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R. K. BONELL

SELECTOR CIRCUITS

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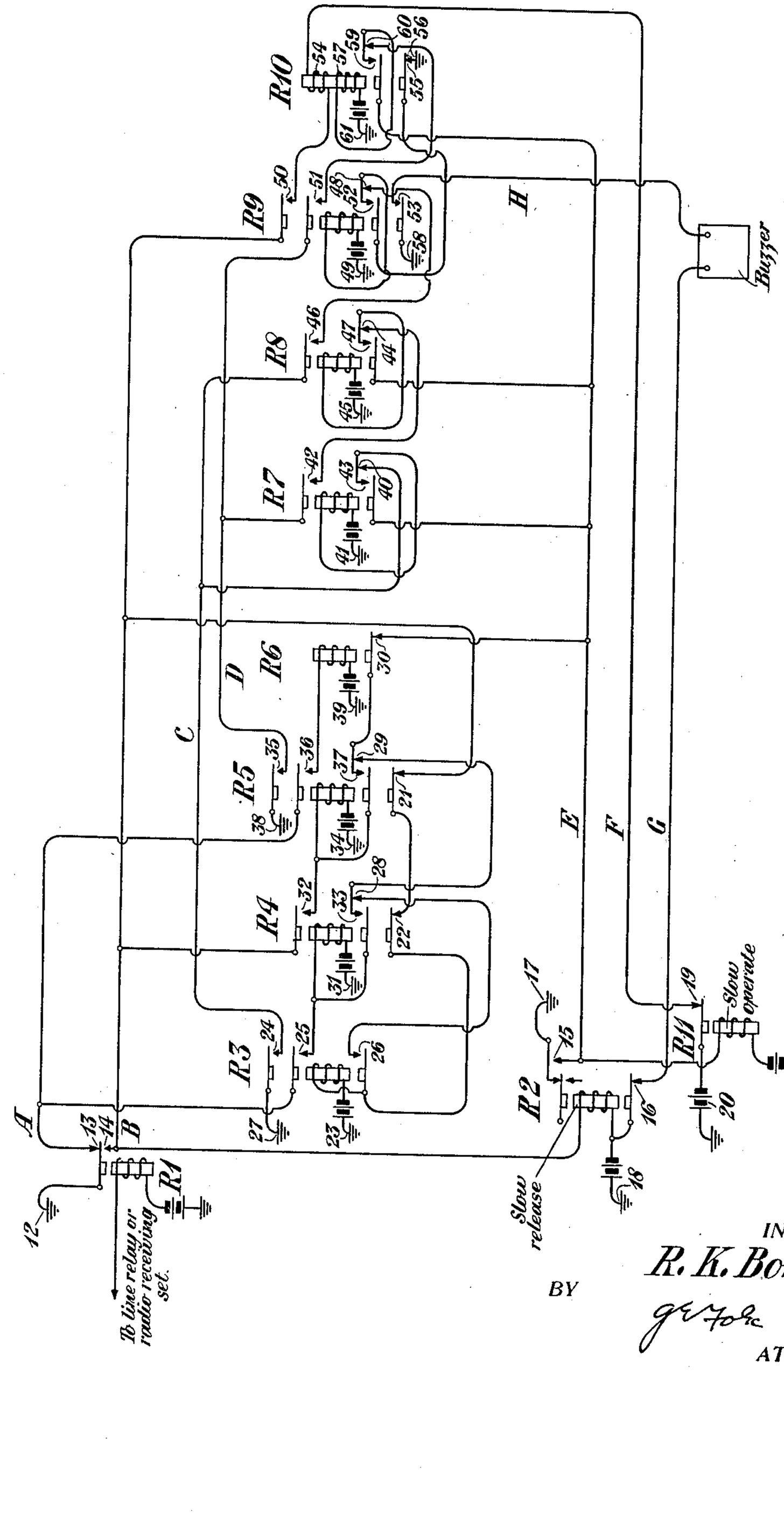

Operating code for selector shown: • • • •

INVENTOR

R. K. Bonell

BY

ATTORNEY

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UNITED STATES PATENT OFFICE.

RALPH K. BONELL, OF EAST ORANGE, NEW JERSEY, ASSIGNOR TO AMERICAN TELEPHONE AND TELEGRAPH COMPANY, A CORPORATION OF NEW YORK.

SELECTOR CIRCUITS.

Application filed November 2, 1923. Serial No. 672,354.

