Feb. 27, 1934. C. C. LANE 1,948,969

ELECTRIC SWITCHING DEVICE

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FIG. 1.

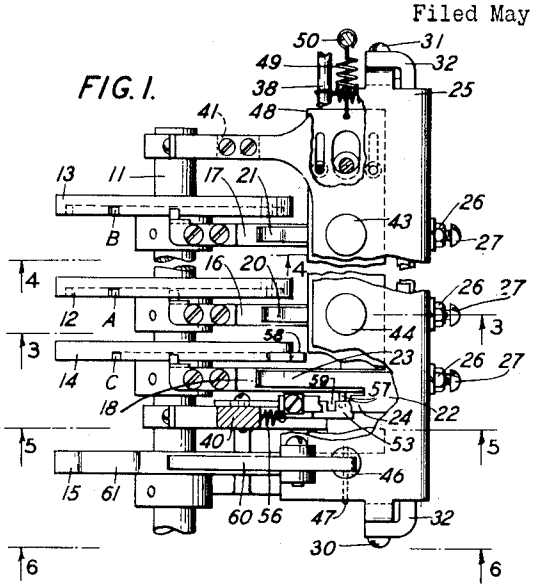

FIG. 4.

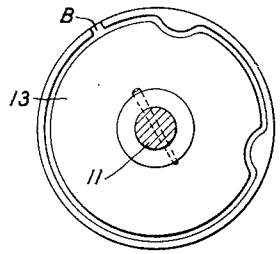

FIG. 2.

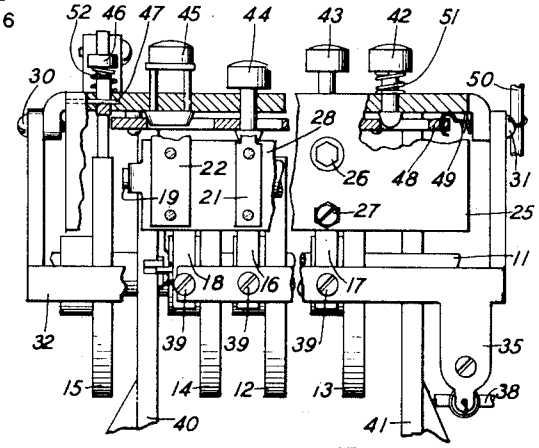

FIG. 3.

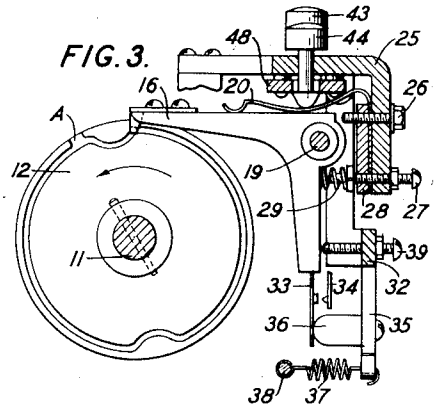

FIG. 5.

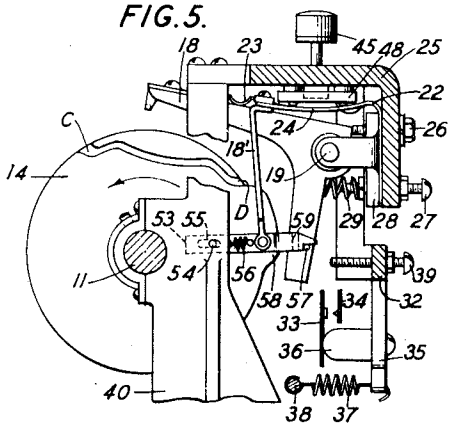

FIG. 6.

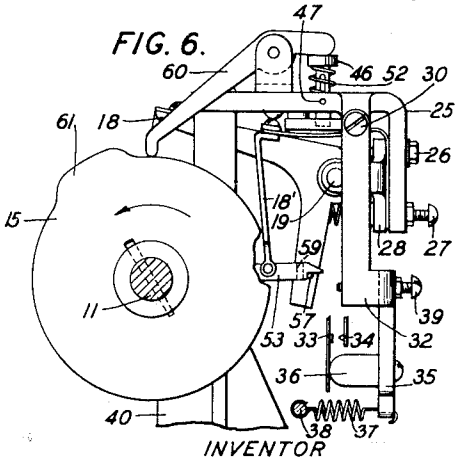

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FIG. 8.

