Oct. 26, 1948. F. H. HIBBARD 2,452,052

SELECTIVELY RESPONSIVE DEVICE

Filed Dec. 30, 1946 2 Sheets-Sheet 1

FIG. 1

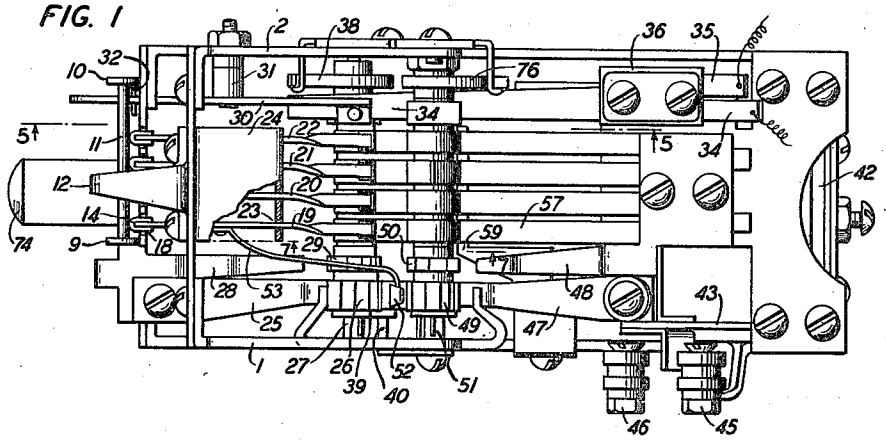

FIG. 2

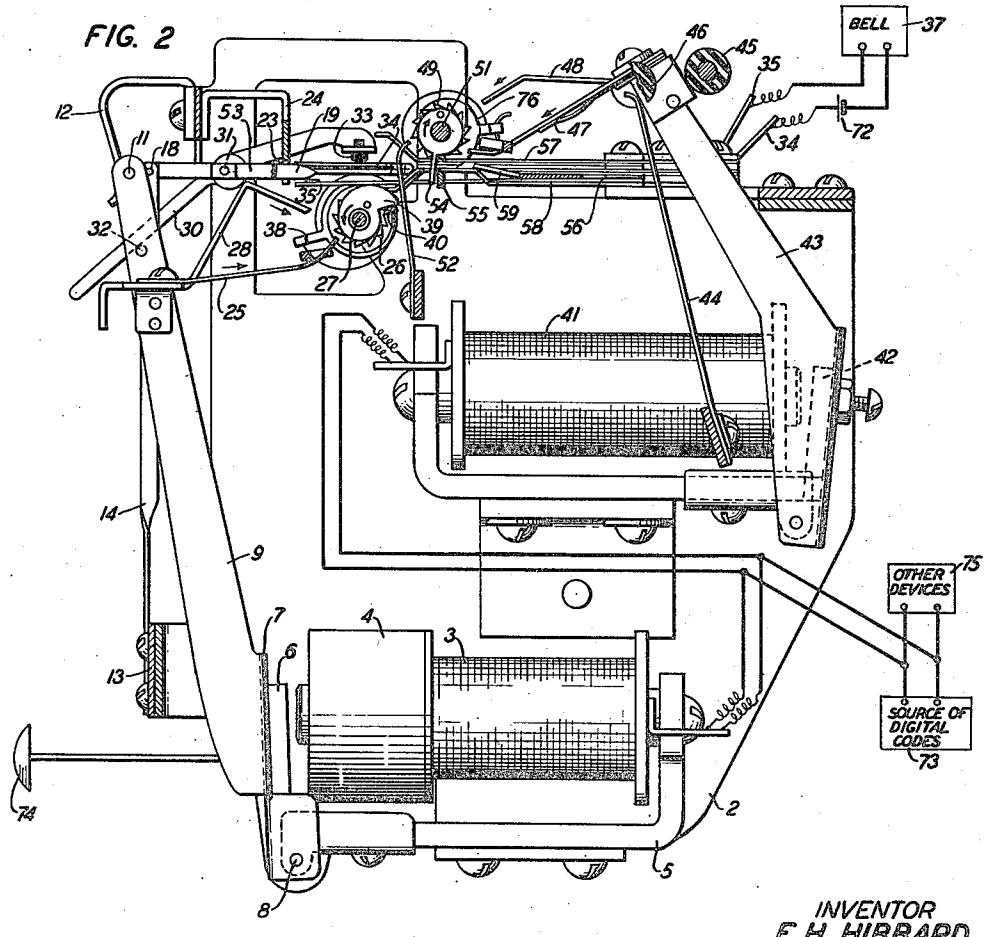

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FIG. 3

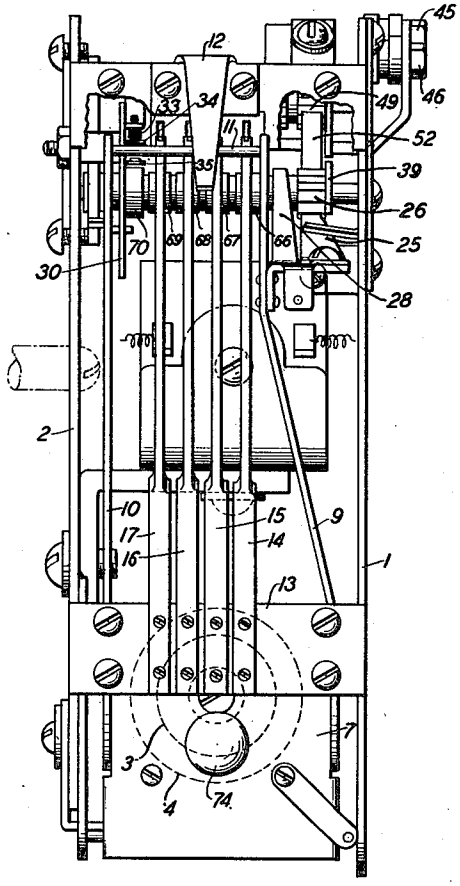


FIG. 4

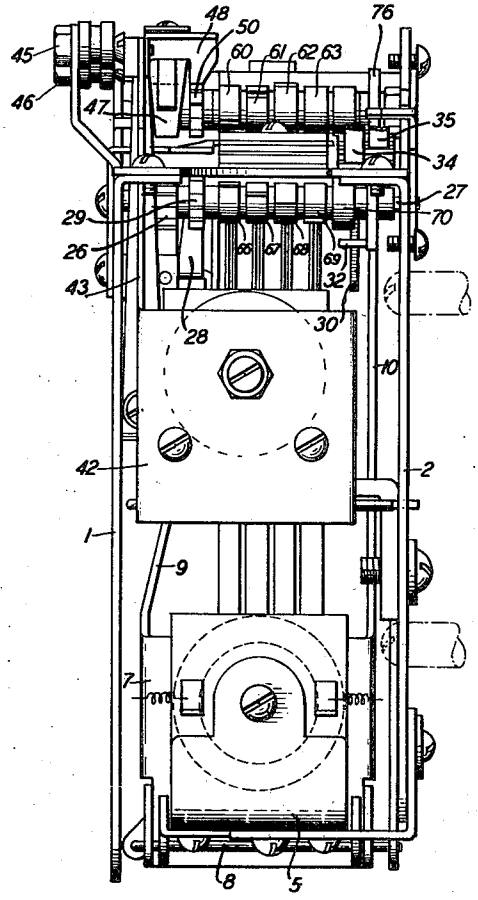


FIG. 5

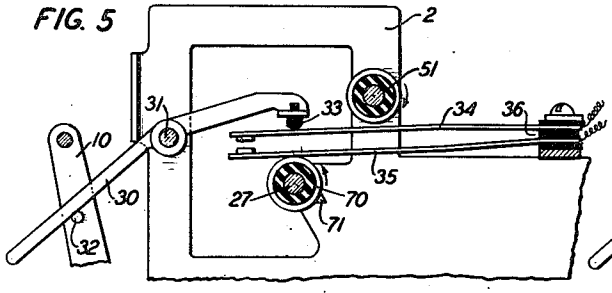


FIG. 6

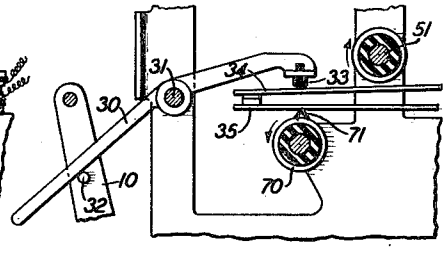


FIG. 7

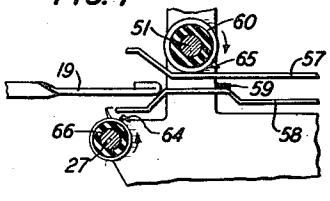
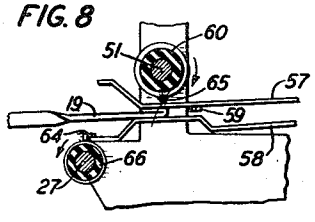


FIG. 8



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UNITED STATES PATENT OFFICE

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SELECTIVELY RESPONSIVE DEVICE

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Application December 30, 1946, Serial No. 719,274

13 Claims. (Cl. 177—353)

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This invention relates to selectively responsive devices and more particularly to electromagnetically actuated mechanisms which are selectively responsive to one, and only one, of several different combinations of a given number of digits having numerous combinations of pulses therein.

Heretofore in connection with selectively responsive devices or mechanisms of the electromagnetically actuated type the selection has been accomplished by means of different polarities of pulses, different amplitudes of pulses, different pulse widths, different time intervals between pulses and others comprising various combinations of these somewhat basic means. The present invention is concerned with what is preferred to be called a digital code system wherein a series of consecutive groups of pulses is transmitted to several devices. Each group of pulses comprises a plurality of individual pulses, the only limitation on which is that the pulses of each of the said groups be separated by not more than a given amount of time. The only limitation upon the series of groups is that the consecutive groups of said series be separated by not less than a given amount of time, the latter amount of time being slightly larger than the former mentioned amount of time. The device to which the series of groups of pulses is transmitted is adapted to respond, by signalling or otherwise, to only one series of groups wherein there are a certain prearranged number of pulses for each group and the groups are transmitted in a certain prearranged sequence.

Heretofore devices selectively responsive to a digital code have been restricted in their versatility in that irrespective of the number of digits or pulse groups transmitted and irrespective of the maximum possible number of pulses in any one group these devices have been restricted to respond satisfactorily to less than the theoretically possible maximum number of digital codes available from such a system. The restriction was in general that the devices could respond only to a series of groups of pulses, or series of digits, wherein the total pulse content of the series was less than the theoretical maximum number of pulses available for such a series from the system employed.

