March 24, 1942. O. CESAREO ET AL 2,277,206

KEY SENDER

Filed June 22, 1940 2 Sheets-Sheet 1

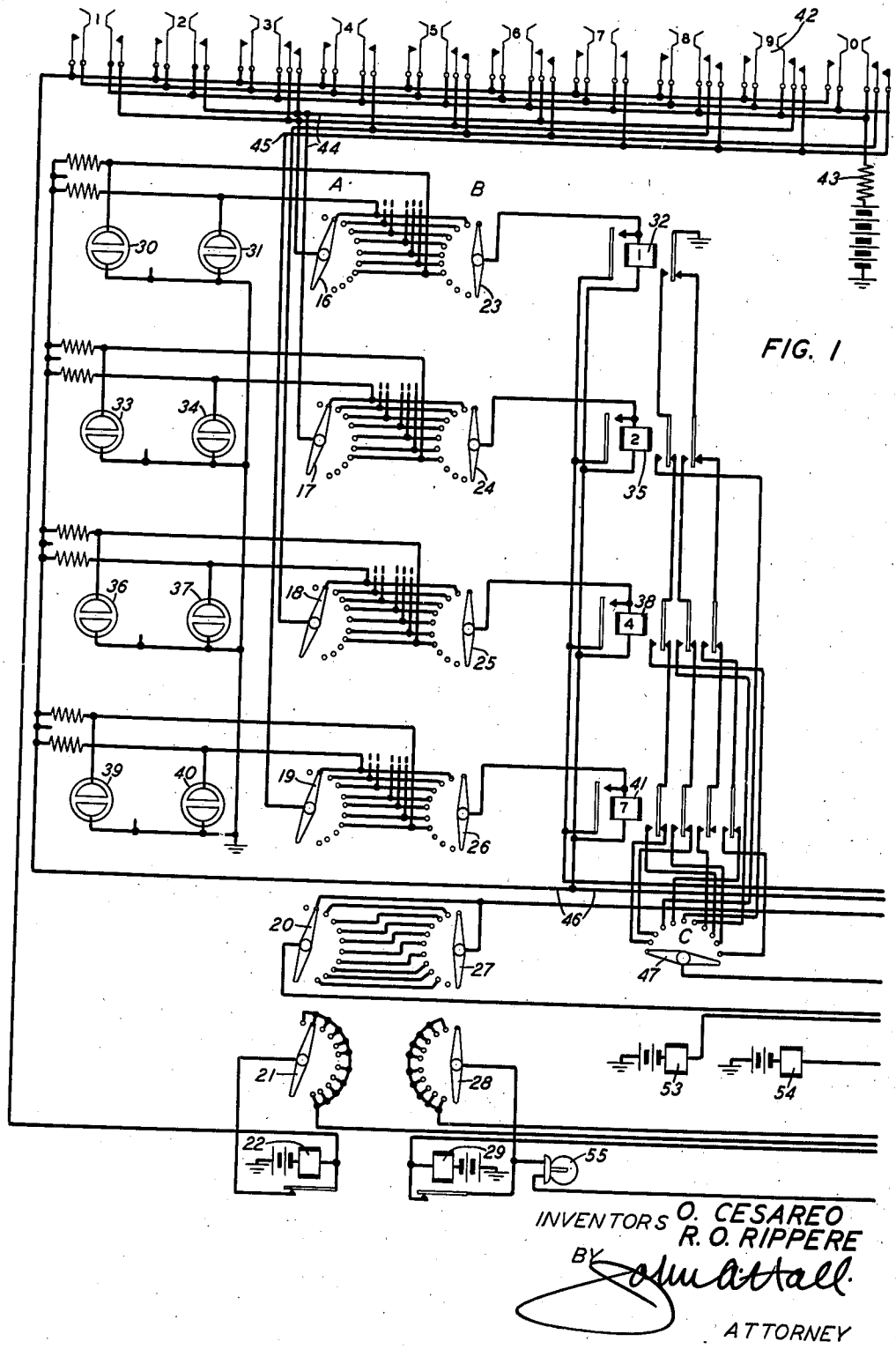

FIG. 1

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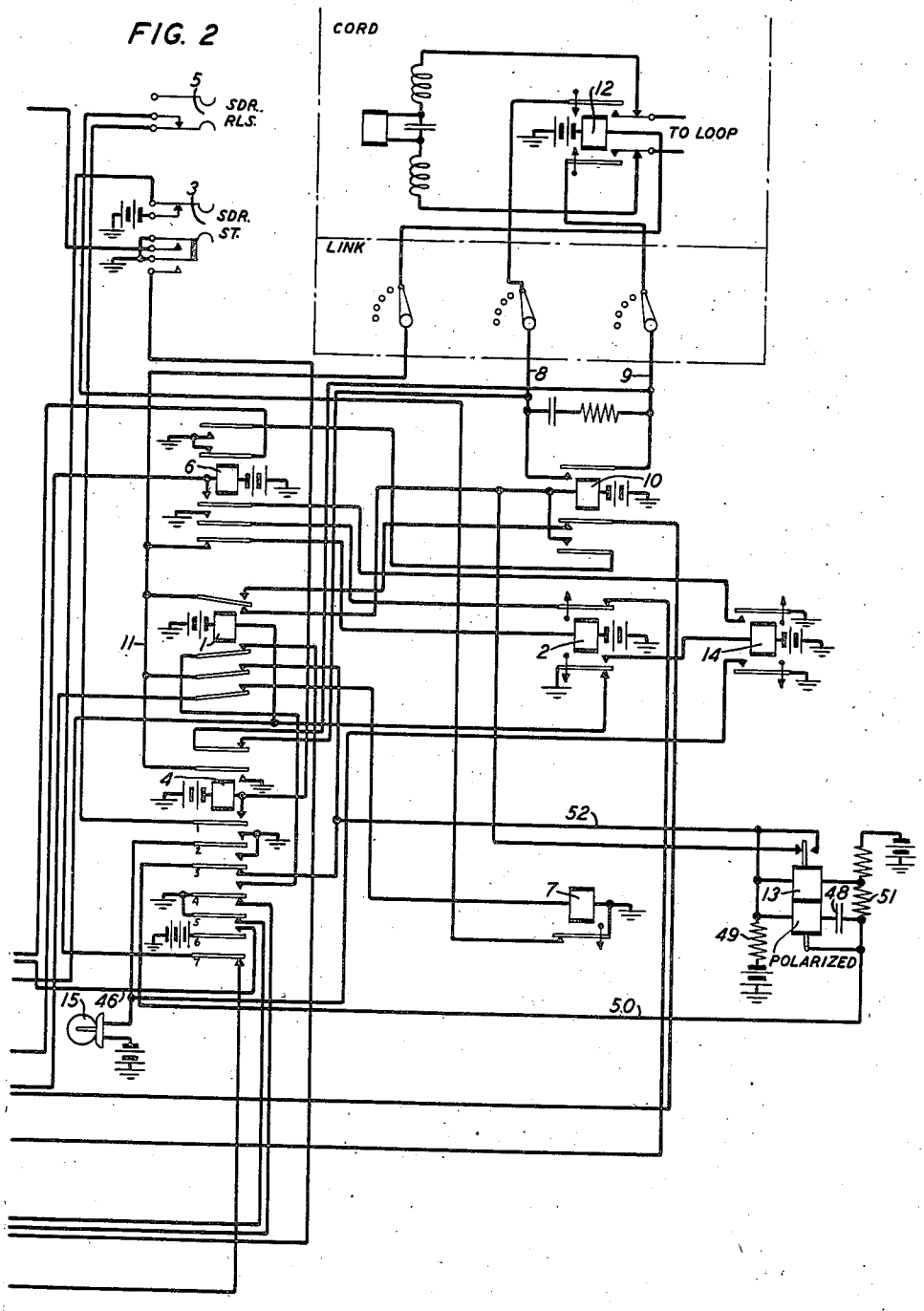
FIG. 2



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KEY SENDER

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5 Claims. (Cl. 179—90)

This invention relates to communication systems wherein connections are established through the transmission of signals representing a numerical designation of a desired connection and it relates particularly to sending arrangements for transmitting this type of signal in response to the successive operation of a bank of keys carrying digital designations.

