
135 the keys in the second group, a source of current supply for the three groups of marking relays for the first group of keys, means including marking transfer relays controlled by said keys and operating in sequence to transfer the source of cur-
140 rent supply from one group of marking relays to the next group to be operated, digit determining relays controlled by the second group of keys and energized from the same source of current supply as the marking relays controlled by the first
145 group of keys, locking circuits for the marking relays, the marking transfer relays and the digit determining relays, marking contacts closed by said marking relays and said digit determining relays, means whereby said marking transfer re-
150

lays and said digit determining relays operate to substitute the single group of marking relays controlled by the second group of keys for one of the groups of marking relays controlled by the first group of keys when a key in the second group is operated, a line battery, a line battery relay controlled by the manually operated keys and operating in sequence with the last of the marking transfer relays to connect the line battery to line contacts, a line relay, means including a pulsing relay operating to repeatedly send pulsations of current to said line relay, said line battery relay operating to close a circuit to said pulsing relay, reversible line contacts controlled by said line relay, and means including a system of counting relays operating in sequence and a system of make impulse holding relays and break impulse holding relays to control the operation of said line relay in accordance with contacts marked by said marking relays.

3. In a transmitter for sending code signals, two groups of manually operated keys, the first group representing digits up to a predetermined number of impulses, the second group representing digits above the number of impulses obtainable by any one key in the first group, three groups of marking relays controlled by the first group of keys, a single group of marking relays controlled by the second group of keys, marking transfer relays common to the two groups of keys and operating in sequence, digit determining relays controlled by said second group of keys, a source of current supply for said three groups of marking relays and for said digit determining relays, marking contacts controlled by said three groups of marking relays, marking contacts controlled by said digit determining relays and said single group of marking relays, means whereby said marking transfer relays operate in response to the operation of the keys in either group to transfer the source of current supply from one group of the three groups of marking relays to another, means whereby said marking transfer relays and said digit determining relays operate to substitute the single group of marking relays for one of the three groups of marking relays when a key in the second group is operated, a line battery, a line battery relay operating in sequence to the last of said marking transfer relays, in response to the operation of said keys, to connect the line battery to line contacts, a pulsing relay, contacts controlled by said line battery relay to close a circuit to said pulsing relay, a line relay receiving current pulsations through said pulsing relay, reversible line contacts operated by said line relay and means including a counting relay system and a system of make impulse holding relays and break impulse holding relays to prevent further movement of said line relay for interdigital pauses in the code signal, said counting relay system having contacts marked by said marking relays.

WILLIAM R. DAVIS.

35 110

40 115

45 120

50 125

55 130

60 135

65 140

70 145

75 150