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SWITCHING SYSTEM CONTROL

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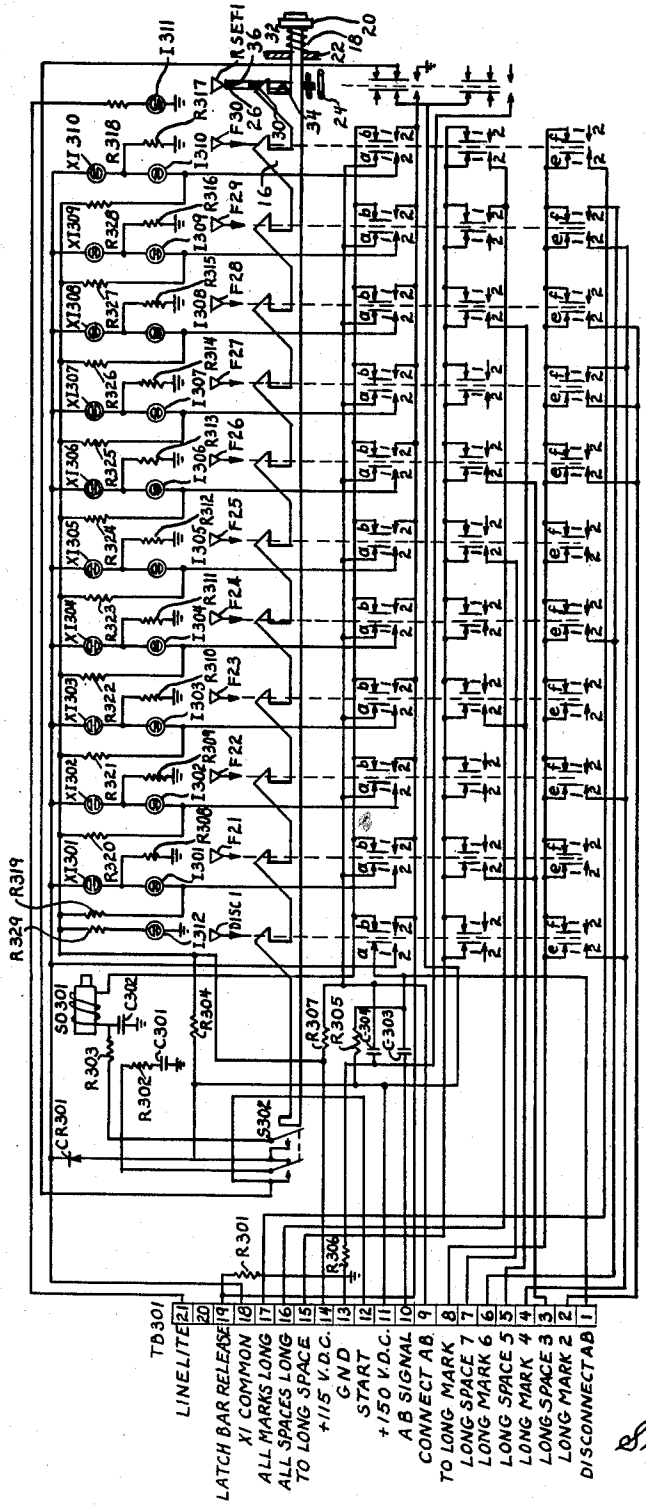


FIG. 1

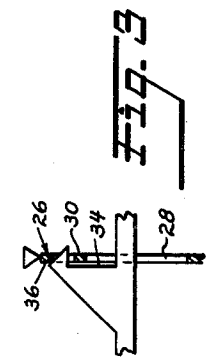


FIG. 3

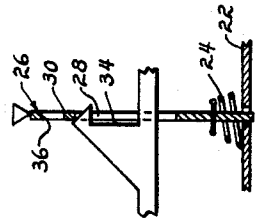


FIG. 2

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SWITCHING SYSTEM CONTROL

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The present invention relates to remote switching systems which basically comprise a sender, a sender control (push-button key cabinet for coding the sender) and a receiver and more particularly to improvements on the sender control unit of such systems.