The object of the invention is to provide a keyboard sender having the advantages of great reliability, economy and simplicity which due to these attributes may be used in locations heretofore considered inappropriate for this type of apparatus. According to the present invention a minimum of apparatus and all of a rugged nature assembled in a simple and easily maintained circuit arrangement is provided which may be placed on subscriber premises and operated by comparatively inexperienced attendants.

A feature of the present invention is the use of cold cathode tubes for registering circuit combinations representing digital designations under manual control.

A further feature is the use of a simple step-by-step switch for steering-in purposes and a similar switch for steering-out purposes. The operation of a digit key will fire an appropriate combination of cold cathode tubes representing a particular place digit and the release of such key will cause the said steering-in switch to advance to the succeeding place so that the immediately following operation of the same or another digit key will fire an appropriate combination of cold cathode tubes representing such succeeding place digit. In this manner a numerical designation of a wanted connection may be rapidly and accurately written up on a bank of cold cathode tubes which remain in an active state until the record is properly transferred and then erased.

Another feature is the use of a set of detecting relays which directly operate a fanning out circuit to translate the code used in the combination firing of said cold cathode tubes into a simple decimal designation for controlling the automatic transmission of digital signals.

Another feature is an automatically operating relay circuit arrangement for generating trains of signals corresponding to the digital designations recorded by code combinations on said cold cathode tubes.

Still another feature is an automatically operating relay circuit arrangement for properly timing the sequence in transmission of separate trains of signals.

A further feature is a release means for returning the complete circuit to normal at any time or under any condition.

The drawings consist of two sheets carrying Figs. 1 and 2. With Fig. 2 placed to the right of Fig. 1, the whole comprises a circuit diagram for explaining the present invention.

With the circuit normal, relay 1 is held operated from ground on the back contact of relay 2. In the upper part of Fig. 2 there are shown two broken-line rectangles. The upper one represents a cord circuit and the lower one a link circuit for connecting the key sender shown in the main parts of Figs. 1 and 2 to the cord circuit. The actual operation of the link will not be explained as this is well known. The diagram here merely represents the fact that the key sender may be connected to various cord circuits. When the operator decides to set up a connection over the cord circuit she has selected, she operates the sender start key 3. Through the lower outer contact of this key a ground is connected to relay 4, which becomes operated and performs a plurality of functions. Relay 4 locks under control of the sender release key 5 to a back contact of relay 7. Relay 4 remains operated until all of the digits have been registered and regenerated as outgoing pulses or until the circuit is released by the operation of the sender release key 5.

The operation of relay 4 prepares the sender for outpulsing by removing a short circuit across the pulsing loop comprising conductors 8 and 9 leading in one instance to the armature and front contact of relay 10 and in another direction to the upper outer armature and back contact of relay 4. The outpulsing loop although opened at the outer upper armature of relay 4, is closed by the upper armature and front contact of relay 10 which becomes operated from ground on conductor 11 supplied at the front contact and inner upper armature of relay 4 and thence through the upper armature and front contact of relay 1. Ground on conductor 11 is also extended through the link circuit to cause the operation of the slow operating cord circuit relay 12. Relay 4 also prepares the pulse generating relay 13 for operation by opening the connection between the right-hand contact of relay 13 and the armature of relay 13 through the lower armature 3 of relay 4 and its back contact and at the same time by connecting ground through the front contact and lower armature 3