It is one feature of the present invention to provide a mechanism of the class mentioned above which is capable of responding satisfactorily to a digital code regardless of the number of digits in the series of same and irrespective of the number of pulses in any digit or group of the said series. For instance, as disclosed herein by example, a

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digital code system employing four digits with a possible maximum of ten pulses per digit presents ten thousand possible different codes using the four digits in all possible combinations and with all possible pulse contents of each digit. The invention herein disclosed is capable of selectively responding to any one of these ten thousand codes while being incapable of responding to any other of the codes while adjusted to respond to the said one of said codes. The present exemplary disclosure of the invention is therefore capable of responding to an unrestricted four-digit code, the word "unrestricted," as it is used herein, meaning not restricted in its capability of responding to any one of the possible maximum number of codes as previously explained.

In the exemplary disclosure set forth herein two parallel ratchet carrying cam shafts are individually stepped by separate electromagnetic motor mechanisms. The two motor mechanisms are subjected to all pulses of all digits of the said code. One cam shaft is designated the digit cam shaft and comprises four hooks equally spaced longitudinally of the shaft and spaced one ratchet step from each other circumferentially of said shaft and in a helical formation along the axis of said shaft. This digit cam shaft is stepped by a slow-to-release electromagnetic motor mechanism arranged to release only upon a time duration between pulses represented by the lapse of time between digits or a greater time length and will not release in the time between pulses of any one digit. The second cam shaft is designated the pulse cam shaft and comprises four cams having a raised portion on each equally spaced longitudinally of the shaft and opposite the said hooks on the digit cam shaft. The circumferential positions of the cams is arbitrary depending on the code to which the device is to respond as will be fully explained hereinafter. The digit shaft contains a cam adapted to move a contact spring when said digit shaft has been stepped four cumulatively successive ratchet steps. There are four resilient spring members adjacent the four pulse cams respectively, each member being adapted, when depressed by its respective pulse cam, to assume a position relative to the digit shaft such that if the respective digit shaft hook is in suitable position thereto the member will engage same and retain the digit shaft in its advanced position. The pulse shaft is stepped one step for each pulse of each digit, the digit shaft being stepped once for each digit. If the pulse content of the first digit is correct so as to position the first spring member to retain the digit

shaft at its advance of one step when the digit magnet releases and if each succeeding spring member is likewise suitably positioned to retain the digit shaft for each of four successive steps, the cam on the digit shaft will be brought to a position where it can move a contact spring and effect a signal indicating response to a given digital code.

The invention briefly set forth above is discussed in detail hereinafter with the assistance of the drawings forming a part of this disclosure, of which:

Fig. 2 is a side view of an exemplary embodiment of the invention shown as part of a signaling system in which the invention is employed to respond selectively to one of a possible plurality of digital codes transmitted thereto, to thereby effect a signal that the full response has been accomplished;

Figs. 1, 3 and 4 are respectively top elevation, front elevation and rear elevation views of the device shown in Fig. 2;

Figs. 5 and 6 are brief detailed sketches taken along the lines 5—5 of Fig. 1 and simplified to illustrate more clearly an operational feature of the invention; and

Figs. 7 and 8 are brief detailed sketches taken along the line 7—7 of Fig. 1 and simplified to illustrate more clearly another operational feature of the invention.

The operating mechanism of Figs. 1 through 4 is attached to and confined by two main side retaining plates 1 and 2. In Fig. 2 an electromagnet 3, having a copper slug 4 thereon, is attached by means of its heel-piece 5 to retaining plate 2, the plate 1 having been removed to expose the mechanism for reference. This magnet 3 will be referred to hereinafter as the digit magnet 3. An armature 6 is provided for the digit magnet 3 and is attached to a plate 7 pivoted on the heel-piece 5 by pin 8. The plate 7 has integral therewith two arms 9 and 10, more clearly shown in Fig. 3. These arms 9 and 10 are joined by a bar 11 at the tops or free ends of said arms, the bar normally resting against a back stop member 12. Attached to the retaining plates 1 and 2, or frame as these retaining plates shall be referred to, by means of a crosspiece 13 are four vertical resilient strips or rods 14, 15, 16 and 17 which are pretensioned to bear against the bar 11 at the top of the arms 9 and 10 to bias this armature assembly against the back stop 12. Fig. 3 illustrates these four rods or strips 14 through 17 most clearly. Pin hinged to the upper ends of the rods 14 through 17, such as by pin 18 for rod 14, are four horizontal fingers 19, 20, 21 and 22 guided by slots, such as 23, in the bottom of a guide plate 24 attached to the frame 1, 2.

When the digit magnet 3 is energized a drive pawl 25 on arm 9 of the armature assembly for magnet 3 will engage ratchet wheel 26 on the cam shaft 27. A spacing pawl 28, also on arm 9, will engage ratchet 29, also on cam shaft 27, to permit only a certain amount of rotation of the shaft 27 for each step of the magnet 3. As the arms 9 and 10 are moved due to energization of magnet 3 the bar 11 will push on the tops of rods 14 through 17 and thus slide the fingers 19 through 22 to the right in Fig. 2, as will be explained in more detail hereinafter in connection with Figs. 7 and 8.

