May 1, 1934. C. S. DEMAREST 1,956,670

SELECTIVE SIGNALING SYSTEM

Filed Nov. 1, 1932 3 Sheets-Sheet 1

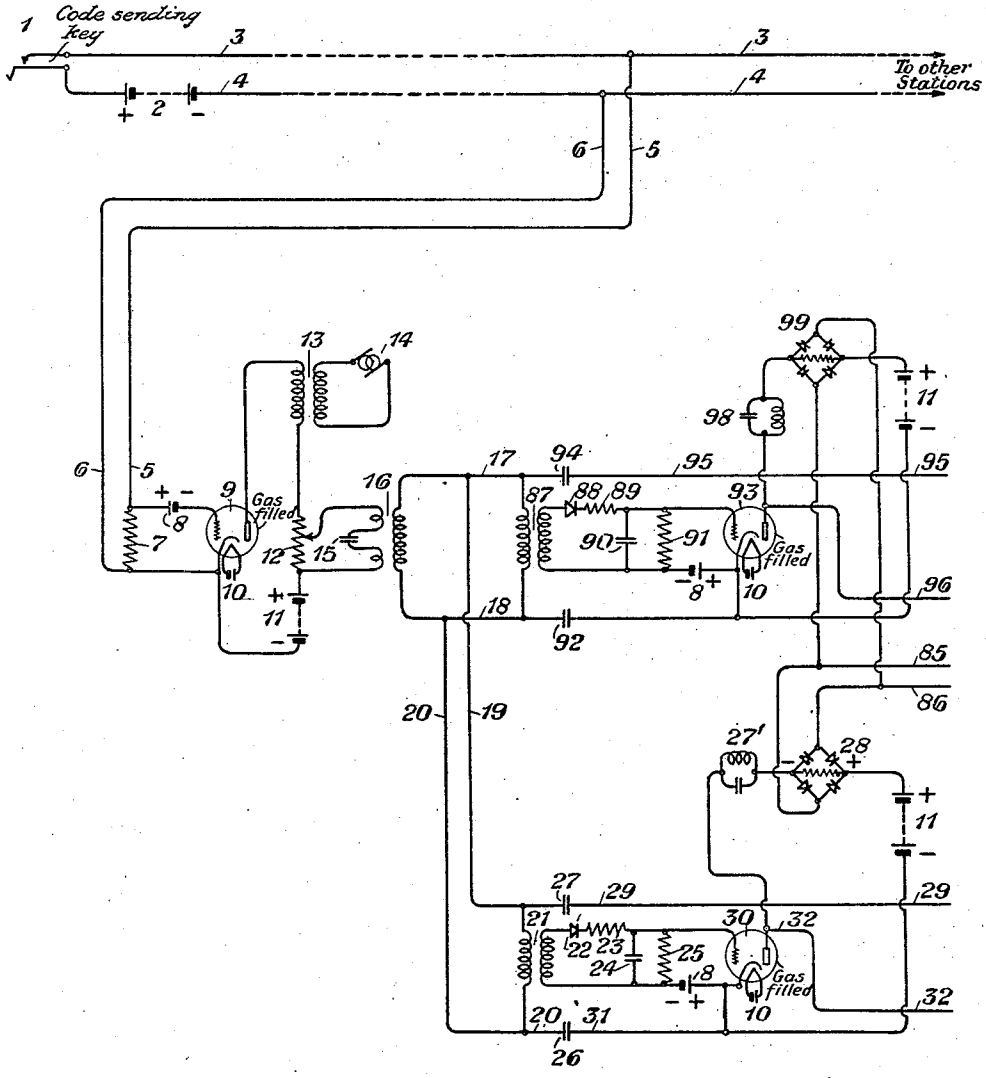