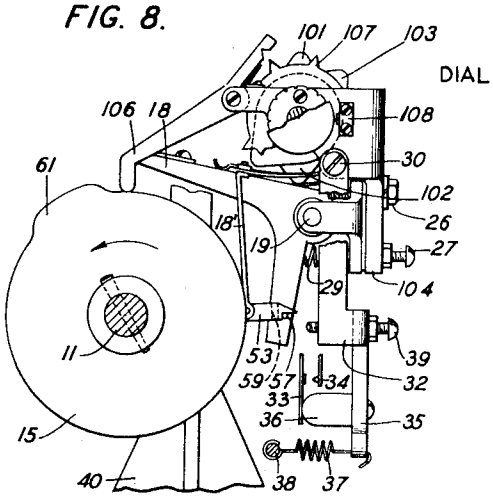


FIG. 9.

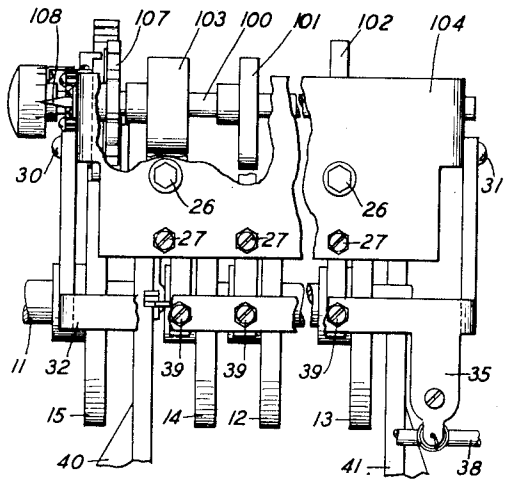
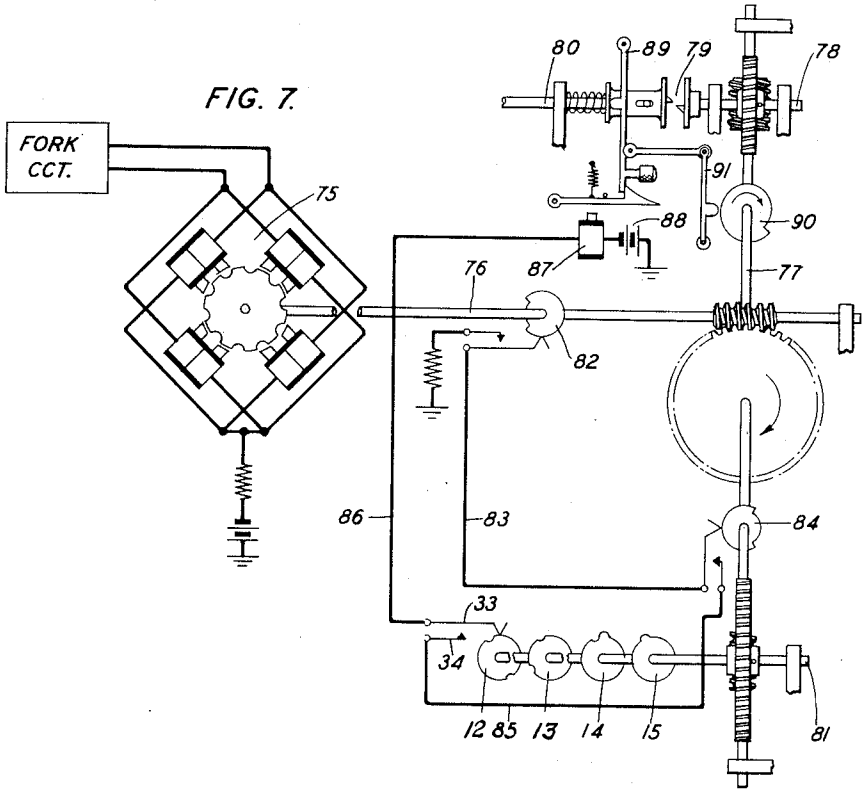


FIG. 7.