A lever 30 pivoted to the frame at 31 is biased to the position shown in Fig. 2 by pin 32 on arm 10. In this position an insulated knob 33 on the end of said lever 30 depresses a contact spring 34 against its natural resilience. Thus when the magnet 3 is energized to move arms 9 and 10, the lever 30, under the action of the resilience in contact spring 34, will turn about its pivot 31 to permit the contact spring 34 to rise. Contact spring 34 cooperates with contact spring 35 in the pile-up section 36 to ring a bell 37 or other signal as will hereinafter be described with particular reference to Figs. 5 and 6.

After the cam shaft 27 has been stepped there is no retaining means to hold it advanced against the action of the spiral spring 38 except as hereinafter described. The shaft 27 will tend to return to its normal position determined by a lug 39 thereon engaging a stop pin 40 on the frame as shown in Fig. 2.

A magnet 41, which may be referred to as the pulse magnet, is attached to retaining plate 2 and has an armature 42 with extension 43 therefor and a spring 44 adapted to bias armature extension 43 to the position shown in Fig. 2 against the back stop 45. A front stop 46 is provided to limit the movement of extension 43 when the pulse magnet 41 is energized.

Similarly to the previous discussion concerning the ratchets 26 and 29 on cam shaft 27, the armature extension 43 carries a stepping or drive pawl 47 and a spacing pawl 48 adapted respectively to engage ratchets 49 and 50 on cam shaft 51 to step said shaft a given amount for each energization of the pulse magnet 41. Ratchet 49 on cam shaft 51, unlike ratchet 26 on cam shaft 27, has a retaining pawl 52 adapted to retain the advanced movement of the cam shaft 51 against the action of spiral spring 53. It is to be noted, most clearly in Fig. 1, that the retaining pawl 52 is engaged by a hook member 53, attached to finger 19, when the fingers 19 through 22 are allowed to move to the left of Fig. 1 upon release of the digit magnet 3. This hook member 53 will retract the retaining pawl 52 from its engagement with ratchet 49 and thereby allow the cam shaft 51 to return to normal where a lug 54 on said shaft engages a stop pin 55 on the framework.

In the pile-up assembly 56 of Fig. 2 are mounted four sets of spring fingers, such as 57 and 58, more clearly shown in Figs. 7 and 8. Spring fingers such as 58 are resiliently biased to rest against a stop member 59 attached to the frame. Spring fingers such as 57 are resiliently biased to rest against the cam surfaces of the cams such as 60 on cam shaft 51, there being four cams 60, 61, 62 and 63, per Fig. 4, each of which cooperates in the above manner with a set of spring fingers, such as described above in connection with fingers 57 and 58 shown in Figs. 7 and 8. The ends of the bottom spring fingers such as 58, are adapted to engage hooks, such as 64, on the cams of cam shaft 27 but will so engage these hooks 64 only when the fingers, such as 19, have been moved to the position shown in Fig. 8 by the action of the digit magnet 3 and associated stepping mechanism and only when the respectively associated raised portion 65 of cams, such as 60, on cam shaft 51 have been positioned in accordance with Fig. 8 due to the action of the pulse magnet 41 and its associated stepping mechanism.

The cams of cam shaft 27 such as 66, 67, 68 and 69 of Fig. 4, each carry a hook, such as 64 of Fig. 7, the hook of each successive cam such as 67 being one ratchet step beyond the hook on the preceding cam such as 66. The raised portions of the cams on cam shaft 51 may be arranged in any relative manner desired as long as they will

be moved to positions corresponding to that of Fig. 8 on a given number of full ratchet steps of ratchet 49. Referring to Fig. 8, the hook 64 when advanced by the digit magnet will be advanced slightly counterclockwise of the position shown in Fig. 8 such that the spring member 58 may be positioned against the cam surface 66 to thereby catch hook 64 when the shaft 27 is released at the end of that particular digit.

The cam shaft 27 carries a fifth cam 70, shown in Figs. 3 and 4 and more clearly in Figs. 5 and 6. If each of the four hooked cams of the cam shaft 27 has been retained by the fingers, such as 58 of Fig. 8, each time the digit magnet 3 releases, the raised portion 71 of cam 70 will be held in the position shown in Fig. 6. When the digit magnet 3 releases the arm 10, the pin 32 attached thereto will force lever 30 to pivot about 31 such that the insulated knob 33 thereon will depress contact spring 34 into contact with contact spring 35 now held upraised against its own tension by the portion 71 of cam 70. This contact of springs 34 and 35 will complete a circuit for bell 37 through battery 72, of Fig. 2, to indicate a correct and full response of the device to the digital codes about to be discussed.

Let it be assumed that it is desired that this particular device be responsive to a digital code comprising four successive digits containing respectively the numbers of pulses of 3—10—4—8. The cam 60 on cam shaft 51 would be set to come to the position shown for it in Fig. 8 on three ratchet steps of ratchet 49 which corresponds to three separate energizations and releases of pulse magnet 41 in responding to three pulses of this digit. It will be noted from Fig. 2 that the digit magnet 3 is in parallel with the pulse magnet 41 to the source of digital codes 73, such as the sources of code 3—10—4—8 assumed for purposes of discussion. The digit magnet 3, however, is provided with a copper slug 4, the effect of which is well known to make this magnet slow releasing. Let it suffice to say that digit magnet 3 is arranged or adjusted to release in the time between digits but will not release between pulses of any one digit, this being a well-known phenomenon. Digit magnet 3 will operate its stepping mechanism on the first pulse of every digit and release between digits, so that regardless of the number of pulses in a digit the cam shaft 27 receives only one step per digit. The second cam 61 of cam shaft 51 will be arranged to assume the position of Fig. 8 upon ten steps from its normal position. Likewise cams 62 and 63 will be arranged to assume the indicated position on four and eight pulses respectively from normal positions, it being remembered that after each digit, the hook member 53 operated by the digit magnet stepping mechanism releases the retaining pawl 52 of ratchet 49 and allows the cam shaft 51 to return to normal from whence it starts for each digit of the code.