General description

The usual application of such systems calls for a receiver at one or more remote locations, and a sender and associated push-button sender control cabinet at one or more control locations, with all locations being interconnected by at least the equivalent of a telegraph or teletypewriter circuit. Functions at remote locations can then be performed by operating push-buttons at control locations. In the commercial embodiment of these systems, each receiver will respond to six individual code signals which are common to all receivers. The four common code signals normally are used for a Master Disconnect, a Master Connect, and two Group codes.

With the addition of one external relay, one receiver can be made to respond to fourteen individual and four common codes, while with the addition of three external relays one receiver can be made to respond to sixty four different codes, one sender, under the control of the push-button sender control units, has the available capacity to generate one hundred twenty eight different codes. The push-button control cabinets (sender control units) have one push-button key and a lamp for each code to be sent. The basic sender control unit has ten such function buttons and lamps. It has, in addition, a Master Disconnect (DISC) key for sending the code for disconnecting any previously activated remote functions and it has a reset (RSET) key for clearing out or resetting the lamp tally. Other types are of push-button control cabinets supplement the basic model. A description and detailed explanation of these are given later.

The system employs a noncoded answer-back signal whereby any receiver which successfully performs a function, sends a short space signal to the line as an answer-back. This signal, when received at the sender, lights the lamp over the push-button that was pressed to send out the signal. This lamp remains lighted until the Disconnect code is sent, and an answer-back signal to this code is received at the sender.

When the system operates on a circuit used alternately for teletypewriter signals, the average time of signalling is 2.0 seconds long and the maximum code is 2.4 seconds long. When the system operates on a circuit not used alternately for teletypewriter service, modifications can be made within the units so the lengths of the code signals can be cut approximately in half.

Each code signal transmitted by the sender consists of four "opens" or space signals on the line. These are called space pulses, and each signal includes four space pulses.

The interval between two space pulses on a line is necessarily a marking condition. The mark intervals between the space pulses of a code signal are called mark pulses. The condition of the line before the code signal starts will be marking, and the condition of the line after the code signal ends is marking. The code signal then consists of interrupting the steady state marking condition of the line with the first space pulse of the code signal, followed by a mark pulse, then the second space pulse, another mark pulse, the third space pulse, and third mark pulse, followed by the fourth space pulse and then the final steady state marking condition of the circuit.

In the basic code signal, the duration of each of the space and mark pulses is approximately sixty milliseconds.

The pulses are numbered consecutively from the beginning of the signal. The space pulses are therefore 1, 3, 5 and 7, and the mark pulses are 2, 4 and 6. Since the space pulses are always the odd numbered ones, and the mark pulses are the even numbered ones, reference to pulses will be made by number only, there being no need for making the further statement that a pulse is a mark or a space.

For selective signalling purposes each code signal, of course, must be different from every other code signal. This difference among the signals, or the adding of intelligence to the basic signal, as it might be called, is obtained by making one or more of the pulses of each code signal a long pulse (400 milliseconds) instead of the basic short length of approximately 60 milliseconds.

Intelligence is added to the basic code signal by lengthening both the space and mark pulses in various combinations. Since there are seven pulses which can be lengthened, the total number of combinations possible is two to the seventh power or one hundred twenty eight. If more pulses were used, the number of combinations possible would be 512 for nine pulses, 2148 for eleven pulses and so on.

It should be noted that the overall duration of each code signal depends upon the number of pulses in it which are long pulses, and thus the overall lengths of the various code signals will not be the same. This, of course, contrasts with the usual teletypewriter code signal where the length of each code signal or character is the same.