of relay 4 to the armature of relay 13. Relay 4 also causes the operation of relay 2 from ground on conductor 11 over the back contact and outermost lower armature of relay 6. Relay 2 causes the operation of relay 14 over the lower armature and front contact of relay 2. Relay 4 in addition causes the lamp 15 to light from the front contact and lower armature 2 of relay 4 to indicate the fact that the sender is in operative condition. Lamp 15 is also energized by the lower armature and front contact of relay 14. The operation of relay 2 removes the operating ground from relay 1, but relay 1 remains operated in a circuit which may be traced through brush 20 of switch A and thence over the outermost lower armature and front contact of relay 1, through the winding of relay 7, to ground. Switch A is a step-by-step switch comprising wipers 16 to 21, inclusive, operated under control of magnet 22. When magnet 22 is energized, the switch is prepared for stepping but the wipers thereof are not moved until magnet 22 becomes deenergized. It will be noted that a similar switch, here known as switch B and having wipers 23 to 28, inclusive, and a stepping magnet 29, is provided with interconnections between the contacts swept over by wiper 20 of switch A and wiper 27 of switch B. It will be shown hereinafter how, when switch A takes a step, it is followed by switch B and the circuit for relay 1 will be traced from wiper 27 to wiper 20 and thus eventually through the winding of relay 7 to ground.

The operation of any of the numerical keys will energize the A stepper magnet 22 and will ignite a combination of the cold cathode gas tubes connected to the No. 1 terminals of the A switch. It will be noted that the permutation code used herein is based on an algebraic conception. The tubes 30 and 31 representing one tube connected to each of the terminals of the A switch, and also relay 32 associated with this group, are given a value of 1. Likewise tubes 33 and 34, and relay 35 associated with this group, are given a value of 2. Tubes 36 and 37, and relay 38 associated therewith, are given a value of 4. Tubes 39 and 40, and relay 41 associated therewith, are given a value of 7. Any digit to be written up on these tubes will ignite a combination of the tubes whose values added together represent the value of the digit. Thus, for instance, if the digit 9 is to be written up by depression of the key 42, it will cause tubes 34 and 40 respectively having the values 2 and 7 whose sum is 9, to be ignited. It should be noted, however, that the digit 10 is recorded on tubes associated with wipers 18 and 19, having values of 4 and 7, respectively, and while this is a slight deviation from the algebraic conception generally used it leads to economy in that one less armature is used on relay 41, and obviates the necessity for an additional contact spring on the numerical key. Specifically, when key 42 is depressed high voltage battery connected through resistance 43 will be extended over conductors 44 and 45, respectively, through brushes 17 and 19 to the upper terminals of tubes 34 and 40. Since upon the operation of relay 4 battery was connected through the lower armature 6 and front contact of relay 4 to conductor 46, this battery now will maintain tubes 34 and 40 in energized condition.

It will also be noted that upon the depression of key 42 ground from the inner lower contacts of sender start key 3 will be connected through the left-hand contacts of key 42 to the stepping magnet 22. As soon as the operator releases key 42, stepping magnet 22 will release and move the brushes 16 to 21, inclusive, in a clockwise direction to their next contacts. In this manner the full designation of the wanted line may be written up on a combination of four cold cathode tubes per digit.