When the first digit is transmitted the cam shaft 27 will step one step thus positioning its first cam hook, such as 64 on cam 66 of Fig. 8, in position to be engaged by a spring, such as 58, providing the number of pulses in the digit corresponds to the cam setting of cam 60, as previously discussed in connection with Figs. 7 and 8. As previously pointed out the cam hook 64 will be positioned slightly more counter-clockwise than as shown in Fig. 8 to enable the spring member 58 to be depressed into contact with cam 66. This is so that the spring member 58 may catch hook cam 64 when the shaft 27 is released at the

end of the particular digit, by the release of the digit magnet. In the assumed case cam 60 was preset to assume the position indicated in Fig. 8 upon three ratchet steps of the cam shaft 51. The end result of this operation is that at the end of three pulses, spring member 58 will be depressed according to Fig. 8 such that when the digit magnet stepping mechanism releases, the spring 58 will engage the hook 64 to hold the cam shaft 27 advanced one step. The digit magnet stepping mechanism in releasing permits the cam shaft 51 to return to normal as has been discussed. Since cam 61 was preset for ten pulses its spring member will engage the hook of cam 67 on shaft 27, which was brought into proper position by the second operation of digit magnet 3 since this hook of cam 67 is one ratchet step beyond the hook of cam 66. Thus at the end of the second digit the cam shaft 27 is held advanced two steps. Likewise without further discussion it is stated that at the conclusion of the fourth digit, since the pulse cams 60 through 63 have been properly preset, the cam shaft 27 will have been advanced and held advanced four complete cumulatively successive ratchet steps. It will be remembered that this result is the one which will bring the cam 71 into the position shown in Fig. 6 and thus to effect the ringing bell 37 or other signalling means by completing a circuit through battery 72 to the signalling means 37.

From the foregoing discussion it is seen that the digit cam shaft 27 will be restored to normal whenever the digit magnet 3 releases at end of each digit unless the number of pulses in the digit corresponds with the preset angular position of the corresponding pulse cam such as 60. To restore cam shaft 27 to normal from its fourth step position per Fig. 6, therefore, requires only that the code source 73 transmit a digit of pulses different in number from that for which the fourth pulse cam 63 is preset. By translating the code in transmission so as to use any number of pulses, such as 2 to 11 to represent code numbers such as 1 to 10, it is possible to avoid presetting the fourth or any pulse cam in any selector to reach the position of Fig. 8 after a single pulse. By this means, the cam shafts of any or all selectors connected to the code source 73, can be restored to normal from the ringing position of Fig. 6 or from any other off-normal position by transmission from the source 73 of a single impulse. This provision is also desirable in order to prevent response of this device to any spurious single pulses such as might be transmitted to the magnets by static or lightning or the like. This requirement of non-response to a single pulse is of practical commercial significance only since the response of the mechanism need not be so limited or restricted if spurious pulses, such as mentioned above, be ignored and if mechanical releasing means is provided at the locality of the mechanisms for reverting the digit cam shaft 27 to normal when preparing to receive an additional code. The spurious pulse consideration need not be considered as far as the invention is concerned as the mechanism is capable of responding to an unrestricted code as previously explained, the feature of non-response to a single pulse being only a suggested expedient which may or may not be necessary in practice. Mechanical means could be provided for the mechanism in the form of a push button 74 which would permit manual operation of the digit stepping mechanism for clearance of cam shaft 27 back to normal, preparing same for the reception of the next code.

A block 75 is shown on Fig. 2 and is intended to designate other selective devices receiving the same codes as transmitted by the source 73 to the mechanism of Fig. 2. It is to be understood that this block 75 may represent 9,999 other mechanisms for a system of digital codes comprising four digits where each digit may consist of one to ten pulses and may represent other quantities depending on the number of digits in the system employed.

It is further to be noted that the invention is not limited in scope to a four-digit system but is readily adapted to systems of more or less than four digits providing the correct number of digit and pulse cams are provided in accordance with the previous discussion concerning the exemplary disclosure herein of a mechanism adapted for a four-digit system.

Furthermore, although I have disclosed the interconnection of the receiving devices with the source of codes as a wire connection, it is obvious that radio transmission is contemplated as well since pulse transmission and reception by radio or wireless means is well known.

The fact that I have disclosed a bell 37 operated by the contact of contact springs 34 and 35 to complete a circuit for the bell through battery 72 is also merely exemplary of a vast number and variety of signalling means well known and suitable for the purpose disclosed. For instance a relay could be operated which in turn might do further work or a vacuum tube could be activated or a motor energized. There will be many such devices or means suggested by this disclosure.