In the application of the system to teletypewriter circuits, pulse 1 is always a long pulse, for reasons concerned with the binding of teletypewriters on the circuit. This is so that the pulses of a code signal do not cause printing on any teletypewriters that may be connected to the circuit during the sending of a code signal. Since this pulse is always long, there is no necessity for mentioning it in reference to the code signals.

The basic system is one in which no additional relays are added to a receiver to increase the number of codes to which it will respond beyond the minimum of six individual and four common codes. The codes used in the basic systems are as follows: 2, 3, 4, 5, 6, 7, 23, 24, 25, 26, 27, 34, 35, 36, 37, 45, 46, 47, 56, 57, 67, 234, 235, 236, 237, 245, 246, 247, 256 ,257, 267, 34567, 234567, and the code in which pulses 2 through 7 are short. The numbers each refer to the pulse or pulses in the code which are long pulses (400 milliseconds) compared to the normally short (approximately 60 milliseconds) for a pulse. Pulse 1 is assumed to be long in all codes.

The possibility is remote that a code signal will be so changed in transmission that the station for which it is intended will not respond, and that a station for which it is not intended will respond. This margin of safety results from the large difference in the lengths of the short and long pulses of a code. A large amount of distortion would have to be present before a short pulse, approximately sixty milliseconds in length, could be lengthened to appear as a long pulse four hundred milliseconds in length, or vice versa. Either a fairly long spacing hit or

a close-down of the line circuit would have to occur to cause such an effect. In the case of either of these conditions, it is probable that the same condition would obliterate one or more pulses of the code signal and no receiver on the line would receive sufficient pulses to operate any function. Therefore, an answer-back signal would not be returned to the sender and a repetition of the code signal would be required.

For a more detailed explanation of the general system, reference is made to United States Patent No. 2,708,744, issued May 17, 1955 to J. T. Neiswinter for Selective Signalling System, and to his copending application Serial No. 324,765, filed December 8, 1952 for Electrical Signalling Systems.

As heretofore indicated, the present invention relates primarily to improvements in sender control units of remote switching systems of this type.

It is an important object of the present invention to provide a sender control unit embodying a plurality of selectively settable mechanically interlocked function selection circuit devices normally effective upon actuation to control the transmission of a signal indicative of the selected function and a function selection indicating means associated therewith to store an indication of each selected function, indicator resetting means effective under key control to release any latched function selecting key and to permit setting of the indicator to any desired indication by manipulation of the function selection keys without transmitting any function selection signal.

A further important object of the present invention is to provide a sender control unit embodying a plurality of selectively settable mechanically interlocked function selection keys normally effective upon actuation to control the transmission of a signal indicative of the selected function and a function selection indicating means associated therewith to store an indication of each selected function, means responsive to further actuation of any latched function selection key to generate a repeat transmission of the function selection signal corresponding to the function of the latched key.

A further object of the present invention is to provide in a sender control unit embodying a plurality of selectively settable mechanically interlocked function selection circuit devices, means for generating an impulse for effecting initiation of transmission of a signal indicative of the function to be selected upon the actuation of any of such circuit devices.

These and other objects of the present invention will become more fully apparent by reference to the appended claims and as the following detailed description proceeds in reference to accompanying drawings wherein:

Figure 1 is a circuit diagram of the sender control unit of the present invention;

Figure 2 is a sectional view illustrating the cooperation between a function selection key and the latch bar, with the function selection key in its unactuated position; and

Figure 3 is a view similar to Figure 2 illustrating the function selection key latched in its actuated position.

Referring now to the drawings and particularly to Figure 1, the sender control unit is provided with twelve push-button keys, keys F–21 and F–30 providing ten discrete function selections, the key DISC–1 being a disconnect key and the key RSET–1 being a reset key. These keys are mechanically interlocked by a latch bar **16**. A switch S–302 is mounted on the switch main frame at the end of the latch bar so that upon depression of any one of the push-button keys other than RSET–1, the switch S–302 is momentarily transferred from the unactuated position shown in Figure 3 to its actuated position.