Fig. 1

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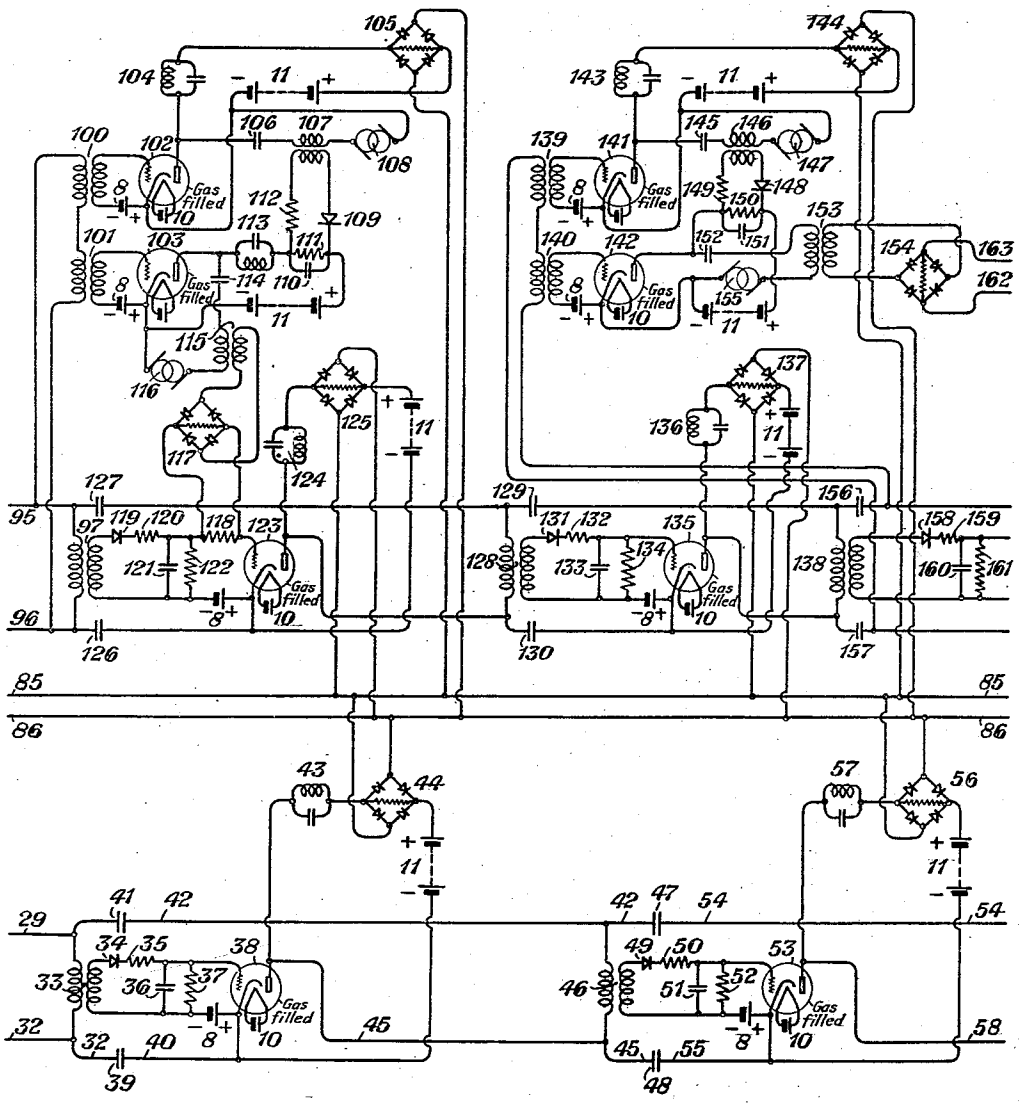