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UNITED STATES PATENT OFFICE

1,948,969

ELECTRIC SWITCHING DEVICE

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Application May 14, 1930. Serial No. 452,160

10 Claims. (Cl. 200—33)

This invention relates to switching devices and more particularly to direction control switching devices such as those employed in communicating systems adapted for simplex operation.

In simplex operated telegraph systems such as those employed for the high speed transoceanic transmission wherein the terminal apparatus is arranged to alternately transmit and receive messages, it has been found necessary to vary the duration of the transmitting and receiving intervals several times daily in accordance with traffic requirements. An object of this invention is to effect these changes in a simple and expeditious manner.

High speed submarine cable systems are at present arranged for simplex operation and the direction of transmission is periodically changed by a combination of shafts rotating at different speeds and having cams thereon cut to close contacts for certain periods during their respective revolutions. At certain intervals all contacts will be closed simultaneously to complete a circuit for operating a switch which reverses the direction of transmission. In the systems disclosed in U. S. Patents 1,689,328, 1,799,214 and 1,823,354, respectively granted to A. M. Curtis on October 30, 1928, A. A. Clokey on April 7, 1931 and Dowd et al on September 15, 1931, these reversals are effected every six minutes or twice during one rotation of the shaft which makes one revolution every twelve minutes. It is stated, however, in the Curtis Patent 1,689,328, that the cam which provides for the six minute intervals is one of a plurality rotating on the same shaft and cut to vary the duration of intervals in a twelve minute period. A contact operating arm is movable to operate with any one of the latter cams and may vary the time of transmission in either direction to accommodate the traffic.

In accordance with the present invention, a desirable simplification is effected whereby the selection of the transmitting and receiving intervals is done in an expeditious and positive manner. This is accomplished by a preselective switch whereby any desired timing ratio of reversing intervals may be had by operating one of a plurality of push-buttons provided for a series of reversing intervals of different duration in accordance with the requirements of traffic. Should any set of contacts on the switch be in an operated position at the time a change to another set of contacts is desired, the operation of the push-button corresponding to the desired position prepares the switch for moving into its new position during the succeeding revolution of the switch shaft. When the effective point is reached whereat the new position is assumed, the contacts previously operated are automatically restored. Furthermore, the switch is arranged to effect continuous transmission in either direction.

A better understanding of the invention will be had by referring to the following detailed description and appended claims taken in conjunction with the drawings, in which:

Fig. 1 illustrates a plan view of the timing switch mechanism;

Fig. 2 is a rear elevation view of Fig. 1 showing sectional views thereof;

Figs. 3, 4, 5 and 6 are cross-sectional elevation views taken along lines 3—3, 4—4, 5—5 and 6—6 respectively in Fig. 1;

Fig. 7 is a schematic circuit arrangement for effecting the transfer from a sending to a receiving position, and vice versa, in a signaling system adapted for simplex operation;

Fig. 8 is a modification of Fig. 1; and

Fig. 9 is a rear elevation view of Fig. 8 showing sectional views thereof.

Like parts are designated by like numbers.

Referring to Fig. 1, rotating shaft 11 is arranged (although not shown) to be operated from the driving motor for a multiplex rotor distributor through a system of reduction gears, the shaft being arranged to make one revolution in twelve minutes, each cycle of operation including a transmitting and a receiving interval of the same or of different duration. Shaft 11 has fixedly mounted thereon a plurality of cams 12, 13 and 14 designed to effect different timing ratios for the transmitting and receiving intervals. For the purpose of illustration, cam 12 may be designed for transmitting and receiving intervals of six minutes each, cam 13 for transmitting for nine minutes and for receiving for three minutes, or vice versa, and cam 14 for transmitting continuously in one direction only, say east to west, the switch being arranged when in normal position, to transmit continuously in a west to east direction. Cam 15 is also fixedly mounted on shaft 11 for preventing the switch from being operated at the time selection is made, thereby providing the preselection feature.