To all whom it may concern:

Be it known that I, RALPH K. BONELL, residing at East Orange, in the county of Essex and State of New Jersey, have invented certain Improvements in Selector Circuits, of which the following is a specification.

This invention relates to selector circuits by means of which a fixed signal may be announced at a given one of a number of stations forming a telephone or telegraph system connected by either wire or radio.

The principal object of the invention is to provide a selector circuit permitting of a greater speed of operation than is possible with the ordinary selector circuits employed heretofore, and which will not require exact timing of the signal impulses.

A further object of the invention is to provide a suitable selector circuit which can be made up from standard telephone or telegraph apparatus, thus obviating the necessity of employing special mechanism.

Applicant's circuit performs the function of the selector circuit generally used for railroad telephone despatching and has, in addition, the following chief advantages:

(1) Only standard telephone or telegraph apparatus is employed. Consequently, the circuit may be made up at any time from apparatus which is quickly available.

(2) The relays of applicant's circuit will operate on 24 volts or less, whereas the ordinary selector circuit used for railroad telephone despatching requires a voltage of 50 or greater.

(3) The speed at which impulses can be sent over a line or received by radio to operate a selector of the ordinary type, is limited by the mechanical operation of the selector. The use of standard relays permits of a considerable increase in the speed of operation.

(4) In the case of the ordinary selector, exact timing of the impulses is essential to reliable operation. In applicant's arrangement, the timing of the impulses, within certain limits, does not affect the reliability of operation.

Applicant's selector circuit is made up of a plurality of relays, standard telephone or telegraph equipment, suitably connected. The number of relays required depends upon the number of preceding stations in the system, which latter number fixes the requirements of the operating code. For any selector of the type, seven relays are necessary: a pulsing relay, a slow-release relay, four "escapement" relays, functioning as two sets of two relays each, and a seventh relay serving to release the relay which controls the annunicator. In addition, one "counting" relay is required for each dot of the operating code. For example, if there are four stations in the system, it requires four dots in the operating code to call one of the stations; consequently, four "counting" relays are required. The calling of the remaining three stations requires circuit including three, two, and one "counting" relays, respectively. Furthermore, if the number of dots in the operating code, corresponding to the circuit, before the long space is an odd number, a slow operating relay is required.

It is proposed, for purposes of illustration, to describe in detail the arrangement and operation of a selector circuit serving the last station of a system of three stations, requiring for the calling of the station the operating code of three dots, long space, dot (. . . .). This detailed description is to be read with reference to the accompanying drawing, which shows diagrammatically a selector circuit suited to the last station of such a system.

The circuit to be described includes a pulsing relay R^1; a slow-release relay R^2; "escapement" relays R^3, R^4, R^5, and R^6, R^3 and R^4 constituting the first set, and R^5 and R^6 the second; "counting" relays R^7, R^8, and R^9—R^9 controlling the annunciator; a relay R^{10}, having the function of releasing relay R^9 at the final dot of the operating code; and a slow operating relay R^{11}—which, as indicated above, is necessary with codes having an odd number of dots before the long space. The escapement relays operate in a manner somewhat similar to the escapement of a clock: after one of the counting relays has operated, the succeeding counting relay cannot operate until the escapement relays have performed certain functions, as will be more fully described below.

Relay R^1, the pulsing relay, is connected to the line relay or the radio receiving set, and is grounded through a battery. The

function of this pulsing relay is to ground alternately the two leads A and B. The single armature of the relay is connected to ground at 12. While the armature remains unattracted, it makes contact at 13, placing ground on lead A; when the relay is operated, the armature, being attracted, breaks contact at 13 and makes contact at 14, taking ground off lead A and placing it on lead B. Thus, it is seen that at the beginning of the first dot, or any other dot, lead B is grounded, and at the termination of the dot ground is returned to lead A.

When relay R^1 is operated at the beginning of the first dot of the operating code, one end of the winding of relay R^2 is grounded through contact 14 at 12. The other end of this winding is grounded at 18 through a battery, as shown in the drawing. Thus, the first dot operates relay R^2. The operation of this relay makes contact at 15 and breakes contact at 16, placing ground on lead E at 17 and taking battery and ground off lead G. Since relay R^2 is a slow-release relay, it will not release until a long space between dots occurs or the signaling impulses cease altogether. Hence, with the given operating code observed, ground remains on lead E and battery and ground are removed from the lead G until the occurrence of the long space following the third dot.