Fig. 2

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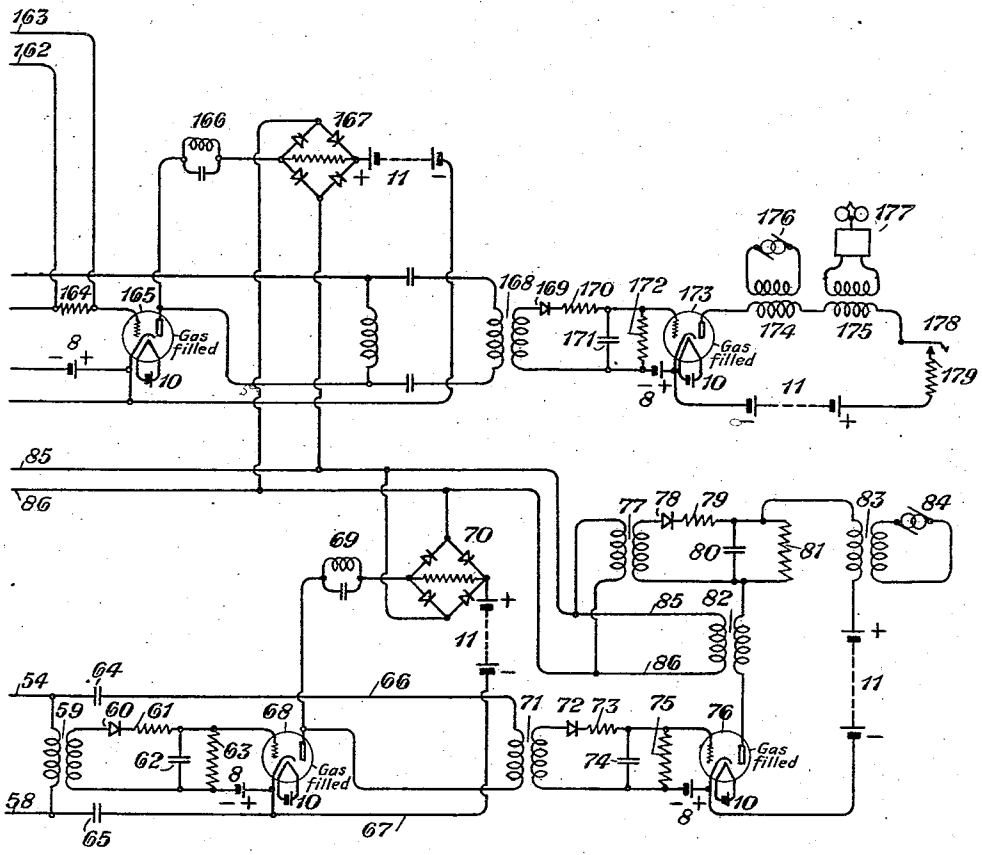


Fig. 3

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1,956,670

SELECTIVE SIGNALING SYSTEM

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4 Claims. (Cl. 177—353)

This invention relates to electrical circuits, and more particularly to that class of electrical circuits used for selective signaling, in which a constant number of coded impulses are sent, divided variously into groups to select the station desired.

Such circuits in the past have employed electro-magnetically operated relays and selectors, having mechanically moving parts, and which require careful adjustment and maintenance of armature of travel, clearance between various members, spring tensions and contact pressures. It is an object of this invention to provide means for such selective signaling not employing moving parts, but which employ instead electrical discharge devices of the gas-filled type, which may be either of the thermionic hot cathode type or of the cold cathode type, although for illustrative purposes only the operation of the invention has been described with reference to the use of the thermionic type, in the description hereinafter following and in the appended drawings.

Other objects and features of this invention will appear from the following description of an embodiment thereof, together with the appended drawings in the Figures 1, 2 and 3 of which the invention is illustrated. Figs. 1, 2 and 3 when taken together comprise a circuit diagram showing a preferred form of the invention.

Referring to Fig. 1, reference character 1 indicates a code sending key of the type well known in the art, which is arranged to be normally open, but which when actuated will send out a constant number of impulses, spaced in a variable and predeterminable manner, to permit the selection of one of a plurality of stations to which it is desired to transmit a signal. The code sending key referred to is illustrated more fully in Patent No. 1,155,640, to Brown. In the arrangements here shown, this number is 5, although obviously any number might be employed, greater than 2, in accordance with the principles of this invention. With a five impulse code, the following selections can be made 1—1—3, 1—2—2, 1—3—1, 2—1—2, 2—2—1, 3—1—1, if three groups are always sent. The numerals represent the number of pulses in the groups, the dashes represent spaces between the groups. Key 1 transmits direct current impulses from battery 2 to signaling conductors 3 and 4, across which the various stations to be selected are bridged. Only one such station has been shown in detail, the conductors 5 and 6 being the bridging connections, leading from conductors 3 and 4 to input resistance 7 of gas-filled tube 9. Obviously, alternating current might equally well be used, of a frequency high in comparison with the frequency of impulses. Gas-filled tube 9 is provided with grid biasing battery 8, which ordinarily applies a grid bias such that no arc will strike therein, while battery 10 supplies cathode heating energy and battery 11 supplies anode potential. The same reference characters have been used to designate the batteries of the same function associated with other tubes throughout the figures of the drawings.