The depression of the disconnect key DISC–1 or of any one of the function keys F–21 to F–30 is effective to shift the latch bar **16** to the left as viewed in Figure 1

to momentarily transfer the contacts of switch S–302, the purpose of which will be explained presently. The latch bar **16** is mounted in the frame supporting the single bay switchbank formed by the *a* to *f* contacts of these keys and is resiliently biased to the right by a compressed coil spring **18** which is compressed between a retainer **20** fixed to the latch bar **16** and portion of the frame **22**. Each of the keys DISC–1, F–21 to F–30 and RSET–1 is biased outwardly by an independent compressed coil spring **24**. Each key DISC–1 and F–21 to F–30 is formed with a metal stem **26** (Figure 2) having an aperture **28** through which the latch bar projects and a cross bar portion **30** which, upon depression of the key, operates upon cam surface **32** to shift the latch bar **16** to the left and which after passing the end of the cam surface **32** is received within the notch **34** in the latch bar **16** as the latch bar **16** is permitted to return to the right to retain the key in its depressed position as shown in Figure 3. If a latch key is further depressed, the surface **36** on key stem **26** will engage cam surface **32** to again shift latch bar **16** to the left to shift the contacts of switch S–302 to their transferred position. This arrangement permits repeat transmission of a signal indicative of a selected function merely by overpressing a latched key as will become more fully apparent as the circuit description proceeds.

In addition to movement of the latch bar by the depression of any one of the 12 keys F–21 to F–30 and DISC–1, the latch bar may be moved in the same manner by energization of the solenoid SO–301. The solenoid SO-301, as is explained in detail in copending application Serial No. 601,320, filed July 31, 1956 for Remote Switching System by D. V. Sinninger, is energized upon depression of any one of the keys in an expansion unit or the reset RSET whenever any one of the twelve keys of the master unit of Figure 1 is latched down. Energization of solenoid SO–301 is effective to release the key which is latched in the unit of Figure 1.

The contacts *c*, *d*, *e* and *f* are wired to effect the code selection, the contacts *c* and *d* being wired in common to the pin **15** of TB–301 for long space selection of the sender unit. Similarly the *e* and *f* contacts of the push-button switches connected in common through pins **8** to the sender unit for long mark selection. The No. 2 contacts of movable contacts *e* and *f* of these push-button switches are selectively wired to pins **2**, **4**, **6** and **17** of TB–301 to establish the desired codes of a long mark in code position 2, 4, or 6 on a code of all marks long. Similarly the No. 2 contacts associated with the movable contacts *c* and *d* of each of these switches are selectively wired to establish the proper code selection to pins **3**, **5**, **7** and **16** to effect the establishment of long spaces in code positions 3, 5 and 7 for all spaces long.

The *a* contacts of F–21 through F–30 control the transmission of the answer back signal which is received from the sender unit through pin **9** of TB–301 to the associated one of the answer back triggers.

The gas tube trigger double stability circuit devices in this embodiment of the invention are each formed by a pair of neon lamps designated XI and I–301 to 310 respectively. The XI lamps are preferably high pressure neon filled lamps, type NE–96, and the lamps designated I are preferably relatively low pressure neon filled lamps of good visible indicating quality, type NE–51. The type NE–96 tube has a firing potential of 135 plus or minus 15 volts and a sustaining potential of 75 plus or minus 10 volts and is selected for its relatively high voltage differential between its firing and sustaining potentials whereas the type NE–51 tube has a firing potential of 75 plus or minus 15 volts and a sustaining potential of 65 plus or minus 15 volts and is selected for its good indicating qualities. Due to the inherent characteristics of this circuit, when the set is first turned on or when power is resumed after having been interrupted or intentionally

turned off, all of the indicator lamps I–301 to I–310 will fire.