When relay R^2 is operated and contact is made at 15, ground is placed on the winding of relay R^{11}, the slow operating relay, at 17. Since the other end of this winding is connected through battery to ground, the operation of relay R^2 causes the operation of relay R^{11}. When relay R^{11} is operated, after a short time interval, the normally closed contact 19 is broken, and the grounded battery 20, normally connected to lead F, is taken off that lead.

At the beginning of the first dot, when ground is put on lead B through the operation of relay R^1, a circuit is closed through contact 14, contact 21, contact 22, the winding of relay R^3, and battery, to ground at 23, and relay R^3, the first escapement relay, is operated. The operation of this relay closes the normally open contacts 24, 25, and 26. The closing of contact 24 places ground on lead C at 27. The closing of contact 25 prepares a path to relay R^4, which path will be completed when the termination of the first dot returns ground 12 to lead A. The closing of contact 26 completes a locking circuit for relay R^3 as follows: from ground at 23, through battery, winding of relay R^3, contact 26, contact 28, contact 29, contact 30, and contact 15, to ground at 17. This locking circuit remains closed until the operation of relay R^4.

At the termination of the first dot, when ground is returned to lead A, a circuit is closed through contact 13, contact 25, the winding of relay R^4, and battery, to ground at 31, and the second escapement relay R^4 is operated. The operation of this relay closes the normally open contacts 32 and 33 and breaks the normally closed contacts 22 and 28. The closing of contact 32 prepares a path to relay R^5, which path will be completed when the beginning of the second dot replaces ground 12 on lead B. The closing of contact 33 completes a locking circuit for relay R^4 as follows: from ground at 31, through battery, winding of relay R^4, contact 33, contact 29, contact 30, and contact 15, to ground at 17. This locking circuit remains closed until the operation of relay R^5. The opening of contact 22 breaks the circuit over lead B to relay R^3, preventing the operation of that relay at the beginning of the second dot, when ground will be placed on lead B. The opening of contact 28 breaks the locking circuit of relay R^3 and releases that relay, thus breaking the path to relay R^4 at 25.

At the beginning of the second dot, when ground is again placed on lead B, a circuit is closed through contact 14, contact 32, the winding of relay R^5, and battery, to ground at 34, and the third escapement relay R^5 is operated. The operation of this relay closes normally open contacts 35, 36 and 37 and breaks the normally closed contacts 29 and 21. The closing of contact 35 places ground on lead D at 38. The closing of contact 36 prepares a path to relay R^6, which path will be completed when the termination of the second dot returns ground 12 to lead A a second time. The closing of contact 37 completes a locking circuit for relay R^5 as follows: from ground at 34, through battery, winding of relay R^5, contact 37, contact 30, and contact 15, to ground at 17. This locking circuit remains closed until the operation of relay R^6. The opening of contact 29 breaks the locking circuit of relay R^4 and releases that relay. The opening of contact 21 breaks the circuit over lead B to relay R^3, preventing the operation of that relay after the release of relay R^4 and the re-closing of contact 22.

At the termination of the second dot, when ground is returned to lead A for the second time, a circuit is closed through contact 13, contact 36 (the path over lead A to relay R^4 has been re-broken at 25 upon the release of relay R^3), the winding of relay R^6, and battery, to ground at 39, and the fourth escapement relay R^6 is operated. The operation of this relay opens the normally closed contact 30 and breaks the locking circuit of relay R^5, thus preparing the group of escapement relays for another cycle of operations.

In the new cycle of operations of the es-

capement relays, the beginning of the third dot operates relay R^8 a second time, placing ground on lead C a second time.

The space following the third dot is a long space, which releases the slow-release relay R^2, and also relay R^{11}.

The operation of the counting relays will now be described:

When, at the beginning of the first dot, ground is placed on lead C at 27 by the operation of relay R^3, a circuit is closed through contact 40, the winding of relay R^7, and battery, to ground at 41, and relay R^7, the first of the counting relays, is operated. The operation of this relay closes the normally open contacts 42 and 43 and opens the normally closed contact 40. The closing of contact 42 prepares a path to relay R^8, which path will be completed when ground is placed on lead D at the beginning of the second dot, and the operation of relay R^5. The closing of contact 43 completes a locking circuit for relay R^7 as follows: from ground at 41, through battery, winding of relay R^7, contact 43, and contact 15, to ground at 17. This locking circuit remains closed until the long space following the third dot releases the slow-release relay R^2 and takes ground 17 off lead E. The opening of contact 40 breaks the circuit over lead C to relay R^7.