It is understood, however, that any other desired timing ratios may be had by providing other cams on shaft 11. A better understanding of the operation of the switch mechanism will be had by considering Figs. 1 to 6 together inasmuch as these figures show different views of the one mechanism, with like parts having like numbers.

Cams 12, 13 and 14 are each provided on one face with an annular channel for effecting the desired timing ratio of transmission to reception in each cycle of operation. On cam 12, shown in Fig. 3, the channel has two depressions 180° apart with a point of entry A to the channel at the beginning of one depression. On cam 13, shown in Fig. 4, the channel has two depressions 90° apart with a point of entry B at the beginning of one depression. On cam 14, shown in Fig. 5, the channel, instead of forming a complete circle as in Figs. 3 and 4, forms an arc beginning at point of entry C and having an angular length of about 90°, the arc having only one depression which is at its middle point. The points of entry A, B and C of the channels are in common alignment. On cam 15, shown in Fig. 6, no channels are provided, but a projection on the periphery of the cam is provided in alignment with the points of entry to the channels on the other cams.

Arranged in engageable relation with the cams 12, 13 and 14 are cam riders 16, 17 and 18 respectively, each of which are provided at its free end with a hooked portion for engaging its associated channel. Cam 15 has a special type of cam rider which will be explained hereinafter. Cam riders 16, 17 and 18 are mounted on shaft 19 which is fixedly mounted on the switch structure, the cam riders being arranged to be actuated in a reciprocating or oscillatory manner when selected for operation. Normally riders 16, 17 and 18 are out of engagement with their respective cams but may be selectively operated under the influence of their respectively associated spring members 20, 21 and 22. Spring member 22 has a bifurcated end having two spring leaves 23 and 24 respectively arranged to simultaneously influence cam rider 18 and connecting rod 18'. The spring members are securely mounted to key plate 25 by means of screws 26 and 27 and clamping bar 28, which bar forms that part of the switch structure which supports shaft 19. Each of screws 27 is positioned in alignment with one of cam riders 16, 17 and 18 and is provided with a coil spring 29 for restoring its associated cam rider to its normal position. Screw 27 and coil spring 29 prevent any unnecessary motion of its associated cam rider. Pivotally supported on the ends of key plate 25 by screws 30 and 31 is a hanging bar 32 which is arranged to open and close circuit contacts 33 and 34 in accordance with the motion applied by cam riders 16, 17 and 18. Integrally formed on bar 32 is a projection 35 which supports an insulated operating stud 36 for actually effecting the opening and closing of contacts 33 and 34 against the tension of coil spring 37 which is fixed to the switch structure at pin 38. The closing of contacts 33 and 34 is effected by any one of the cam riders 16, 17 and 18 bearing against its associated coil spring 29 and its associated adjusting screw 39. Contacts 33 and 34 may be insulatively mounted in any suitable manner on the switch structure. The switch structure may be mounted on a fixed base (not shown) by means of standards 40 and 41 and the key plate 25 is fixedly mounted to the tops of the standards as shown in Fig. 1.

Key plate 25 is provided with a line of circular apertures adapted for push-buttons 42, 43, 44 and 45 and a plunger 46. Button 42 is held in normal position by coil spring 51. Buttons 43, 44 and 45 are held in normal positions by spring members 20, 21 and 22 with which they are respectively engaged, and plunger 46 is held in normal position by coil spring 52. Each push-button has a button-shaped head formed integrally on the lower end of its shank for the purpose of locking the button in either an unoperated or a normal position and plunger 46 has a longitudinal slot in its shank wherein a pin 47 fixedly mounted in key plate 25, as shown is adapted to regulate the amount of motion applied to the plunger. Movably mounted on the under side of key plate 25 is a locking plate 48 which is adapted to shift longitudinally against the tension of coil spring 49 when any one of the push-buttons is depressed. When the selected push-button reaches its fully depressed position the coil spring 49 which is fixedly mounted on the switch structure by pin 50, causes plate 48 to return to its normal position thereby locking the button in its operated position. The button-head on the shank of push-button 45 is of a sufficient area to engage spring leaves 23 and 24 of spring member 22. The operation of any one of push-buttons 43, 44 and 45 causes the spring member associated therewith to bear down on the cam rider which engages the periphery of its associated cam which is rotating at a speed of one revolution per twelve minutes. The rider bears down on the cam periphery until the point of entry to the channel is reached at which time the hooked portion of the rider drops into the channel and rides therein following any depressions that may appear in the channel. The rider, in being carried down the channel depressions, closes contacts 33 and 34 for an interval of about three or four seconds which is the period in which the rider is in the depressed portion of the channel. The interval between closures of contacts 33 and 34 is determined by the push-button selected.