In order that the lamps may serve as function, activation record elements as well as answer-back indications, a storage action must take place. Once a lamp is lighted it must remain lighted after the activation pulse subsides so that the pulsing source can be routed to other lamps for their subsequent activation.

The neon glow lamps exposed to view as function indicators are the I lamps, type NE–51. This type of lamp, acting alone on its differential between fire and sustain values of voltage, is not a reliable storage device. However, when paired with the high gas pressure neon glow lamp type NE–96, the combination becomes a reliable storage or bistable arrangement. This is because the NE–96 has a relatively high differential between fire and sustain voltages even under the widest possible tolerances encountered with respect to lamp characteristic extremes; initially and after aging. Two type NE–96 lamps operating together in a bistable or flip-flop circuit make a highly reliable storage device, but this type of lamp is not as suitable for indicating service as the brighter NE–51. Although paired NE–51 lamps are not reliable storage elements, a circuit storage pair comprising one NE–96 and one NE–51, as used in this control unit circuit, provide both adequate reliability and satisfactory illuminating properties.

Each indicator consists of a type NE–51 and a type NE–96 glow lamp connected virtually in parallel through a common resistor. Thus only one lamp of the pair can burn at a time since the sustaining voltage across the burning lamp is below the firing voltage of its mate. Once one of the pair is pulsed to burn, the other one extinguishes and this state endures until a counter pulse reverses the order.

The arrangement of the circuit is such that the NE–51 lamps are displayed in view over the function keys and are pulsed on individually as the remote individual functions are activated and return answer-back pulses. Each lighting of an NE–51 lamp extinguishes its concealed mate, the NE–96.

On a Disconnect code, the answer-back pulse operates to pulse on all NE–96 lamps simultaneously, thus extinguishing all NE–51 lamps which may have been burning at the moment.

The common connections between the lamps XI–301 to XI–310 to the indicator lamps I–301 to I–310 respectively are connected to ground through the resistors R–308 to R–317 respectively which are in the commercial embodiment of the invention 150,000 ohm resistors. The opposite terminals of the lamps XI–301 to XI–310 are connected through a common line and through clamping diode CR–301 to pin 11 of TB–301 a 150 volt D.C. connection. Pin 14 of TB–301 is connected through resistor 304 (a constant voltage drop resistor known commercially as a Globar resistor) to the 150 volt D.C. power source at pin 11 of TB–301. The indicator lamps I–301 to I–310 are connected in parallel through resistors R–319 to R–328 (100,000 ohm each) to a common line connecting them through resistor R–304 to the 150 volt D.C. power source at pin 11.

By this circuit arrangement, the voltage at the common connection between the XI lamps and the I lamps with the XI lamps conducting is plus 75 volts. This makes the voltage across the associated I lamp equal to 115 minus 75 or 40 volts so that the associated I lamp will not fire. With the I lamp conducting, the voltage at the common connection between the I lamp and the XI lamp is equal to 115 minus 65 volts or equal to 50 volts. This makes the voltages across the associated XI lamp equal to 150 minus 50 or 100 volts and the XI lamps will not fire.

The I lamps are those which form the visual indication of a received answer back signal indicative of the successful performance of the selected function. When an answer back signal is received, it is transmitted through the No. 1 and 2 *a* contacts of the depressed one of the function keys F–21 to F–30 and is applied to the associated one of the I lamps. The receipt of an answer back signal through pin 10 is effective to apply a plus 265 volt pulse through the closed No. 1 and 2 *a* contacts of a latched one of the function selection keys F–21 to F–30 to the associated one of the indicator lamps I–301 to I–310. This pulse fires the one of the tubes I–301 to I–310 through which it is applied and extinguishes the associated one of the lamps XI–301 to XI–310. The receipt of an answer back signal through pin 10 in response to depression of the disconnect key DISC–1 is effective to transmit a 300 volt positive pulse through the No. 1 and 2 *a* contacts of DISC–1 to the common line to which all of the XI tubes are connected. This fires all of the XI tubes and extinguishes any one of the I tubes which has been fired. (The pulse voltages above given are accurate only when the respective one of the neon I and XI tubes are out of the circuit.)