When, at the beginning of the second dot, ground is placed on lead D at 38 by the operation of relay R^5, a circuit is closed through contact 42, contact 44, the winding of relay R^8, and battery, to ground at 45, and the second counting relay R^8 is operated. The operation of this relay closes the normally open contacts 46 and 47 and opens the normally closed contact 44. The closing of contact 46 prepares a path to relay R^9, which path will be completed when ground is placed on lead C for the second time at the beginning of the third dot and the second operation of relay R^3 The closing of contact 47 completes a locking circuit for relay R^8 as follows: from ground at 45, through battery, winding of relay R^8, contact 47, and contact 15, to ground at 17. This locking circuit remains closed until the long space following the third dot releases the slow-release relay R^2 and takes ground 17 off lead E. The opening of contact 44 breaks the circuit over lead D to relay R^8.

When, at the beginning of the third dot, ground is placed on lead C for the second time by the second operation of relay R^3, a circuit is closed through contact 46 (the path over lead C to relay R^7 has been broken at 40), contact 48, the winding of relay R^9, and battery, to ground at 49, and the third counting relay R^9 is operated. The operation of this relay closes the normally open contacts 50, 51, 52, and 53 and opens the normally closed contact 48. The closing of contact 50 prepares a path over lead B to the first winding 54 of relay R^{10}, which path will be completed at the beginning of the final dot and the closing of contact 14. The closing of contact 51 prepares a path over lead D to the second winding 57 of relay R^{10}. This path would have, in addition to the function described below, a further use if the number of counting relays should be increased to suit a code having more than three dots before the long space. In such a case, relay R^{10} would be connected so as to act as a fourth counting relay, and additional relays connected to leads C and D, alternately, to the number required, a final relay taking over the function of relay R^{10} of the circuit herein described, that of releasing the final counting relay after the operation of the annunciator controlled by that relay. This circuit including the winding 57 of relay R^{10}, serves to prevent the response of the buzzer to an improper code signal (see below). The closing of contact 52 completes a locking circuit for relay R^9 as follows: from ground 49, through battery, winding of relay R^9, contact 52, and contact 55, to ground at 56. This locking circuit remains closed until broken at 55 by the passing of current through the second winding 57 of relay R^{10}. The closing of contact 53 connects lead H to ground at 58. This lead is connected at its other end to one terminal of an annunciator—shown in the drawing as a buzzer. The other terminal of this buzzer is connected to lead G. Hence, all that is required after the operation of relay R^9 in order to operate the buzzer, is the placing of battery and ground on lead G. The dot which caused the operation of relay R^9 was the third dot of the code, and there follows after this dot a long space. As indicated above, a long space results in the release of the slow-release relay R^2. When the lower armature of relay R^2 returns to its normal position, it makes contact at 16 and connects lead G through battery to ground at 18. (Contact 14 is now open). This closing of contact 16—occurring during the long space—operates the buzzer, thus causing the desired signal at the proper station. The opening of contact 48 breaks the circuit over lead C to relay R^9.

When the final dot of the operating code places ground 12 on lead B, a circuit is closed through contact 50, winding 54 of relay R^{10}, contact 19, and the battery 20, to ground. The dot also operates relay R^2, closing contact 15. When contact 15 is closed, the operating circuit of relay R^{11} is, after a short interval of time, completed, and contact 19 is broken, taking battery and ground off lead F. But, since relay R^{11} is slow operating, before contact 19 is bro-

ken, current passes through the winding 54 of relay R^{10} and attracts the armatures of that relay. The attraction of the upper armature (with referecne to the drawing) closes the normally open contact 59 and opens the normally closed contact 60, while the attraction of the lower armature opens the normally closed contact 55. These contacts are so adjusted that contact 55 will not open, breaking the circuit including the winding of relay R^9, before contact 59 is closed. The closing of contact 59 completes a circuit from ground at 61, through battery, winding 57 of the relay R^{10}, contact 59, and contact 15, to ground at 17, energizing the winding 57 and locking the relay in operated position. The opening of contact 55 breaks the locking circuit of relay R^9, releases that relay, reopens contact 53, and so takes ground 58 off lead H, breaking the buzzer circuit and terminating the signal. Relay R^{10} remains in operated condition until ground 17 is removed from lead E upon the release of relay R^2 as a rseult of the cessation of the signaling impulses.