Having described the invention fully hereinbefore and not wishing the scope thereof to be limited to the specific exemplary disclosure used, I append the following claims which alone define the scope of the invention.

What is claimed is:

1. A selectively responsive device adapted to respond to all codes of a plural-digit code system and adapted to enable operation of a signal circuit in responding to only one of said codes, said device comprising two shafts, each shaft having cams thereon, mechanism for rotating each shaft, one shaft rotatably responsive to each pulse of each digit of said code, the other shaft rotatably responsive to only the first pulse of each digit of said code, means for testing simultaneously the positions of at least one cam of each shaft after rotational response thereby to each digit, the positions of said cams on said shafts being predetermined and preset in accordance with the code desired to effect enabling of said signal circuit, said means operative, when said tested cams are successively in the proper preset positions upon each such test for each digit of said code, to enable operation of said signal circuit.

2. A selectively responsive device adapted to respond to all codes of a plural-digit code system and adapted to enable operation of a signal circuit in responding to only one of said codes, said device comprising two shafts, each shaft having cams thereon, spring means for biasing each shaft to its normal position, rotating mechanism for rotating each shaft, one shaft rotated cumulatively in response to each pulse of each digit of said code and returned to normal after each digit, the other shaft rotated in response to only the first pulse of each digit of said code and normally returned to normal after each digit, means for testing simultaneously the positions of at least one cam of each shaft after rotational response of each shaft to each digit, the positions of said cams on said shafts being predetermined and preset in accordance with the code desired to effect enabling of said signal circuit, said means operative, when said tested cams are in the proper preset positions upon each such test for each digit of said code, to retain said other shaft cumulatively advanced after each digit to thereby enable operation of said signal circuit.

3. A selectively responsive device adapted to respond to all codes of a plural-digit code system and adapted to enable the closing of contacts in a signal circuit in responding to only one of said codes, said device comprising two shafts, each shaft having cams thereon, spring means biasing each shaft to its normal position, rotating mechanism for rotating each shaft, one shaft rotated cumulatively in response to each pulse of each digit of the said code, and returned to normal after each digit, the other shaft rotated in response to only the first pulse of each digit of the said code, means for testing simultaneously the positions of at least one cam of each shaft after rotational response of each shaft to each digit, the positions of said cams on said shafts being predetermined and preset in accordance with the code desired to effect enabling of said signal circuit, said means operative, when said tested cams are in the proper preset positions upon each such test for each digit of said code, to retain said other shaft cumulatively advanced after each digit to thereby enable a cam on said other shaft to enable closing of said contact springs to complete said signaling circuit after said two shafts have responded to all digits of said code.

4. A selectively responsive device adapted to respond to all codes of a plural-digit code system and adapted to enable operation of a signal circuit in responding to only one of said codes, said device comprising a first shaft, a plurality of first cams on said first shaft, a second shaft, a plurality of second cams on said second shaft, said second cams preset in accordance with the code desired to enable the signal circuit, spring means for biasing said shafts to their normal positions, a stepping mechanism for said first shaft adapted to step said first shaft once per digit of said code, a stepping mechanism for said second shaft adapted to step said second shaft once per pulse of each digit of said code, means for retaining said second shaft advanced after each pulse of each digit, means for releasing said second shaft after each digit of said code, additional means cooperable with one cam of each shaft to retain said first shaft successively in its advanced positions when both stepping mechanisms have released, means actuated by said first shaft and adapted to enable operation of a signalling means only when said first shaft has been retained in successive advanced positions upon the plurality of consecutive digits of said code.

5. An electromagnetic selectively responsive device adapted to respond to all codes of an unrestricted plural-digit code system and adapted to enable closing of contacts in a signal circuit in responding to only one of said codes, said device comprising two shafts, each shaft provided with a plurality of cams, a ratchet on each shaft, spring means for biasing said shafts to their normal positions, a stepping mechanism for one of said shafts and adapted to step said one shaft once per digit of said code, a stepping mechanism for the second of said shafts and adapted to step

said second shaft once per pulse of each digit of said code, means for retaining the advance of said second shaft after each pulse of each digit, means actuated by said stepping mechanism for said one shaft to release said second shaft retaining means after each digit of said code, members located adjacent the cams of said second shaft and adapted to be actuated by said cams, when said cams are stepped into engagement therewith, to retain said first shaft in its advanced position when both stepping mechanisms have released, at least one of said cams of said first shaft adapted to enable the closing of said signalling contacts only when said first shaft has been retained in successive advanced positions upon the plurality of consecutive digits of said code.

6. An electromagnetic selectively responsive device adapted to respond to all codes of an unrestricted plural-digit code system and adapted to enable closing of contact springs in a signal circuit in responding to only one of said codes, said device comprising a first shaft provided with a first ratchet and a plurality of first cams, a second shaft parallel to said first shaft and provided with a second ratchet and a plurality of second cams respectively adjacent said first cams, spring means for biasing said shafts to their normal positions, electromagnetic stepping motor mechanism for said first shaft adapted to step said first shaft once per digit of said code, electromagnetic stepping motor mechanism for said second shaft adapted to step said second shaft once per pulse of each digit of said code, ratchet retaining means for said second ratchet to retain the advance of said second shaft after each pulse of each digit, means actuated by said stepping mechanism for said first shaft and adapted to release said second ratchet retaining means after each digit of said code, resilient spring members actuated by said second cams when said second shaft has been stepped a number of ratchet steps corresponding to the circumferential positions of the said second cams, said spring members adapted, when actuated, to engage said respectively adjacent first cams to thereby retain said first shaft in its advanced position when both electromagnetic stepping mechanisms have released, the last cam of said first cams adapted to enable contact between said contact springs when the said first shaft has been retained in successive advanced positions upon consecutive digits of said code to thereby enable completion of said signaling circuit.