As stated above, cam 12 is designed to provide six minute sending and six minute receiving intervals; cam 13 for nine minute sending and three minute receiving intervals; and cam 14 for sending continuously in an easterly direction, continuous transmission in a westerly direction being effected when the switch is in normal position. The effects of operating push-buttons 43 and 44 are similar and may be readily understood from Figs. 3 and 4 respectively taken in conjunction with what has been heretofore stated, but in order to transmit continuously in one or the other direction, different operations are effected. Transmitting continuously, in a westerly direction, push-button 42 is operated, which causes plate 48 to shift momentarily to the left, thereby releasing any other button which happens to be operated at the time, and locking button 42 in an operated position by the return of plate 48 to its normal position through the tension of coil spring 49. In this position of the switch none of the cam riders 16, 17 and 18 are in engagement with their respectively associated cams. Therefore as long as no push-button other than push-button 42 is operated, the circuit for operating the transfer or change-over switch, as will be hereinafter explained, will remain open at contacts 33 and 34 and transmission in a westerly direction will be continued.

When transmission in an easterly direction is desired, push-button 45 is depressed, thereby releasing button 42 through the tension of coil spring 51 or any one of the other buttons which may happen to be operated at the time through the tension of its respective spring member. The depression of button 45 causes rider 18 to bear down through the resiliency of leaf 23 of spring

member 22 on cam 14. Simultaneously button 45 bears down on leaf 24 of spring member 22 and exerts a downward pressure on connecting rod 18' which is pivotally mounted on latching bar 53 as shown. Bar 53 is also slidably arranged on standard 40 by pin 54 in engagement with slot 55 and is normally held in the position shown by means of coil spring 56 fixed to standard 40 and pin 57 mounted in cam rider 18. But when downward pressure is exerted on cam rider 18 and connecting rod 18' simultaneously, pin 57 becomes disengaged from bar 53 and the lower portion of cam rider 18 moves to the right to engage adjusting screw 39 tending to push hanging bar 32 outward from the switch structure, thereby causing the insulated stud 36 to increase the tension on coil spring 37. However, when the hooked end of the cam rider 18 enters the channel of cam 14 at point C, the bar 32 is pushed further outwardly. As cam 14 continues to rotate the cam rider is depressed more as the depression of the channel is reached, at which time bar 32 and stud 36 are moved sufficiently outward to allow the contacts 33 and 34 to momentarily close. The closure of contacts 33 and 34 completes the operating circuit for the changeover and the transfer switch begins operating to reverse the direction of transmission. As cam 14 continues to rotate, the cam rider will become disengaged from the cam channel at point D and ride over the projection 58, forcing the cam rider upward against the pressure of spring member 22 and the pin 57 will pass over the sloping surface of bar 53 which is now in a depressed position due to the downward pressure exerted on connecting rod 18' to engage slot 55 in bar 53 where it will remain to hold the cam rider 18 out of engagement with cam 14 as long as push-button 45 remains in an operated or depressed position. When another push-button is operated, button 45 is restored, releasing the pressure on cam rider 18 and connecting rod 18' and the tension of coil spring 56 allows bar 53 and pin 57 to return to their normal positions.

