

Nov. 11, 1941.

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2,262,471

SELECTIVE ELECTRIC SWITCH APPARATUS

Filed Sept. 16, 1938

2 Sheets-Sheet 1

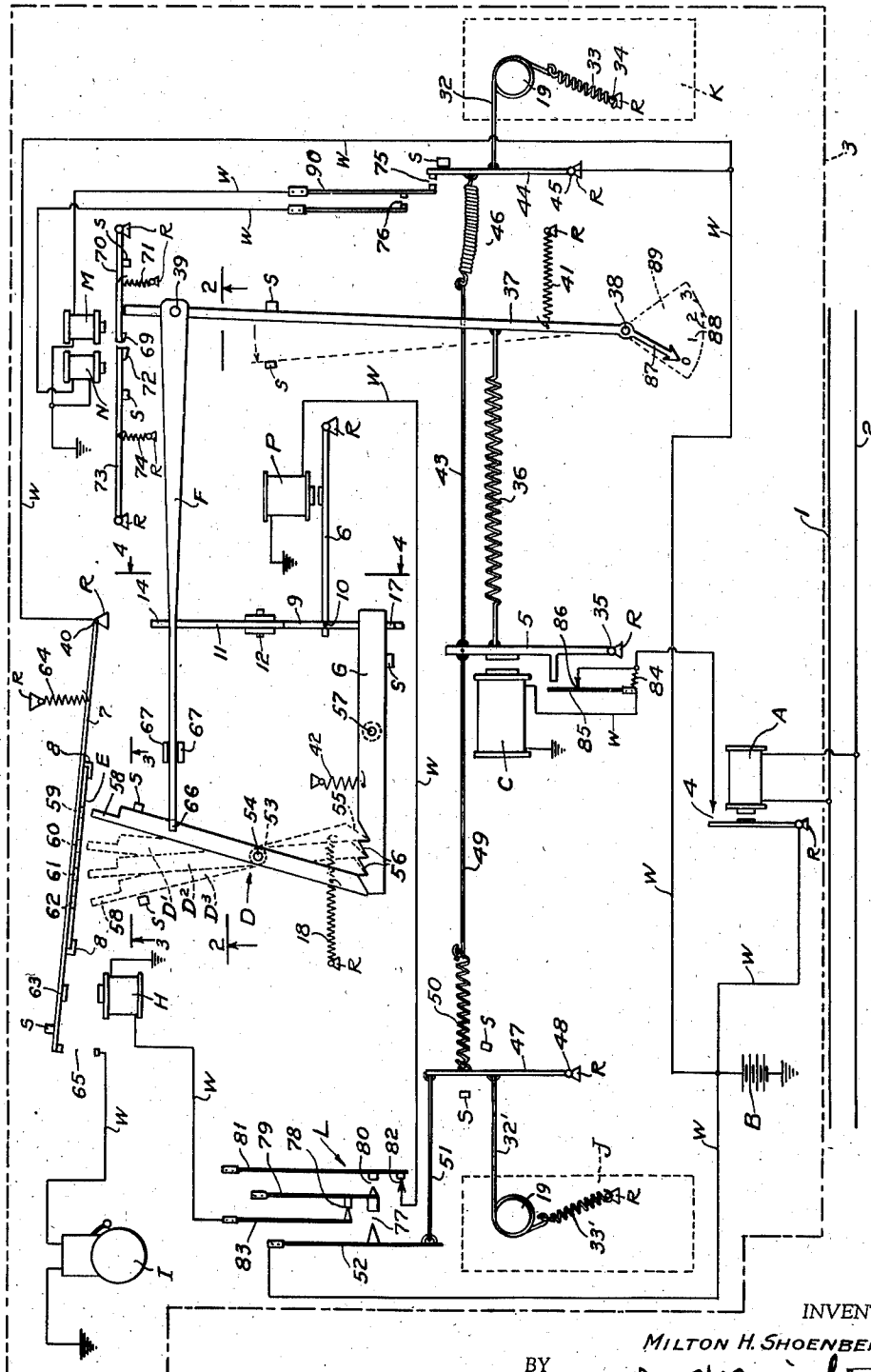


FIG. 1 -

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2 Sheets-Sheet 2

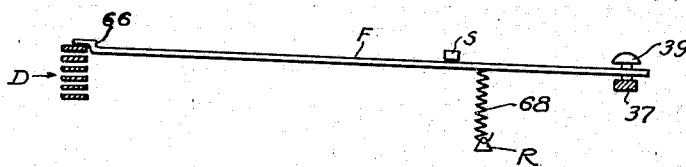


Fig. 2.

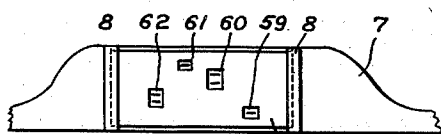


Fig. 3.

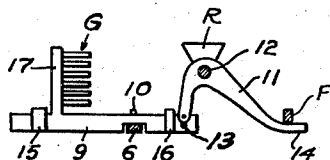


Fig. 4.

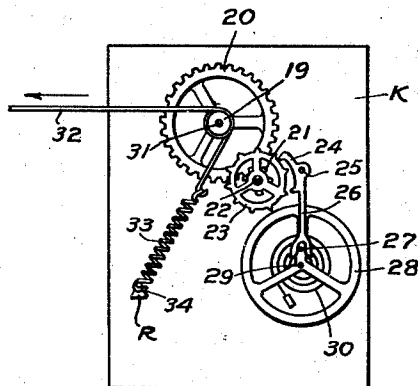


Fig. 5.

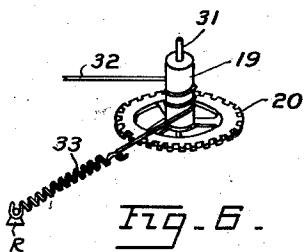


Fig. 6.

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UNITED STATES PATENT OFFICE

2,262,471

SELECTIVE ELECTRIC SWITCH APPARATUS

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Application September 16, 1938, Serial No. 230,303

7 Claims. (Cl. 177-342)

This invention relates principally to selective electric call systems adapted to signal any one of the plurality of stations on the line without signalling the other stations, and the invention has for its principal objects improvements in the apparatus used in such systems whereby the mechanism is rendered simple and reliable; also selective switch apparatus which will operate in any position without regard to gravity may be set for any desired code by use of an interchangeable matrix; and also which will respond to regular code signal impulses made and timed manually through ordinary call bell operation, or an automatic transmitter.

Other features and advantages of the invention appear in the following description and accompanying drawings, and are specifically set out in the appended claims.

In the drawings:

Figure 1 is a diagrammatic plan of the apparatus and electrical connections showing all of the principal elements of the invention.

Figure 2 is a cross section of a portion of Figure 1 as seen from the line 2-2 thereof.

Figure 3 is a side view of the matrix or interchangeable code plate, as seen from the line 3-3 of Figure 1.

Figure 4 is a fragmentary cross section of Figure 1, as seen from the line 4-4 thereof.

Figure 5 is a detailed and enlarged plan view of one of the timers to determine the time interval between some of the contacts and movements of the mechanism.

Figure 6 is a perspective sketch showing the cord wound clock drum arrangement.

Briefly described, the apparatus may be said to be an arrangement of selector switch elements preferably including a local operating circuit, and adapted to be hooked up through means of a relay to the call bell circuit of any of a plurality of stations on the line, one of the apparatuses being connected at each station in place of its call bell, so that its receiving relay will be operated by the incoming electrical impulses set up by any of the other stations sending in a call as by turning the bell ringing crank for the desired number of short and long calls for the particular station wanted, or by otherwise manually closing and opening a call switch, or pressing a button switch successively for the long and short "bells" constituting the call of the particular station desired.