7. An electromagnetic selectively responsive device adapted to respond to all codes of an unrestricted plural-digit code system and adapted to enable closing of contact springs in a signal circuit in responding to only one of said codes, said device comprising a first shaft provided with a first ratchet and a plurality of first cams arranged about said first shaft such that each successive cam is one ratchet step beyond its immediate predecessor and the first of said first cams is one ratchet step beyond the normal position of said first shaft, the last two of said first cams being circumferentially adjacent, a second shaft provided with a second ratchet and a plurality of second cams, each of the said second cams located circumferentially of said second shaft a number of full steps of said second ratchet from the normal position of said second ratchet carrying shaft, spring means for biasing said shafts to their normal positions, an electromagnetic stepping mechanism for said first shaft adapted to step said

first shaft once per digit of said code, an electromagnetic stepping mechanism for said second shaft adapted to step said second shaft once per pulse of each digit of the said code, ratchet retaining means for said second ratchet to retain the advance of said second shaft after each pulse of each digit, means actuated by said stepping mechanism for said first shaft and adapted to release said second ratchet retaining means after each digit of said code, resilient spring members located adjacent said second cams and adapted to be depressed by said second cams when said second shaft has been stepped a number of ratchet steps corresponding to the circumferential positions of said second cams, said spring members adapted, when depressed, to engage said first cams to thereby retain said first shaft in its advanced position when both electromagnetic stepping mechanisms have released, the last cam of said first cams adapted to actuate one of said contact springs only when said first shaft has been retained in successive advanced positions upon consecutive digits of said code and the other of said contact springs adapted to be moved into electrical contact with said one contact spring upon release of stepping mechanism for said first shaft to thereby enable completion of said signaling circuit.

8. An electromagnetic selectively responsive device adapted to respond to all codes of an unrestricted plural-digit code system and adapted to enable closing of contact springs in a signal circuit in responding to only one of said codes, said device comprising a first shaft provided with a first ratchet and a plurality of first cam surfaces arranged helically about said first shaft such that each successive cam surface is one ratchet step beyond its immediate predecessor and the first of said first cam surfaces is one ratchet step beyond the normal position of said first shaft, the last two of said first cam surfaces being circumferentially adjacent, a second shaft parallel to said first shaft and provided with a second ratchet and a plurality of second cam surfaces respectively adjacent said first cam surfaces, each of said second cam surfaces located circumferentially of said second shaft a number of full steps of said second ratchet from the normal position of said second shaft, spring means for biasing said shafts to their normal positions, a slow releasing electromagnetic stepping mechanism for said first shaft adapted to step said first shaft once per digit of said code, a fast releasing electromagnetic stepping mechanism for said second shaft adapted to step said second shaft once per pulse of each digit of said code, ratchet retaining means for said second ratchet to retain the advance of said second shaft after each pulse of each digit, means actuated by said stepping mechanism for said first shaft and adapted to release said second ratchet retaining means after each digit of code, a resilient spring member located beneath each second cam surface and adapted to be depressed by said second cam surface when said second shaft has been stepped a number of ratchet steps corresponding to the circumferential position of said second cam surface, said spring member adapted, when depressed, to engage the respective first cam surface adjacent said second cam surface to thereby retain said first shaft in its advanced position when both electromagnetic stepping mechanisms have released, the last of said first cam surfaces adapted to raise one of said contact springs only when said first shaft has been retained in suc-

cessive advanced positions upon consecutive digits of said code and the other of said contact springs adapted to be moved into electrical contact with said one contact spring upon release of said stepping mechanism for said first shaft to thereby enable completion of said signalling circuit.

9. An electromagnetic selectively responsive device adapted to respond to all codes of an unrestricted plural-digit code system and adapted to enable closing of contact springs in a signal circuit in responding to only one of said codes, said device comprising a first shaft provided with a first ratchet and a plurality of first cams equally spaced along the axis of said first shaft, all but the last one of said first cams comprising hooks opening along the same circumferential direction of said first shaft and arranged helically about said first shaft such that each successive hook is one ratchet step beyond its immediate predecessor and the first of said hook cams is one ratchet step beyond the normal position of said first shaft, the last of said first cams having a raised portion adjacent the last of said hook cams circumferential of said shaft, a second shaft parallel to said first shaft and provided with a second ratchet and a plurality of second cams equally spaced along the axis of said second shaft and respectively adjacent said first hook cams, each of said second cams having a raised portion located circumferentially of said second shaft a number of full steps of said second ratchet from the normal position of said second shaft, spring means for biasing said shafts to their normal positions, a slow releasing electromagnetic stepping mechanism for said first shaft adapted to step said first shaft once per digit of said code, a fast releasing electromagnetic stepping mechanism for said second shaft adapted to step said second shaft once per pulse of each digit of said code, ratchet retaining means for said second ratchet to retain the advance of said second shaft after each pulse of each digit, means actuated by the stepping mechanism for said first shaft and adapted to release said second ratchet retaining means after each digit of said code, a resilient spring member located beneath each second cam and adapted to be depressed by the raised portion of said respective second cam when said second shaft has been stepped a number of ratchet steps corresponding to the circumferential position of said raised portion of said respective second cam, said spring member adapted when depressed to engage the hook of said first hook cam adjacent said respective second cam to thereby retain said first shaft in its advanced position when both electromagnetic stepping mechanisms have released, the raised portion of the last of said first cams adapted to raise one of said contact springs only when said first shaft has been retained in successive advanced positions upon said plurality of consecutive digits of said code and the other of said contact springs adapted to be moved into electrical contact with said one contact spring upon release of said stepping mechanism for said first shaft to thereby enable completion of said signaling circuit.