It is to be noted that relay R^5 cannot operate as soon as the contacts of relay R^3 are closed but must wait until relay R^4 has been operated at the end of the dot. The interlocking of relays R^3 to R^6 allows relay R^7 to operate at the beginning of the first dot, but prevents the immediate operation of relay R^8, which cannot operate until after the operation of relay R^5 at the beginning of the second dot. Relay R^9 cannot operate until the beginning of the third dot has operated relay R^3 for the second time. Likewise, if more than three counting relays are necessary, each counting relay can operate only after the corresponding number of dots have come through and the corresponding number of escapement relays have functioned. By virtue of this arrangement, the given counting relay which controls the annunciator will be operated, and consequently give the signal, only in response to the code signal allotted to that relay or station, that is, the given counting relay cannot operate unless, for instance, the given number of dots, and no more, have peceded the long space. Given this arrangement, any other signal than that corresponding to the given station will not produce the announcing signal. The escapement relays function to prevent, for instance, the successive operation of all the relays in response to a single dot. Even though one or more counting relays, preceding the counting relay which controls the annunciator, have operated, the signal controlling relay cannot operate until the escapement relays have functioned again in response to further impulses in accordance with the code signal.

It has been seen that, in the circuit specifically described and shown in the drawing, counting relay R^9 controls the buzzer. If the operating code is the correct one—in this case, three dots, long space, dot—relay R^9 will be operated after the third dot, and the buzzer will sound. The function of the final dot is to terminate the operation of the buzzer—by releasing relay R^9 through the operation of relay R^{10}. If fewer than the necessary number of dots come through, relay R^2 will, after a suitable interval, release, taking ground 17 off lead E and releasing all relays which may have been locked in operated positions. On the other hand, if more than the number of dots required to operate relay R^9 precede the long space of the code, on the fourth dot, when ground 38 is placed on lead D a second time, a circuit is closed to relay R^{10} through contact 51, contact 60, winding 57 of relay R^{10}, and battery, to ground at 61, and both armatures of relay R^{10} are attracted, making contact at 59 and breaking contact at 55. The closing of contact 59 completes the locking circuit for relay R^{10} as follows: from ground at 61, through battery, winding 57, contact 59, and contact 15, to ground at 17. The opening of contact 55 takes the locking ground 56 off relay R^9. Hence, relay R^9 cannot operate after the third of a series of more than three consecutive dots, even though a long space follows any dot after the third. Thus, the operation of the buzzer in response to an improper signal, of fewer or more dots than the fixed number, is prevented.

What is claimed is:

1. In a selector circuit, two sets of relays, circuit means whereby one relay of a set responds to the initiation of a signal impulse to permit the operation of another relay of the set upon the termination of that impulse, circuit means whereby the operation of the latter relay releases the former, circuit arrangements whereby the second set of relays responds to the succeeding impulse in like manner, circuit arrangements whereby the first and second sets of relays respond alternately to further succeeding impulses in new cycles of operations, a series of counting relays, and circuit means whereby said counting relays are actuated successively in response to the alternate operations of the two sets of relays.

2. In a selector circuit, a series of four relays, circuit means whereby the first relay of said series responds to the initiation of a signal impulse to permit the operation of the second relay upon the termination of that impulse, circuit means whereby the operation of the second relay releases the first and permits the operation of the third relay in response to the initiation of the succeeding impulse to permit, in turn, the operation of the fourth relay upon the

termination of that impulse, circuit means whereby the operation of the fourth relay releases the third and prepares the entire series of relays for a new cycle of operations in response to further succeeding impulses, a series of counting relays, and circuit means whereby said counting relays are actuated successively in response to the alternate operations of the first and third relays.

3. In a selector circuit, two sets of relays, circuit means whereby one relay of a set responds to the initiation of a signal impulse to permit the operation of another relay of the set upon the termination of that impulse, circuit means whereby the operation of the latter relay releases the former, circuit arrangements whereby the second set of relays responds to the succeeding impulse in like manner, circuit arrangements whereby the first and second sets of relays respond alternately to further succeeding impulses in new cycles of operations, a series of counting relays, circuit means whereby said counting relays are actuated successively in response to the alternate operations of the two sets of relays, and circuit means whereby all but a predetermined one of said counting relays are released upon the occurrence of a long break in the succession of signal impulses.

4. In a selector circuit, a series of four relays, circuit means whereby the first relay of said series responds to the initiation of a signal impulse to permit the operation of the second relay upon the termination of that impulse, circuit means whereby the operation of the second relay releases the first and permits the operation of the third relay in response to the initiation of the succeeding impulse to permit, in turn, the operation of the fourth relay upon the termination of that impulse, circuit means whereby the operation of the fourth relay releases the third and prepares the entire series of relays for a new cycle of operations in response to further succeeding impulses, a series of counting relays, circuit means whereby said counting relays are actuated successively in response to the alternate operations of the first and third relays, and circuit means whereby all but a predetermined one of said counting relays are released upon the occurrence of a long break in the succession of signal impulses.