The various short and long calls operate suitable magnets to consecutively move a plurality of pivoted stops or fingers to a predetermined

position, and at which a movable matrix or code plate arranged to fit over the stops or fingers (when in such predetermined position only) moves and causes the signal circuit to be actuated for operating the signal, and which may be either a bell or a lamp, or other device which it is desired to operate. After a predetermined time of operating the signal, or predetermined time interval in case the signal does not operate (as when a wrong code has been sent) an automatically timed release returns all elements to their starting points.

In the drawings, 1 and 2 represent the common line wires which extend to any number of stations. The elements enclosed within the dot and dash lines 3 constitute the selective switch elements and its local circuit.

At each station is a receiving or line relay A which, upon being energized by a current impulse from the line wires, will close the local circuit at 4 as long as the impulse continues, and if the impulses received are those set up by the manual operation of an ordinary telephone bell magneto, a shaded magnet is used in the relay to stay closed with the slow alternating current, generally about 25 cycles per second frequency.

The local circuit includes a battery B or other source of switch operating current, for simplicity here shown as grounded to the frame of the apparatus or common ground wire at one side, as likewise are the elements operated thereby, all as conventionally indicated.

Before describing the construction of my improved selective switch assembly, its principal elements will be named and each given a letter designation.

C is the main operating magnet energized by the incoming call signals either directly or by way of the line relay A.

D is a set of pivotally mounted superimposed fingers or stops, the ends of which cooperate with the matrix or code plate when the fingers are moved to various positions.

E is the matrix or perforated code plate.

F is a push rod which is operated by movement of armature 5 of magnet C to consecutively push the fingers to various positions depending on the length of time magnet C is energized.

G is a series of superimposed pivoted ratchet bars respectively arranged for locking one of the fingers D in whatever position it may be moved to by the push rod.

H is a magnet which draws the code plate towards the ends of the fingers after a predetermined time following the last signal impulse.

I is any signal device, here indicated as a bell.
J, K are two clockwork mechanisms for controlling the time intervals between certain electrical contacts.

L indicates a plurality of coacting electric contact elements which successively come into action after the last signal impulse.

M and N are magnets which determine the length of the push rod stroke on any finger or fingers corresponding to the length of the signal impulse.

P is the resetting magnet which trips all of the ratchet bars G so that the fingers will return to starting position, and also lifts the push rod to its starting position resting upon the upper finger.

R indicates an anchor or frame portion to which a lever or rod is pivotally mounted.

S indicates fixed stops to limit motion of the various levers.

6 is the pivoted armature of the resetting magnet P.

7 is a pivoted lever on which the code plate E is removably secured as by sliding into grooves or retainers 8 at its ends and/or side.

9 is a sliding rod pivotally connected at 10 to the armature 6 of the resetting magnet.

11 is an arm pivoted at 12 to a fixed point R and pivoted slottedly at 13 to rod 9, and formed with a hooked outer end 14 extending under the push rod so as to lift the same over the topmost finger of the stack of fingers D when rod 9 is moved toward the push rod upon energizing of the resetting magnet. Rod 9 is slidably supported as in brackets 15, 16 (see Figure 4) and is provided with an upstanding lug 17 which engages all of the ratchet bars G to move them against the force of their individual return springs 42 enough to free the engaged ends of the fingers D so that they can all return to starting position by their individual springs 18 as soon as the push rod is lifted.

The timing clock mechanisms J and K each comprise the features shown in Figure 5, a cylindrical drum 19 pivoted on its axis 31 to a suitable frame (indicated generally as K) and provided at one end with a large spur gear 20 meshing with a pinion 21 fast on a shaft 22 which also carries an escapement wheel 23 engaged by an escapement 24 mounted on a shaft 25 and the slotted arm 26 of which escapement is engaged by a pin 27 on a balance wheel 28 mounted on shaft 29 and fitted with the common type of hair spring 30 which may be provided with the usual adjustments for determining its speed of oscillation.