10. An electromagnetic selectively responsive device adapted to respond to all codes of an unrestricted four-digit code system and adapted to enable closing of contact springs in a signal circuit in responding to only one of said codes, said device comprising a first shaft provided with a first ratchet and five first cams equally spaced along the axis of said first shaft, the first four of said first cams comprising hooks opening along the same circumferential direction of said first shaft and arranged helically about said first shaft such that each successive hook is one ratchet step beyond its immediate predecessor and the first of said first four hook cams is one ratchet step beyond the normal position of said first shaft, the last of said first cams having a raised portion adjacent the fourth of said first four hook cams circumferential of said shaft, a second shaft parallel to said first cam shaft and provided with a second ratchet and four second cams equally spaced along the axis of said second shaft and respectively adjacent said first hook cams, each of said second cams having a raised portion located circumferentially of said second shaft a number of full steps of said second ratchet from the normal position of said second shaft, spring means for biasing said shafts to their normal positions, a slow releasing electromagnetic stepping mechanism for said first shaft adapted to step said first shaft once per digit of said code, a fast releasing electromagnetic stepping mechanism for said second shaft adapted to step said second shaft once per pulse of each digit of said code, ratchet retaining means for said second ratchet to retain the advance of said second shaft after each pulse of each digit, means actuated by said stepping mechanism for said first shaft and adapted to release said second ratchet retaining means after each digit of said code, a resilient spring member located beneath each second cam and adapted to be depressed by the raised portion of said respective second cam when said second shaft has been stepped a number of ratchet steps corresponding to the circumferential position of said raised portion of said respective second cam, said spring member adapted when depressed to engage the hook of said first cam adjacent said respective second cam to thereby retain said first shaft in its advanced position when both electromagnetic stepping mechanisms have released, said raised portion of the last of said five first cams adapted to raise one of said contact springs but only when said first shaft has been retained in successive advanced positions upon four consecutive digits of said code and the other of said contact spring adapted to be moved into electrical contact with said one contact spring upon release of said stepping mechanism for said first shaft to thereby enable completion of said signaling circuit.

11. A selectively responsive device adapted to respond to all codes of a plural-digit code system and adapted to enable operation of an electrical circuit in responding to only one of said codes, said device comprising two shafts, cams on each of said shafts, means for rotating one of said shafts in response to each pulse of each digit of said code, means for rotating the other of said shafts in response to only one pulse of each digit of said code, means for testing simultaneously the rotated positions of at least one cam on each of said shafts after each shaft has been rotated in response to each of said digits, said cams preset on said shafts in accordance with said one code and arranged thereby to assume predetermined rotated positions for each digit of said one code, said means operative upon testing said cams in said predetermined rotated positions successively for each digit of said one code to enable operation of said circuit.

12. A selectively responsive device adapted to respond to all codes of a plural-digit code system and adapted to enable operation of an electrical circuit in responding to only one of said codes,

said device comprising two parallel shafts, a plurality of first cams spaced along one shaft, a plurality of second cams spaced along the other shaft, some of said first cams paired with some of said second cams, means for rotating one of said shafts in response to each pulse of each digit of said code, means for rotating the other of said shafts in response to only the first pulse of each digit of said code, means for testing the relative rotated positions of said paired cams at the conclusion of rotation of said shafts in response to each digit, said paired cams preset on said shafts in accordance with said one code and arranged to assume predetermined relative rotated positions for each digit of said one code, said means operative upon testing said paired cams in said predetermined relative rotated positions successively for each digit of said one code to enable operation of said circuit.

13. A selectively responsive device adapted to respond to all codes of a plural-digit code system and adapted to enable operation of an electrical circuit in responding to only one of said codes, said device comprising two parallel shafts, spring means biasing each shaft to its normal position, a plurality of first cams spaced along one shaft, a plurality of second cams spaced along the other shaft, some of said first cams paired with some of said second cams, mechanism for rotating one of said shafts in response to each pulse of each digit of said code, said one shaft returned to normal by

said spring means after rotation thereof in response to each digit, means for rotating the other of said shafts in response to only the first pulse of each digit of said code, means for testing the relative rotated positions of said paired cams at the conclusion of rotation of said shafts in response to each digit, said paired cams preset on said shafts in accordance with said one code and arranged to assume predetermined relative rotated positions for each digit of said one code, said means operative when said paired cams are tested in the said predetermined relative rotated positions upon each such test for each digit of said code to retain said other shaft cumulatively advanced after each digit to thereby enable a cam on said other shaft to close said contact springs to complete said signaling circuit after said two shafts have responded to all digits of said codes.

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