The answer back signal received from the sender is applied through pin 10 of TB–301 to the common connection to capacitors C–303 (.25 mfd.) and C–304 (.1 mfd.). Capacitor C–303 is normally charged to 150 volts by a circuit from ground through R–306 (68,000 ohm), C–303 and R–305 (47,000 ohm) to the 150 volt D.C. voltage connection at pin 11. The answer back signal at pin 10 is a connection to 150 volt D.C. voltage which is effective to raise the common connection between C–303 and R–305 to approximately 300 volts. This point is connected to the No. 1 *a* contact of disconnect key DISC–1 and through pin 1 of TB–301. When the disconnect switch DISC–1 has been depressed, this pulse is transmitted through the movable *a* contact between contacts 1 and 2 to the common connection to all of the XI tubes to fire any of those tubes which have been extinguished and thereby extinguish the fired I tubes.

The answer back signal through pin 10 of TB–301 is also applied to the capacitor 304 which is normally charged to 115 volts by the circuit from ground through R–306, C–304 and R–307 (47,000 ohm). R–304 is a non-linear resistor, known in the trade as a Globar resistor which is voltage responsive and is effective to maintain the voltage at the common connection between R–304 and R–307 at substantially plus 115 volts D.C. Resistor R–304 reduces voltage variation at the divider point to about one-fifth the value which would be present with a conventional linear resistance type voltage divider.

The answer back signal is therefore effective to establish a pulse of 265 volts positive at the common connection between C–304 and R–307 which is connected to the No. 1 *a* contacts of each of the function selector switches F–21 through F–30. An answer back signal received through pin 10 of TB–301 is therefore effective to apply a 265 volt pulse signal through the No. 1 and 2 *a* contacts of the latched one of the function selector keys F–21 to F–30 to the associated one of the indicator lamps I–301 to I–310 or I–401 to I–412 to render that lamp conductive and extinguish the associated one of the XI lamps.

The depression of any one of the keys F–21 to F–30, or the disconnect key DISC–1 is effective by shifting the latch bar 16 to mechanically release any latched key and to momentarily transfer the contacts of the switch S–302. Capacitor C–301 (.05 mfd.) is normally charged to 150 volts through the circuit from ground through C–301, R–302 (1000 ohm), the normally closed contacts of S–302 to pin 11 of TB–301. Upon the transfer of the contacts of switch S–302 upon operation of the associated latch bar, C–301 applies a pulse through the transferred contacts of S–302 to pin 12 of TB–301 which is connected to the sender unit to energize a start relay in the sender circuit. Immediately subsequently, the sender unit momentarily applies a positive signal to pin 19 of TB–301 which

is connected to the No. 2 *b* contacts of disconnect switch DISC–1, and function selector switches F–21 to F–30. The No. 1 *b* contacts of disconnect switch DISC–1 and F–21 to F–30 are connected in common to latch bar operating solenoid SO–301. The solenoid SO–301 is connected to ground through a surge capacitor C–302 (20 mfd.) and the common connection between the two is connected through resistor R–303 (1000 ohm) to a movable contact of S–302.

If, for example, key F–21 is latched and key F–22 is depressed, the key F–21 will be mechanically released by the action of the latch bar 16 and the latch bar 16 will transfer the contacts of S–302 to charge the capacitor C–302 positively relative to ground through the circuit from ground through capacitor 302, resistor R–303 and the transferred contacts of S–302 to the 150 volt D.C. voltage source at pin 11 of TB–301. With capacitor C–302 charged in this manner, a subsequently received pulse through pin 19 of TB–301 and the *b* contacts 1 and 2 of the depressed key F–22 will be ineffective to energize the solenoid SO–301. This arrangement is essential to prevent immediate release of a key which has just been depressed.