Tube 9 serves as a repeater of signaling impulses and provides a means for applying signaling impulses to the balance of the circuit which will be of constant amplitude, and not affected by any variations in amplitude of the impulses received at the station, due to variations in resistance or leakage of line conductors 3 and 4.

When a positive impulse is applied to the grid of tube 9, due to closure of the contacts of key 1, the grid will be rendered less negative and an arc will strike between anode and cathode. The circuit from cathode to anode passes through anode battery 11, potentiometer 12 and the secondary of transformer 13 in series. The primary of transformer 13 is connected to alternating current source 14. As long as the signaling impulse maintains the grid of tube 9 more positive than its normal value, current, both direct from battery 11, and alternating from source 14 through transformer 13 will flow in the anode circuit. The amplitude of the alternating voltage across transformer 13 is such that at each negative half cycle, the anode of tube 9 is reduced to or below that of the cathode. Hence as soon as the signaling key 1 opens, and the grid of tube 9 is restored to its normal negative potential, the arc will be extinguished on the next negative half cycle.

The primary of transformer 16 is bridged across potentiometer 12, condenser 15 preventing direct current flow through this winding. The secondary of this transformer applies the signaling impulses, now translated into spurts of alternating current of the frequency of source 14 to conductors 17 and 18, and also to conductors 19 and 20. These conductors convey the impulses to two trains of pulse-operated gas-filled tubes, arranged so that for each impulse only one tube in the trains will operate.

Considering first the lower group, to which pulses are applied by conductors 19 and 20, which lead to the primary of transformer 21; the secondary of this transformer applies the impulse to the grid of tube 30, through rectifier 22, and resistance 23, to condenser 24, in parallel with which

is resistance 25. These resistances and capacities are so adjusted that the rectified potential across condenser 24 will build up slowly and will not attain a value sufficient to override the biasing battery 8 and cause an arc to strike in tube 30 until considerably more than half the time of one impulse has elapsed. It may be remarked in this connection that key 1 is so constructed that the impulses sent out are all of the same predetermined length, while the operation of tube 9 adjusts the impulses applied to tube 30 to a constant amplitude. An arc will not strike in tube 30 until near the end of the impulse. When this occurs a path is completed from conductor 19 through condenser 27 to conductor 29 and thence to the primary of transformer 33 (shown in Fig. 2) and to conductor 32 to the anode of tube 30, through arc path thereof to conductor 31 to condenser 26 and thus back to conductor 20. The secondary of transformer 33 applies the impulse to the grid of tube 38, through rectifier 34 and resistance 35, to condenser 36 and resistance 37 so as to override the bias of battery 8 and cause an arc to strike in tube 38, after a predetermined delay. But as tube 30 did not operate until near the end of the first pulse, the remainder of this pulse will be of too short a duration to cause an arc to strike in tube 38. The second impulse, coming after a space during which the charge on condenser 36 can leak off through resistance 37, will in a like manner to that described for tube 30, cause an arc to strike in tube 38, after more than half of the second pulse has been received. As soon as the arc strikes in tube 38, the pulse current input is extended from conductor 29 through condenser 41 to conductor 42, thence through the primary of transformer 46 to conductor 45 to and through the arc path of tube 38 to conductor 40 and through condenser 39 to conductor 32. As before the remainder of the second pulse will not cause an arc to strike in tube 53, the grid of which is connected to the secondary of transformer 46 through the delay circuit composed of rectifier 49, resistances 50 and 52, condenser 51 and biasing battery 8, but the arc will strike in tube 53 after more than half of the third impulse has been received, extending the input to transformer 59 from conductor 42, through condenser 47 over conductors 54 and 58, the arc path of tube 53, conductor 55 and condenser 48 to conductor 45. And as before, the remainder of the third pulse will not cause an arc to strike in tube 68, but this will occur after more than half of the fourth pulse, due to the operation of the delay circuit formed by rectifier 60, resistances 61 and 63, condenser 62 and grid biasing battery 8. When the arc strikes in tube 68, the input is extended from conductor 54 through condenser 64 to conductor 66 to the primary of transformer 71, arc path of tube 68 and back L conductor 58 through condenser 65, over conductor 67. The remainder of the fourth pulse will not last long enough to operate tube 76, the grid of which is connected to the secondary of transformer 71 through the delay circuit composed of rectifier 72, resistances 73 and 75, condenser 74 and grid biasing battery 8. But the fifth pulse will operate tube 76, as hereinbefore explained. The tubes 76, 68, 53, 38 and 30, with their associated circuits, form a pulse counting arrangement. Each tube operated will remain operated until extinguished by the operation of rectifier circuits in the direct current branches of the anode circuits. The arrangements in the case of all the pulse counting tubes except tube 76 are identical. Anti-resonant circuits 27', 43, 57, and 69 are provided to keep alternating current from the pulsing path out of the direct current branch of the circuit. Interposed between the anti-resonant circuits and the anode battery 11 are resistance-rectifier elements, 28, 44, 56 and 70, which are so arranged that when alternating current of sufficient amplitude is applied to the alternating current terminals thereof a direct potential equal but opposite to that of the anode battery 11 is developed across the resistance in the unit, which reduces the anode potential at the tubes to zero and interrupts the arcs therein. The alternating current terminals of these and certain other rectifier units are bridged across conductors 85 and 86, and consequently, when alternating current is applied to these conductors all tubes whose anode circuits contain rectifier resistance elements connected to the aforesaid conductors will have their anode potentials reduced to zero and the arcs therein extinguished.

