May 14, 1946. F. A. HUBBARD 2,400,148

TELEPHONE CALL TRANSMITTING DEVICE

Filed June 23, 1943 2 Sheets-Sheet 1

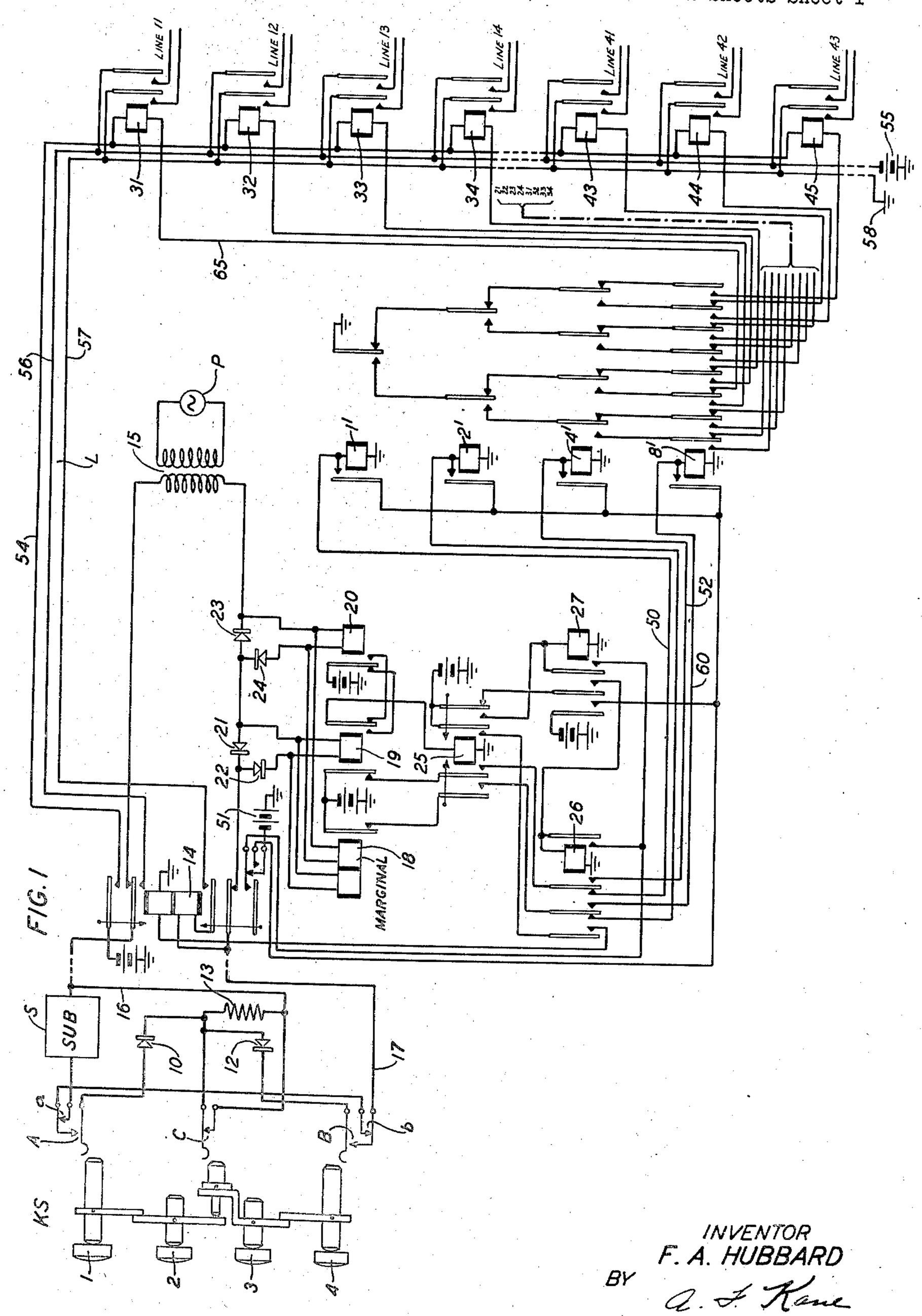