As wiper 20 moves off its first contact the circuit for relay 1 is opened and relay 1 is thereupon allowed to release. The B switch is now caused to step to its No. 1 terminal. Upon the operation of relay 4 a ground was extended over the lower armature 4 and front contact of relay 4, the innermost lower armature and front contact of relay 1 to the magnet 29. Now upon the release of relay 1 this circuit is broken and the wipers 23 to 28, inclusive, are stepped forward. Through wipers 24 and 26 and due to the energization of tubes 34 and 40, relays 35 and 41 are energized and these relays lock through their left-hand armatures to ground supplied over the inner upper armature and back contact of relay 6. It should be noted that the left-hand armatures of relays 32, 35, 38 and 41 are known as preliminary make contacts. They are so arranged that contact will be made between these armatures and their contacts before the other armatures of these relays have completed their travel. Through the ground thus supplied, the corresponding tubes 34 and 40 are short-circuited momentarily and are thus quenched, but the relays 35 and 41 remain operated for the time being. Thus the digit 9 is recorded by the operation of relays 35 and 41 and a ground is extended to the ninth terminal of the C switch, represented by the wiper 47. This ground may be traced from the right-hand armature of relay 32 and its back contact, outer right-hand armature and front contact of relay 35, middle right-hand armature and back contact of relay 38, second inner right-hand armature and front contact of relay 41 to the ninth terminal traversed by wiper 47.

The release of relay 1 removes the locking circuit of relays 13 and 10 and allows them to pulse.

Ground being removed from the right-hand contact of relay 13, condenser 48 is placed in a charging circuit from battery through resistance 49, the lower winding of relay 13 to ground on conductor 50 supplied over lower armature 3 and front contact of relay 4. An energizing circuit may also be traced from battery through resistance 49, the upper winding of relay 13 and resistance 51 to ground. When the condenser 48 has become sufficiently charged, relay 31 will move its armature from the position shown to its right-hand contact. Thereupon ground will be removed from the winding of relay 10 and this relay will open the outpulsing circuit through conductors 8 and 9. When relay 13 moves to its right-hand armature, ground is again placed on conductor 52 whereupon the condition for holding the armature of relay 13 to its left-hand contact is again established. Thus relay 13 will move its armature back and forth between its left and its right-hand contacts periodically and at a rate determined by the value of condenser 48 and the resistances 49, 51, etc.

Relay 10 therefore pulses out on the loop and at the same time steps the C switch over its terminals once for every pulse sent out. The circuit may be traced from battery, the winding of magnet 53, over the inner lower armature and back contact of relay 10, the back contact and upper

armature of relay 1, to ground on conductor 11. When the number of pulses corresponding to the digit registered are sent out, the C switch operates relay 6 from the marking ground on its ninth terminal. This ground extends over wiper 47 to the winding of relay 6 and thence to battery. Relay 6 stops the pulsing circuit by locking the relay 10 operated and releases the detecting relays 32, 35, 38 and 41. It also releases relay 2 which after an interval determined by its slow releasing characteristics reoperates relay 1 which then locks through the wiper 27 and its first contact and the second contact and wiper 20 of the A switch providing the A switch has not by this time moved forward to another terminal. The operation of relay 1 also locks in relay 13, so that this relay will not pulse again for the time being. The C switch is provided with a release magnet 54 which now becomes operated in a circuit from battery, the winding of release magnet 54, the back contact and upper armature of relay 2, the middle lower armature and front contact of relay 6 to ground, whereupon the C switch is released and wiper 47 returns to normal.

Relay 2 releasing also causes the release of relay 14 which in turn unlocks relay 6, allowing this relay to return to normal. At this time the circuit for relay 2 is again established over the outermost lower armature of relay 6, whereupon relay 2 and thereafter relay 14 again become operated. The reoperation of relay 2 releases relay 1 provided the A and B switches are not synchronized a step apart as, for instance, when wiper 27 is on its first contact and wiper 20 is on its second contact. If the A and B switches are synchronized, relay 1 remains locked up in series with the ground on relay 7. This blocks the B switch and prevents it from progressing faster than the A switch. If the A switch is more than one terminal ahead of the B switch, or as soon as the A switch progresses due to a succeeding digit being keyed, relay 1 releases, allowing the pulsing circuit to proceed as described hereinbefore.

When all of the desired digits have been keyed and registered, the operator releases the sender start key which removes the operating ground from relay 4, thus placing relay 4 under control of relay 7.