Cam 15 is provided with a special type of cam rider 60 which is constantly in engagement with the periphery thereof. It is also provided, as stated above, with a projection 61 on its periphery in line with the points of entry A, B and C to the channels on the other cams. The purpose of this cam is to prevent the operation of any push-button during the time the points of entry A, B and C are in position whereby any cam channel may be engaged by its associated cam rider. In other words, this arrangement provides a preselective feature whereby a cam rider associated with an operated button will have to ride over a cam periphery for a part of its revolution before the switching operation is started. This feature is obtained by causing the plunger or locking button 46 to be depressed once in each revolution of cam shaft 11 by the cam rider 60 passing over projection 61, and button 46 prevents longitudinal movement of locking bar 48 due to an attempt to operate any of the push-buttons. Inasmuch as the points of entry to the channels of the other cams are in alignment with projection 61, no cam rider can be operated until cam rider 60 passes off projection 61. Therefore, the instantaneous operation of the switch in response to the operation of any button is prevented.

A better understanding of utility of the switch mechanism may be had by referring to Fig. 7 which shows a schematic circuit for operating the timing mechanism for a simplex operated signaling system, such as disclosed in U. S. Patent 1,823,354 granted to Dowd et al supra. A multiplex rotary distributor (not shown) is driven by vibrating-fork-driven phonic wheel motor 75 at a speed of rotation of, say, 300 revolutions per minute, the distributor being mounted on shaft 76. By connecting shaft 76 through a system of reduction gears to shaft 77, the latter shaft may be given a speed of five revolutions per minute or one revolution in twelve seconds. Shaft 77 is connected at one end through a system of gears of a 1:1 ratio, to a shaft 78 which is in engageable relation through clutch 79 with a shaft 80 of the changeover or transfer cam switch. The changeover switch by means of a series of cams mounted thereon, effects at either terminal station the transfer of the signaling line or cable from the transmitting to the receiving apparatus or vice versa. Thus shaft 80 is also given a speed of five revolutions per minute or one revolution in twelve seconds. Shaft 77 is connected at its other end through a system of reduction gears to shaft 81, which is given a speed of one revolution in twelve minutes. Shaft 81 corresponds to the shaft 11 in Figs. 1 to 6 inclusive, whereon are shown cams 12, 13, 14 and 15, any one of which is arranged to cause the operation of contacts 33 and 34. On shaft 76 is fixedly mounted cam 82 which allows ground to be connected momentarily to conductor 83 on every revolution of the shaft. On shaft 77 is fixedly mounted cam 84 which allows conductor 83 to be connected to conductor 85 for about four seconds out of every twelve seconds. Cams 12, 13 and 14 depending on which one of the push-buttons 43, 44 and 45 of Fig. 1 is selected for operation, interconnects conductors 85 and 86 momentarily at the desired intervals in every 12 minutes. Assuming that the button 44 is depressed, a circuit will be momentarily closed from ground on cam 82 through the contacts of cams 84 and 12 in series, through the winding of magnet 87 to grounded battery 88. Magnet 87 operates momentarily to allow lever 89 to move to the right whereby the teeth of clutch 79 become engaged to rotate shaft 80 at the rate of five revolutions per minute or one revolution in twelve seconds and to thereby rotate the cams which effect the transfer of the line for a reversal in the direction of transmission. However, the rotation of shaft 80 is not continuous because of eccentric cam 90 which is fixedly mounted on shaft 77 which is in engageable relation with a toggle-jointed member 91 which, in turn, is pivotally connected to lever 89. The release of lever 89 forces member 91 against the rotating cam 90 which is arranged to complete a revolution every twelve seconds. Cam 90 is so cut that at the end of six seconds or one half revolution its periphery forces member 91 and lever 89 to the left to engage the released armature of magnet 87, thereby disengaging the teeth of clutch 79. By this arrangement, shaft 80 is made to rotate a half revolution every six minutes, the duration of the rotating interval being six seconds. Therefore, by operating key 44 the system alternately transmits and receives for intervals of six minutes each. The operation of any of the other push-buttons will change in any twelve minute period the duration of the transmitting and receiving intervals as desired.