Passing about the drum 19 is a flexible cord, braided wire, belt, or very small chain 32 which takes about two turns around it (see Figure 6) and secures at one end to a small spiral tension spring 33 anchored at 34 to a fixed part R, all so that when this cord or string is pulled in the direction of the arrow (of Figure 5) it will at once grip the drum and revolve the clock mechanism under control of the balance wheel escapement, and under a given pull exerted upon it (superior to the pull of tension spring 33) will only yield in the direction of the arrow at a definite rate of speed, yet if the cord 32 were suddenly released by the pulling agent, spring 33 would instantly twirl the thereby loosened cord loops about the drum (without materially reversing the clock) until the energy of spring 33 was spent or was balanced by resistance applied at the other end of the cord.

This timer is thus instantly started by a pull on the cord and as quickly stopped by relaxing the cord, and is applied to control the time interval between electric contacts by linking the cords of both clockworks through yielding connection to the movable armature 5 of magnet C as will now be described.

Armature 5 is pivoted at 35 to a fixed point R and is normally retracted by a coiled tension spring 36 connected to a lever 37 pivoted at 38 to a fixed point and which lever is also loosely pivoted at 39 to the push rod F so as to move the push rod to the left each time magnet C is energized, lever 37 being returned to starting point (against stop S when spring 36 is relaxed) by a weaker tension spring 41.

Armature 5 is also pivotally and insulatingly linked as by a wire link 43 with another lever 44 pivoted at 45 to a fixed point, but which latter link 43 has interposed in its length a spiral tension spring 46 of somewhat greater strength than spring 33 of the clockwork.

Clockwork J on the opposite side of armature 5 is similarly connected to armature 5 through the intermediary of a lever 47 (corresponding to 44) pivoted at 48 to a fixed point and to which the cord 32' of clock J connects, and which lever 47 is pivotally linked to armature 5 as by a wire link 49 interposed in which is a spiral tension spring 50 corresponding to spring 46 in strength so as to overcome the cord pull back spring 33' of clockwork J while having sufficient force in excess to do the work required.

Lever 47 is also pivotally and insulatingly linked as at 51 with a spring return contact arm 52 of the group of contact elements L for operation as will later be described.

The wiring from the battery B to the various grounded magnets and movable contacts is generally designated W and since it is easily traced in the drawings the various leads need not be specifically described to unnecessarily prolong the description.

The superimposed fingers D are spaced apart as by washers or hubs 53 surrounding their common fixed pivot 54, the lower ends are each beveled as at 55 to fit any of the several notches 56 of the ratchet bars G which are also spaced to match and pivoted to a fixed axis 57. The outer ends of the fingers or stops D are reduced in size as indicated at 58 so as to readily pass through openings or slots provided in the matrix or code plate E when in certain positions. The openings and slots are indicated best in Figure 3 at 59, 60, 61 and 62.

Code plate lever 7 which is pivoted at one end at 40 carries an armature 63 adjacent the opposite end adapted to be attracted by magnet H and is normally retracted by a pull back spring 64 so that the code plate will clear the ends of the fingers D and also to hold open bell circuit operating contacts 65 at the extreme end of the lever.

All of the superimposed fingers normally are positioned at the right hand position against the stop S, and any of them may occupy any of the four positions indicated when moved from the first position by push rod F and held in the new position by the ratchet bars G.

Push rod F moves longitudinally back and forth between guides 67 upon lever 37 being rocked, and is formed with an offset 66 at its outer end adapted to overlie the uppermost of the fingers and drop to the next finger below upon each retraction of the rod, a small spring

68 being provided to insure this action so as to make it independent of gravity, even if the whole switch assembly be mounted upside down.

To limit the forward (left hand) movement of the push rod to definite strokes, so as to selectively move the fingers from the full line starting position to any of the three other positions D¹, D², D³, where they will be held by the ratchet bars G, I provide fixed and movable stops as follows: In starting position all fingers are to the right in full line position against fixed stop S, and push rod F is retracted and its operating lever 37 is to the right in full line position against stop S. When magnet C is energized and armature 5 is drawn to it, linking spring 36 at once pulls lever 37 to the left until its extreme end strikes a stop at 69 on pivoted armature arm 70 of magnet M and which arm is normally pulled down by a spring 71, and this allows the push rod to move a finger from the starting position to the second position D¹.