FIG. 1

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FIG. 2

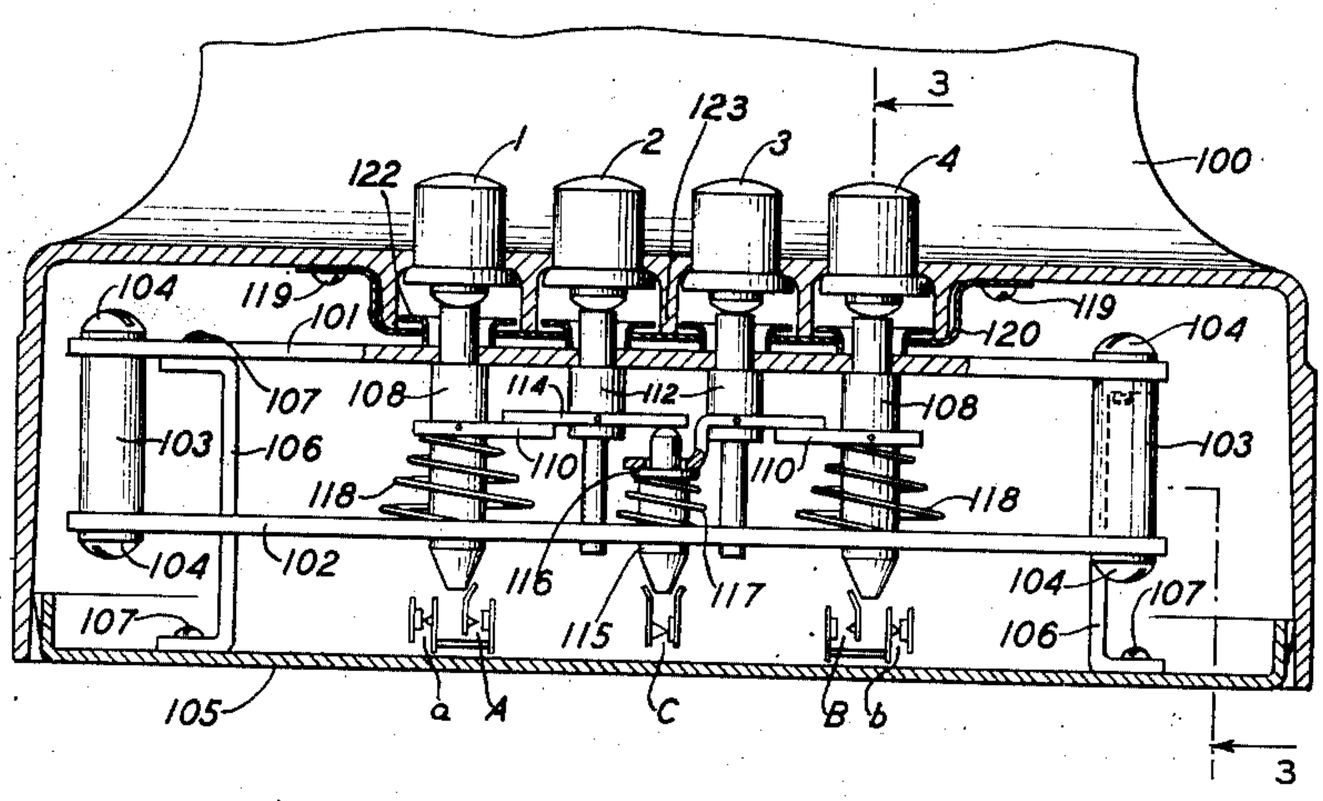
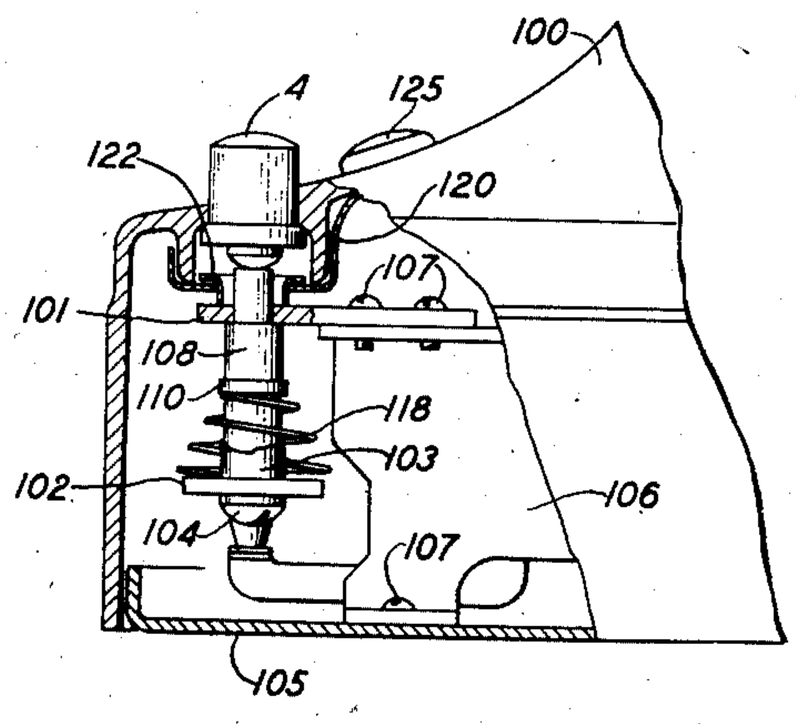