5. In a selector circuit, two sets of relays, circuit means whereby one relay of a set responds to the initiation of a signal impulse to permit the operation of another relay of the set upon the termination of that impulse, circuit means whereby the operation of the latter relay releases the former, circuit arrangements whereby the second set of relays responds to the succeeding impulse in like manner, circuit arrangements whereby the first and second sets of relays respond alternately to further succeeding impulses in new cycles of operations, a series of counting relays, circuit means whereby said counting relays are actuated successively in response to the alternate operations of the two sets of relays, circuit means for preparing an annunciator circuit in response to the operation of a predetermined one of said counting relays, and circuit means for completing said annunciator circuit in response to a long break in the series of signal impulses.

6. In a selector circuit, a series of four relays, circuit means whereby the first relay of said series responds to the initiation of a signal impulse to permit the operation of the second relay upon the termination of that impulse, circuit means whereby the operation of the second relay releases the first and permits the operation of the third relay in response to the initiation of the succeeding impulse to permit, in turn, the operation of the fourth relay upon the termination of that impulse, circuit means whereby the operation of the fourth relay releases the third and prepares the entire series of relays for a new cycle of operations in response to further succeeding impulses, a series of counting relays, circuit means whereby said counting relays are actuated successively in response to the alternate operations of the first and third relays, circuit means for preparing an annunciator circuit in response to the operation of a predetermined one of said counting relays, and circuit means for completing said annunciator circuit in response to a long break in the series of signal impulses.

7. In a selector circuit, two sets of relays, circuit means whereby one relay of a set responds to the initiation of a signal impulse to permit the operation of another relay of the set upon the termination of that impulse, circuit means whereby the operation of the latter relay releases the former, circuit arrangments whereby the second set of relays responds to the succeeding impulse in like manner, circuit arrangements whereby the first and second sets of relays respond alternately to further succeeding impulses in new cycles of operations, a series of counting relays, a signal annunciator, means whereby one relay of said series, upon actuation, grounds one side of the signal annunciator, circuit means whereby said counting relays are actuated successively in response to the alternate operations of the two sets of relays, and circuit arrangements whereby battery and ground are placed on the other side of said signal annunciator upon the occurrence of a long break in the series of signal impulses subsequent to the actuation of the counting relay controlling said signal annunciator.

8. In a selector circuit, two sets of relays, circuit means whereby one relay of a set responds to the initiation of a signal impulse to permit the operation of another relay of the set upon the termination of that impulse, circuit means whereby the operation of the latter relay releases the former, circuit arrangements whereby the second set of relays responds to the succeeding impulse in like manner, circuit arrangements whereby the first and second sets of relays respond alternately to further succeeding impulses in new cycles of operations, a series of counting relays, one relay of said series, upon actuation, grounding one side of a signal annunciator, circuit means whereby said counting relays are actuated successively in response to the alternate operations of the two sets of relays, circuit arrangements whereby battery and ground are placed on the other side of said signal annunciator upon the occurrence of a long break in the series of signal impulses subsequent to the actuation of the counting relay controlling said signal annunciator, and circuit means whereby the signal annunciator circuit is broken upon the termination of the long break in the series of signal impulses.

9. A selector circuit for the transmission of the impulses of a fixed signal code, comprising a pulsing relay; a series of four relays and means whereby the relays of the series are successively operated upon the initiation and termination, alternately, of the signal impulses, means whereby the first of said relays, when operated, grounds a first lead, and means whereby the third of said relays, when operated, grounds a second lead; circuit means for locking the first three of said relays in operated position; circuit means for releasing the immediately preceding relay upon the operation of each of the last three of said relays; a series of counting relays and means whereby said counting relays are connected alternately to said first and second leads; an annunciator and means whereby said annunciator is connected on one side to ground upon operation of one of said counting relays; a slow-release relay and means whereby said slow-release relay is operated simultaneously with the operation of the first relay and maintained in operated position during the successive operations of the relays, said slow-release relay, upon its release, including means for connecting battery and ground to the other side of said annunciator; and means for breaking the circuit including said annunciator upon the conclusion of the impulses of said fixed signal code.

In testimony whereof, I have signed my name to this specification this 1st day of November 1923.

RALPH K. BONELL.