When magnet M is energized and its armature is lifted, lever 37 moves further to the left under the force of spring 36 until it is again arrested by a stop 72 formed at the end of pivoted armature arm 73 of magnet N, thus allowing push rod to move the finger to the next position D². When magnet N is energized its armature arm 73 is drawn toward it against the force of its releasing spring 74, and thereby permits the push rod to move the finger to the third position D³ against a common stop S for all of the fingers and/or a final limit stop S for lever 37.

If, now with both magnets M and N holding their armatures out of the way of lever 37, magnet C were de-energized, spring 41 would pull lever 37 and the push rod back to starting position, but the fingers would still be held by the ratchet bars G in the various positions to which they had been moved, and also the push rod would have dropped to the lowest finger not yet pushed from starting position or to the plane of the lowest one if that also had been moved.

To release the ratchet bars so that the fingers can return to starting position under the action of their individual springs 18 and also to raise the push rod to the top finger again, the resetting magnet P is energized to draw its pivoted armature arm 6 upward to release ratchet bars G from the fingers, so that they at once return to starting position.

The matrix or code plate E may be of sheet metal or composition material and its openings 59 to 62 are in line with the four positions which the ends of the fingers may assume, the hole or slot 59 being of a length to receive all of the fingers not moved from starting position and the other openings being respectively of a length (across the plate) to only receive one or more fingers at their positions as the particular code for that station may require, thus the black dashes in the openings of the code plate of Fig. 3 indicate the ends of the fingers as properly moved for that plate, and show its code to be:

One long, two short, and two extra long, and with one finger still being in starting position aligned in hole 59.

It will be evident from a study of Figure 3 that with any other position of the fingers, the code plate would not fit over their ends and armature lever 7 could not be drawn toward magnet H to close the alarm bell circuit at 65, for if any of the six fingers were displaced in either direction from the positions shown they

would be opposite the blank wall of the plate and form an effective stop against its movement.

While the illustration shows but six fingers and three positions of each, not counting the starting position, it is evident that a greater or lesser number of fingers or positions may be used if desired, though the number shown provides for a great many different codes, the simplest being but one short signal impulse to move the uppermost finger to position D¹. As the push rod drops to the next finger upon each retraction, it is evident that the positions of the already moved fingers above do not interfere with any desired moving of successive fingers.

It will be evident from the above that in order to change the code at which a station can respond, it suffices to merely slip the code plate or matrix, out of its retaining grooves or from any other securing means used, and substitute one with a different arrangement of holes and slots. It is also evident that the code of each code plate may be "read off" as it were, by glancing at the plate, as explained for the plate of Figure 3.

A description of operation of the various electric contacts to energize the various magnets in proper sequence will now be made.

Upon a short energizing impulse sent through magnet C as by a momentary pressure of a remote signal button and release, or short twist of the magneto crank, lever 37 is instantly pulled to the left to stop 69 and the upper finger is moved to position D¹, but as the current is broken again in a moment the lever 37 and push rod return to starting position, but the push rod has fallen to the next finger.

Assume that the next impulse is a long one—i. e. held closed for a few seconds (say two or three as may be predetermined by the initial setting of the apparatus), in such case lever 37 will first stop at 69 but as spring 46 is under tension clockwork K is set in motion to gradually unwind or "pay out" cord 32 to permit lever 44 to slowly move to the left and close a contact at 75 which at once energized magnet M to lift stop 69 and permit lever 37 to move to stop 72 to bring the finger to position D².

If the long signal contact made is extra long, say five seconds or more (as may be predetermined), then contact 76 would also be closed by the moving lever 44 through the yielding of spring arm 90 to energize magnet N, and permit the push rod to move the finger to position D³. Assuming now that one extra long "bell" were the correct code for this station, there would only be a hole in the code plate over the end of this finger at position D³ while the unmoved fingers would still be opposite a hole or slot to accommodate them only formed in the plate. Now, upon release of the long signal, all the parts just considered including the clockwork controlled cord 32 return instantly to starting position, but as spring 36 is considerably superior to spring 50, it stretches the latter and yieldingly pulls on lever 47 which at once starts clockwork J to slowly "pay out" cord 32' and thus similarly control the speed of movement of lever 47.