If however, F–21 is latched and any one of the function keys of an expansion unit is depressed, the capacitor C–302 will not have been charged so that the positive pulse received through pin 19 will be transmitted through the No. 1 and 2 *b* contacts of F–21 to the solenoid SO–301 to energize solenoid SO–301 to operate the latch bar of the unit to release the key F–21.

The depression of the reset key RSET–1 is effective to suppress a start signal by applying ground through its No. 2 and 3 *b* contacts to the pin 12 of TB–301. In addition through its No. 2 and 3 *a* contacts it applies 150 volts D.C. from pin 11 of TB–301 to the common connection to the No. 2 *b* contacts of all other keys of the units to effect release of the last depressed one of those keys by energization of the latch bar operating solenoids SO–301. Further as the reset key RSET–1 is depressed it momentarily shorts its No. 1 and 3 *c* contacts together to apply momentarily 150 volts D.C. to the common connection between capacitors C–304 and C–303 to simulate an answer back signal which as previously described is effective if the disconnect key DISC–1 was previously depressed to fire all of the XI tubes and extinguish all of the I tubes or if the previously depressed key was one of the function selector keys F–21 to F–30 to fire the associated one of the I lamps I–301 to I–310.

To simulate calls the RSET–1 key needs only to be pressed once and released. Holding it forward grounds the Start line. When the key is in motion halfway between forward and back positions, a momentary connection is made between +150 volts and the answer back pulsing line. This simulates a pulse on that line to fire an indicator lamp I–301 to I–310 through some latched function key F–21 to F–30 with C–304 acting as the discharge voltage-doubling capacitor. If the DISC key is latched, the pulse routes through C–303 as the voltage-doubling capacitor. Additionally, when the RSET key is pressed to the forward position +150 volts is applied to the latch bar release lines to actuate the local solenoid through any locally pressed key or to operate the solenoid of some other expansion control unit.

From the foregoing detailed description, it is apparent that the present invention provides a greatly improved sender control unit for selective switching circuits in that it is so arranged as to be more stable in operation, more compact in structure and economical to manufacture, and more rapidly adaptable to installations of widely varying function selection capacity requirements.

The invention may be embodied in other specific forms without departing from the spirit or essential characteristics thereof. The present embodiments are therefore to be considered in all respects as illustrative and not restrictive, the scope of the invention being indicated by the appended claims rather than by the foregoing description, and all changes which come within the meaning and range of equivalency of the claims are therefore intended to be embraced therein.

What is claimed and is desired to be secured by United States Letters Patent is:

1. A control unit for controlling the actuation of a transmitter for a remote switching system comprising a plurality of selectively settable function selection switches, a mechanically interlocking latch mechanism so interconnecting said selection switches that upon the actuation of any one of said selection switches said one of said switches will be locked in its actuated position and during movement of said one switch to its actuated position is effective to release any previously actuated selection switch to return to its unactuated position, and means responsive to the movement of said latch mechanism during the said actuation of any of said selection switches for generating a short duration impulse for transmission to the transmitter to initiate transmission of a signal indicative in code of the function of the actuated selection switch, said impulse generating means comprising a capacitor, means for storing a charge in said capacitor while said latch mechanism is in its normal position, and means operative under control of said latch mechanism during the actuation of any one of said selection switches for discharging said capacitor to thereby produce an electrical signal.

2. The control unit defined in claim 1 wherein said latch mechanism includes a spring biased latch bar and said storing and discharging means include a single pole double throw switch device actuated between its two positions by movement of said latch bar during actuating movement of any of said selection switches.

3. The control unit defined in claim 1 wherein each of said switches when latched in actuated position is capable of limited further movement in its direction of actuation, and said control unit further comprises means responsive to further movement of a latched switch in its actuating direction for reactuating said impulse generating means to generate a further start impulse to effect re-transmission of a signal indicative in code of the function of the actuated selection switch.

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