The principle of the method of code selection used herein is that spaces of definite and predetermined duration, several times that normally occurring between successive pulses, are introduced between groups, but the total number of pulses remains constant. The pulse counting tubes are utilized to determine when the entire code has been received and operate independently of spacing between impulses. The selecting arrangements proper provide timed disabling circuits connected between successive tubes in a second sequence, similar to the counting tubes, so that if coded impulses grouped other than according to the predetermined code for which the particular group is wired are received, all five of the selecting tubes will not be operated, and no signal will be received. The arrangements shown in the drawings appended hereto are for a code group 1—2—2. Any other code can be set up by proper connection of the disabling delay circuit.

The selecting tubes receive impulses from the conductors 17 and 18 which are connected to the secondary of transformer 16 in parallel with conductors 19 and 20. The primary of transformer 87 is connected between conductors 17 and 18. A delay circuit as hereinbefore described, consisting of rectifier 88, resistances 89 and 91, condenser 90 and grid bias battery 8 is interposed between the grid of tube 93 and the secondary of transformer 87, so that an arc will strike in tube 93 after the major portion of the first code impulse has been received. As soon as the arc strikes in tube 93, the impulse received over conductors 17 and 18 is extended onto conductors 95 and 96, through condenser 94 to conductor 95, and through condenser 92 arc path of tube 93 to conductor 96. As in the case of the pulse counting tubes, the delay circuit consisting of rectifier 119, resistances 120 and 118, condenser 121 and biasing battery 8, interposed between the grid of tube 123 and the secondary of transformer 97 whose primary is connected between conductors 95 and 96 prevents the operation of tube 123 on the remainder of the pulse. At the same time the remainder of the first pulse causes arcs to strike in tubes 102 and 103, being applied to the grids thereof through input transformers 100 and 101 whose primaries are bridged across conductors 95 and 96. As soon as tube 103 operates, alternating current flows from source 116 through the primary of transformer 115, condenser 114 and the arc path of tube 103 back to source 116. The secondary of transformer