Lever 47 being insulatingly linked at 51 to spring contact arm 52 will first close contacts 77 and thereby, through already closed contacts 78, will energize code plate magnet H to pull the plate down over the finger at D³ and at the same time close contact 65 and ring the bell I.

Continued movement of lever 47, however, will break the code plate magnet circuit at contacts

78 by contacts 77 moving a dummy spring arm 79 to right, and through it will make contact at 80 to energize the resetting magnet P to trip all of the fingers and push rod back to starting position as previously explained.

The energizing of the resetting magnet is only momentary, however, as lever 47 still has a small way to go before it meets stop S and hence it continues to move spring dummy arm 79 as well as spring arm 81 to the right until it breaks the resetting magnet circuit at 82, and which is the final position of rest of the parts, until a new signal comes in.

It should be noted that contact carrying arm 83 is not a spring arm or strip as are the others, but is fixed, though its contact point as well as any of the other contact points are either adjustable on their arms, or the arms may be individually bent more or less to yield the desired make or breaking point during the travel of lever 47. Such well known adjustability of the points is also presumed for contacts 75, 76 and 65 as is common in all electric contact apparatus of this kind.

When the next signal comes in and armature 5 snaps to magnet C, spring 50 is completely slacked off, or sufficiently so for clockwork spring 33' to instantly return the cord around the drum and pull lever 47 to the left until it meets a stop S, and all of the contacts at L will be open except 82 and 78, which will be closed, and this is the position they are shown in the drawings as it is presumed that armature 5 has just this instant been released and lever 47 is just starting to move. Under such condition at least one of the fingers would be displaced from starting position as this would be before the tripping magnet P was energized, and it makes the action of the contacts easier understood to show it this way.

To minimize the battery drain when the magnets are energized, any of them may have a resistance automatically brought into its circuit after the initial contact as it requires but a fraction of the energy to hold the armature in place after the flux is built up. Such an arrangement is shown at magnet C where 84 is the resistance coil through which the energizing current must pass upon the moving armature 5 striking a spring contact arm 85, and breaking the direct energizing circuit at 86, the resistance coil 84 being figured to pass only enough current to hold the armature. This feature also reduces arcing at the terminals 4 when the contact is broken.

An important feature of the apparatus is that as each station is to be equipped with it, the successive positions of the fingers are clearly heard by the "click" set up by the lever 37 striking the stops as well as the snap of the spring ratchet bars as they engage the ends of the fingers. Thus one click tells that the short contact has done its work to move the finger to position D¹, two clicks that the longer contact has moved the finger to the position D², and so on. Yet if desired, a visible indicator hand 87 may be attached to lever 37, or to the push rod, to successively come to figures 88 arranged on a suitable dial 89, to show when the particular length of call has completed its action. In practice, however, as several seconds between lengths of call signals can easily be predetermined so as to correspond with the average manual operation of magneto call bells, such a visible or audible signal may be dispensed with.

Having thus described my improved selective switch apparatus and the manner of its operation, it will be evident to anyone skilled in the art that many changes in detailed construction may be resorted to without departing from the spirit of the invention, and also that although I show the apparatus arranged to operate on a normally open circuit, that it may be equally applied to a closed circuit system, and the words "contact" or making or breaking a circuit are equally applicable to the opposite terms for closed circuit work, and my appended claims are intended to cover either arrangement, as well as any variation in mechanical structure which produce the effect and results above set forth.

Also, while I show my apparatus arranged to operate a signal, it is manifest that the signal circuit may be any other circuit which it is desired to selectively make or break, and any such variation is intended to be covered in my claims.