When the A and B switches become synchronized upon pulsing out the last digit registered, the operation of relay 2 allows relay 7 to operate in series with relay 1. The operation of relay 7, at this time with the sender start key 3 normal, releases relay 4. The release of relay 4 blocks the outpulsing path, releases all of the locked up relays except relay 1 and relay 7, and closes ground to the contacts traversed by A switch wiper 21 and B switch wiper 28. Since these wipers connect to self-breaking contacts on the stepping magnets 22 and 29 respectively, these switches are automatically driven to their normal positions.

The circuit may be returned to normal at any time in the progress of the operation hereinbefore described by simply restoring the sender start key 3 and operating the sender release key 5, which latter action releases relay 4. Since the sustaining potential of any lock-in cold cathode tubes is controlled by relay 4, these tubes are extinguished.

The release of relay 4 extinguishes the lamp 15 but lights lamp 55 until wiper 28 has returned to normal. Lamp 55, therefore, indicates that the apparatus has not entirely returned to normal even though lamp 15 by becoming dark indicates that the circuit is no longer in use. When wiper 28 returns to normal and lamp 55 becomes extinguished, the operator will know that the circuit is ready to receive a new series of impulses.

What is claimed is:

1. In a communication system, a keyboard sender comprising a single set of manually operated designation keys, means comprising a plurality of sets of cold cathode tubes and a sequence switching means for successively recording a complete designation in code on said tubes, means comprising a translator and a sequence switching means for successively translating said coded records into designations of another type and signal generating means under control of said last means for transmitting signals representing said complete designation.

2. In a communication system, a keyboard sender comprising a single set of manually operated designation keys, means comprising a plurality of sets of cold cathode tubes and a sequence switching means responsive to said keyset for successively recording a complete designation in permutation code on said tubes, means comprising a translator and a sequence switching means for successively translating said coded records into numerical code designations and signal generating means under control of said last means for transmitting signals representing said complete designation.

3. In a communication system, a keyboard sender comprising a single set of manually operated designation keys, a plurality of digital recorders each comprising a plurality of cold cathode tubes responsive in permutation code to said keys, a digit counterresponsive to the number of operations of said keys for successively connecting said recorders to said keys, timed operating means for successively subjecting a signal generating circuit to said operated recorders and said signal generating circuit comprising translating means responsive to the said tubes of said recorders for translating the permutation code records on said recorders into numerical codes, a signal generator responsive to said translating means and timing means for separating the transmission of the said translated signals into distinct groups.

4. In a communication system, a keyboard sender comprising a single set of manually operated designation keys, a plurality of digital recorders each comprising a set of four cold cathode tubes, said keys being included in a circuit arrangement for firing said tubes in a permutation code, a digit counterresponsive to the number of operations of said keys for successively connecting said recorders to said keys, timed operating means for successively subjecting a signal generating circuit to said operated recorders, said signal generating circuit comprising a set of four corresponding detecting relays for transferring the individual coded records on said recorders to said common signal generating circuit and for thereupon erasing the record on said recorders, said detecting relays operating a fanning out circuit for translating said permutation code records into numerical code conditions, a counting switch for measuring the said numerical conditions, a signal generating relay and means under control of said counting switch and said signal generating relay for transmitting numerically coded signals.

5. In a communication system, a keyboard sender comprising a timed signal transmitter for sending switch setting signals at an established rate, a single set of manually operated designation keys responsive at any rate of operation of which an operator is capable, a plurality of sets of two element cold cathode tubes for recording designations in code responsive to said keys, each said tube being included in a circuit having one branch leading to said keys for firing said tube and another branch leading to a source of sustaining potential for maintaining said tube in operation after being fired, said first branches of said tube circuits leading also to detecting means, said detecting means and means operated thereby for controlling said timed signal transmitter, and overtake means for further controlling said timed signal transmitter when said keys are operated at a slower rate than said signal transmitter.

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