115 is connected to the rectifier 117 and the rectified output thereof increases the negative bias of the grid of tube 123 to the point where it cannot be operated by a received impulse. But when tube 102 operated, which occurred simultaneously with the striking of an arc in tube 103, an alternating current path was established from alternating current generator 108 through the primary of transformer 107, condenser 106, the arc path of tube 102 and so back to generator 108. The secondary of transformer 107 builds up a charge on condenser 110 and a drop in resistance 111 opposing the anode battery 11 of tube 103, but this supplied through resistance 112 in such a manner that an appreciable time, substantially equivalent to that between pulse groups, is required before the reverse potential so built up is sufficient to suppress the arc in tube 103. When this occurs, alternating current is no longer supplied to rectifier 117 from source 16 and the bias on the grid of tube 123 is restored to normal so that it can now operate on the second code impulse, provided that followed the first by the predetermined spacing interval between code groups. If the first code group consisted of more than one impulse it is evident that one or more will be lost during the time that tube 123 is blocked by the high bias on its grid from rectifier 117. Assuming that the code impulse sent had such a space after the first impulse, after the operation of tube 102 has suppressed the arc in tube 103, the second impulse will, after the delay introduced by the rectifier 119, resistances 120 and 122, condenser 121 and biasing battery 8, cause an arc to strike in tube 123, near the end of the said second impulse. This will extend the impulse circuit through condenser 126, arc path of tube 123 to transformer 128, through the primary thereof, condenser 127 and back to condenser 95. The secondary of transformer 128 is connected to the grid of tube 135, so that this tube will operate on the next impulse, after a delay nearly equal to the length of the pulse, but will not have operated on the remainder of the second pulse, as hereinbefore explained. This is accomplished by rectifier 131, resistances 132 and 134, condenser 133 and grid biasing battery 8. An arc will be established in tube 135 near the end of the third impulse, extending the impulse path to the primary of transformer 138 through the arc path of tube 135, and operating tubes 141 and 142, through the input transformers 139 and 140 which have their primaries bridged, in series, across the primary of transformer 138. As before, source of alternating current 155 supplies alternating current through transformer 153 and the arc path of tube 142 to rectifier 154 and applies a negative bias over conductors 163 and 162 to resistance 164, so that tube 165 cannot respond to the fourth pulse unless the normal spacing delay intervened between the third and fourth pulses, while the delay circuit consisting of rectifier 158, resistances 159 and 161, condenser 160 and grid biasing battery 8 prevented the remainder of the third pulse from operating tube 165. The arc path in tube 141, however, as before completed an alternating current path from alternator 147 through the primary of transformer 146 and condenser 145 which resulted in the slow building up of potential opposing the anode battery 11 of tube 142 across resistance 150 and condenser 151, thus quenching the arc therein and removing the excess bias on the grid of tube 165. If the fourth impulse follows the third with a spacing interval between, tube 165 will operate near the end of the fourth impulse, and this will extend an impulse path to the primary of transformer 168 through condensers 156 and 157 and the arc path of tube 165. The delay circuit consisting of rectifier 169, resistances 170 and 172, condenser 171 and biasing battery 8 will prevent the operation of tube 173 until near the end of the fifth impulse.

It should be noted that all tubes operated remain so, except for tubes 103 and 142. However, the direct current anode circuits of all tubes contain circuits 98, 104, 124, 136, 143 and 166, and rectifier resistance networks 99, 105, 125, 137, 144 and 167, and the alternating current terminals of said rectifier units are connected across conductors 85 and 86, in a manner similar to those in the pulsing tube circuits.

Now on the fifth pulse an arc was established in tube 76 in any case, and in tube 173, but only therein if the coded group of impulses contained spaces after the first and after the third pulses. The anode circuit of tube 76 completes an alternating current path from generator 84 through transformer 83, through primary of transformer 82 to the arc path of tube 76. The secondary of transformer 82 is connected to conductors 85 and 86, and applies alternating current thereto, extinguishing all tubes except 173, if operated, and 76. But the primary of transformer 77 is bridged across conductors 85 and 86, and its secondary is connected to rectifier 78, which after a delay builds up a potential across resistance 81 and condenser 80, the delay being determined by resistance 79, so that after a slight delay, sufficient to insure the extinction of all other tubes except 76 and 173, 76 will itself be extinguished.