Attention is called to the fact that on account of the exaggerated size and movement of the fingers shown in the drawings for clarity, the final positions of the ends of the fingers lie on a curved plane, whereas the code plate shown is flat, and hence it requires a much greater movement of the code plate to close the signal circuit, as some of the fingers are much further away from the plate than others. In actual construction, however, the ends of the fingers are very small and their different positions are relatively close together so that a flat code plate functions very nicely, though it is evident where the apparatus is made to give still more positions of the fingers or the arc of their positions requires too much movement of the code plate, the pivotal point of the fingers may be greatly extended to give a flatter arc of movement or the code plate may be bent to the same arc and the pivotal point of its supporting lever placed to reduce the movement required to the minimum.

It will be noted from the above description that in an existing telephone installation operated with magneto bell code, my apparatus may be placed in any number of the stations while leaving some still without it, and that if the proper code plates be used the old hand-made signals may be made just as before without requiring any instructions to the users who need not even know that a selective apparatus was intercepting their hand-made bell calls, but in such stations as are fitted with the selective apparatus the bell will only ring when the code of impulses for that particular station is called, unless more than one station is equipped with the same code plate. The bell will, of course, simply ring but will not ring the code.

Certain claims covering the switch controlling means including a clockwork for determining the time between the making of switch contacts originally included herein, have been filed in a divisional application, Serial No. 413,882, filed October 6, 1941.

I claim:

1. In a selector switch of the character described, a plurality of movably mounted stops, means normally holding the stops in one position, electro-magnetic means arranged to move the stops to a second position one after the other respectively upon successive momentary energizing of said electro-magnetic means, said electro-magnetic means arranged to move any of said stops past said second position to a third position upon maintaining the energizing of said elec-

tro-magnetic means for a longer period of time, a signal circuit rendered operative by a final predetermined position of said stops, and means for automatically returning all stops to starting position upon the energizing of said signal, or after a predetermined time interval upon a failure to energize said signal.

2. In a selector switch of the character described, a plurality of superimposed pivotally mounted fingers, means normally holding the fingers in one position, electro-magnetic means arranged to move the fingers separately to a second position one after the other respectively upon successive momentary energizing of said electro-magnetic means, said electro-magnetic means arranged to move any of said fingers separately past said second position to a third position upon maintaining the energizing of said electro-magnetic means for a longer period of time, and movably mounted means cooperating with the ends of all of said fingers including any unmoved fingers when in predetermined arrangement arranged to operate a signal.

3. In a selector switch of the character described, a plurality of superimposed pivotally mounted fingers, means normally holding the fingers in one position, electro-magnetic means arranged to move the fingers to a second position one after the other respectively upon successive momentary energizing of said electro-magnetic means, said electro-magnetic means arranged to move any of said fingers past said second position to a third position upon maintaining the energizing of said electro-magnetic means for a longer period of time, and a movably mounted apertured code plate with its apertures formed to cooperate with the ends of all of said fingers including any unmoved fingers when in predetermined arrangement arranged to operate a signal.

4. In a selector switch of the character described, an apertured code plate, a plurality of fingers presenting ends toward the face of said code plate, means mounting said fingers for movement to position said ends variously over the area of said plate, means mounting said plate for movement toward the ends of said fingers to be stopped thereby unless the apertures in said plate coincide with the positions of the ends of said fingers when moved, and the plate being completely movable to a point with said ends projecting into said apertures when they do coincide with the positions of said ends, and an electric circuit operated upon the complete movement of said plate.

5. In a construction as set out in claim 4, electromagnetically operated means for successively moving said fingers to various positions over the area of said plate.

6. In a construction as set out in claim 4, said fingers being normally positioned in a row, and electromagnetically operated means for successively displacing any number of them from said row.

7. In a construction as set out in claim 4, said fingers being normally positioned in a row, and electromagnetically operated means for successively displacing any number of them from said row to position in a second row, and optionally to a third row, means holding the fingers in all of the various positions to which they may be moved, spring means urging all fingers to return to starting position, and delay action means releasing the finger holding means to permit all to return to starting position.

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