Figs. 8 and 9 respectively illustrate an end ele-

vation and a rear elevation view of a modification of the switch shown in Figs. 1 to 6 inclusive, wherein a dial replaces the push-buttons and locking plunger, and the eccentric cams 101, 102 and 103 effect the operation of the cam riders. Otherwise the operation of the modification is substantially the same as that of the switch shown in Figs. 1 to 6. The eccentric cams are fixedly mounted on shaft 100 which may be rotated into any desired position by operating the dial, the shaft being rotatably mounted on plate 104 which may be supported by standards 40 and 41 in any suitable manner. Cams 12, 13, 14 and 15 are operated in the same manner and effect the same functions as the corresponding cams in Figs. 1 to 6. In order to provide the preselection feature, cam 15 is provided with another special type of cam rider 106 which is pivotally mounted on plate 104 and is arranged to operate in a manner similar to the special cam rider 60 shown in Fig. 6. However, instead of operating a locking plunger, cam rider 106 is arranged at its free end to engage a toothed cam 107 to thereby lock the dial while cam rider 106 is passing over the projection 61 on cam 15, or in other words, while cam riders 16, 17 and 18 are passing over the points of entry A, B and C to the channels on their respective cams 12, 13 and 14. The setting of the dial may be determined by indicator 108.

What is claimed is:

1. A switching device comprising a plurality of continuously rotating elements, a member in engageable relation with each of said elements, a circuit changing contact controlled by said member, selective means for arbitrarily engaging said member with said element, and means for automatically continuing the engagement of said arbitrarily selected member with said element and for releasing any other member from engagement with its respective element.

2. A switching device comprising a continuously rotating member, a plurality of elements mounted on said member, a contact in engageable relation with each of said elements, an individual means for operating said contacts, each of said means being arranged to automatically restore its associated contact to normal when any of the other of said means is actuated into an operated position.

3. A switching device comprising a continuously rotating member, a plurality of elements fixedly mounted on said member, an oscillating member in engageable relation with each of said elements, individual means for arbitrarily operating said members, and means for automatically restoring any previously operated member to normal when another of said members is operated.

4. A switching device comprising a continuously rotating member, a plurality of annular elements fixedly mounted on said member, an oscillating member individual to each element for engaging a channel of distinctive character on each of said elements, the points of entry for said oscillating members to said channels being in common alignment, arbitrarily selected means individual to said oscillating members for operating any one of said members and for automatically restoring to normal any previously operated member.

5. A switching device in accordance with claim 4 wherein each of said channels has a distinctive irregular alignment.

6. A switching device according to claim 4 wherein means are provided for preventing any of said oscillating members from entering their respective channels at the time the member is selected.

7. A switching device in accordance with claim 4 wherein means are provided for delaying the engagement of any one of said oscillating members with its respective channel should such member be selected when it is passing over the point of entry to the channel.

8. In an impulse transmission system adapted for simplex operation, a switching device comprising a synchronously controlled, continuously rotating member, a plurality of annular elements fixedly mounted on said member, an oscillating member arranged to engage a channel of a distinctive irregular alignment on each of said annular elements, a resilient member for operating each of said oscillating members, means for arbitrarily preselecting any one of said oscillating members through its respectively associated resilient member for engaging a channel of a particular annular element, means for automatically restoring any previously operated oscillating member to its normal position, a pair of circuit changing contacts controlled by said oscillating members and means whereby said contacts cooperate with any one of said oscillating members to effect a change in the direction of transmission over a circuit at regular or irregular intervals.

9. In an impulse transmission system adapted for simplex operation, a switching device in accordance with claim 9 wherein the annular elements are cams each having a continuous periphery in the form of a true circle.

10. In an impulse transmission system adapted for simplex operation, a switching device for effecting changes in the direction of transmission of a circuit, said device comprising a synchronously controlled, continuously rotating member, a plurality of annular elements fixedly mounted on said member, an oscillating member in engageable relation with each of said elements, a resilient member for arbitrarily engaging said oscillating member with its respectively associated element, means for automatically continuing the engagement of said oscillating member with said element and for disengaging any other oscillating member from its respective element, and a circuit changing contact, the making and breaking of said contact being determined by the engagement of any one of said oscillating members with its respectively associated element.

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