This leaves only tube 173 operated, and this only if the code group received corresponded to the connection of the delaying circuits composed of tubes 102, 103 and 141, 142 together with their associated circuits. The arc circuit of tube 173 completes an alternating current path from source 176 through transformer 174 and the primary of transformer 175, key 178, resistance 179, anode battery 11 and back to the transformer 174 through the arc path of tube 173.

The secondary of transformer 175 supplies current to ringer or alternating current bell 177 which will, therefore operate whenever an arc is established in tube 173. This bell may be silenced by operating key 178 which opens the anode circuit of tube 173, extinguishing the arc therein. If, for example, the code utilized was 2—2—1 instead of 1—2—2, as heretofore explained, the signal device 177 would not be operated for the following reasons. The impulses would operate the five pulse counting tubes 30, 38, 53, 68 and 76, as heretofore described. The first pulse would also operate the selecting tube 93, as heretofore described, and tubes 102 and 103 would be operated. Tube 103 would prevent tube 123 from operating until tube 103 was extinguished by the voltage built up in circuit 12, 110, 109 and the secondary of transformer 107. As heretofore pointed out, the time taken to disable tube 103 is greater than normal intervals between the signal pulses. As the code now being used is 2—2—1, it will be seen that there is no spacing interval between the first two pulses, and that the spacing interval occurs between the second and third pulses. Accordingly, the second pulse will not operate tube 123 but will be lost. The third pulse might operate tube 123. The fourth pulse might operate tube 135, and the fifth pulse

might operate tube 165. By this time the fifth pulse would also have operated tube 76 of the series of counting tubes, and the system would function to restore all of the tubes to their original extinguished condition before the tube 173 could be operated and the signal device 177 caused to function.

While this invention has been described with respect to a specific embodiment thereof, it is not to be regarded as so limited, but to include any and all organizations falling within the scope and spirit of the appended claims.

What is claimed is:

1. In a selector device, a first series of gas filled discharge tubes, means for operating the tubes of said series successively by a predetermined number of coded impulses, a second series of gas filled discharge tubes, means for operating the tubes of said second series successively by said predetermined number of coded impulses when said impulses are arranged in arbitrary groups, signaling means controlled by the operation of the last tube of said second series, and means controlled by the operation of the last tube of said first series for extinguishing all of said tubes except the last tube of said second series.

2. In a selector device, a first series of gas filled discharge tubes, means for so interconnecting said tubes that each tube will be responsive to succeeding ones of a predetermined number of coded impulses, a second series of gas filled discharge tubes, means for so interconnecting said tubes that each tube will be responsive to succeeding ones of a predetermined number of coded impulses when said impulses are arranged in arbitrary groups, signaling means controlled by the operation of the last tube of said second series, and means controlled by the operation of the last tube of said first series for extinguishing all of said tubes except the last tube of said second series.

3. In a selector device, a first series of gas filled discharge tubes, means for so interconnecting said tubes that each tube will be responsive to succeeding ones of a predetermined number of coded impulses, a second series of gas filled discharge tubes, means for so interconnecting said tubes that each tube in said series will be dependent for its operation on the operation of the preceding tube of said series, means for delaying the responsiveness of certain of the tubes of said second series to arbitrary ones of said predetermined number of coded impulses, signaling means controlled by the operation of the last tube of said second series, and means controlled by the operation of the last tube of said first series for extinguishing all of said tubes except the last tube of said second series.

4. In a selector device, a first series of gas filled discharge tubes, means for so interconnecting said tubes that each tube will be responsive to succeeding ones of a predetermined number of coded impulses, a second series of gas filled discharge tubes, means for so interconnecting said tubes that each tube will be responsive to succeeding ones of a predetermined number of coded impulses when said impulses are arranged in arbitrary groups, said last mentioned interconnecting means comprising two auxiliary gas filled discharge tubes associated with one of the tubes of said second series and operated by the next preceding tube therein, one of said auxiliary tubes being adapted when operated to hold extinguished the tube of the second series with which it is associated and the other of said auxiliary tubes being adapted when operated to extinguish the first auxiliary tube after a predetermined interval, signaling means controlled by the operation of the last tube of said second series, and means controlled by the operation of the last tube of said first series for extinguishing all of said tubes except the last tube of said second series.

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