FIG. 4

KEYS OPERATED	CONTACTS		REGISTER MAGNETS	LINE SELECTED
	FIRST	SECOND		
1, 1	A	A	1', 4'	11
1, 2	A	A, C	1', 4', 8'	12
1, 3	A	B, C	1', 8'	13
1, 4	A	B	1'	14
2, 1	A, C	A	1', 2', 4'	21
2, 2	A, C	A, C	1', 2', 4', 8'	22
2, 3	A, C	B, C	1', 2', 8'	23
2, 4	A, C	B	1', 2'	24
3, 1	B, C	A	2', 4'	31
3, 2	B, C	A, C	2', 4', 8'	32
3, 3	B, C	B, C	2', 8'	33
3, 4	B, C	B	2'	34
4, 1	B	A	4'	41
4, 2	B	A, C	4', 8'	42
4, 3	B	B, C	8'	43

FIG. 3



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Patented May 14, 1946 2,400,148

UNITED STATES PATENT OFFICE

2,400,148

TELEPHONE CALL TRANSMITTING DEVICE

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Application June 23, 1943, Serial No. 491,959

5 Claims. (Cl. 177—380)

This invention relates to telephone call transmitting devices used in telephone systems of the type in which the establishment of telephone connections between calling and called stations is controlled from the calling station by means of manually operable keys.

Key calling telephone systems have been devised heretofore which provide facilities whereby a telephone subscriber may selectively establish direct connections to any of a plurality of frequently called stations without resorting to the use of the regular telephone dial, or relying upon the assistance of an exchange attendant in completing such connections. Such systems are usually characterized by the use of a key-set at the calling subscriber's station comprising a plurality of manually operable keys or buttons, each assigned to a different one of the frequently called stations. Each key or button functions, when actuated, to effect the transmission of a distinct station selecting signal comprising a particular combination of positive and/or negative direct current impulses to a signal receiving circuit. The signal receiving circuit controls a group of register relays which are operated in various combinations, depending upon the character of the impulse combination transmitted from the calling station, to selectively control the operation of called station-connecting switching devices. A particular system of this type is disclosed in Patent No. 2,364,771, issued December 12, 1944, to Henry M. Bascom and Francis A. Hubbard, and is characterized by the use of a key-set whose keys function during both their downstrokes and their upstrokes to transmit complete station identifying signals of the two-interval type. The utilization of both strokes of a station selecting key in this system obviates the need for a ground connection at the subscriber's station and renders it possible to transmit fifteen different station selecting signals over the metallic loop which comprises the subscriber's substation circuit, the signal receiving circuit and the two interconnecting line conductors.

It is the object of this invention to simplify and otherwise improve key calling telephone systems of the general type disclosed in the above-identified patent.

This object is attained in accordance with a feature of the invention by the use of a four-button key-set whose keys are actuated twice or in various combinations of two keys consecutively, each combination of two key operations controlling the selection of a different called subscriber's line. This feature results in a simplification of the subscriber's telephone set and renders it possible to effect fifteen different station selections with but four keys.

The key-set of this invention controls a simplified signal receiving circuit whose signal receiving relays function on a release basis to control the selective operation of the register relays of the register circuit. More particularly, the signal responsive relays are all operated in response to the initiation of a call at a subscriber's station and prior to the actuation of the station selecting keys, and are then selectively released singly or in combinations in accordance with the actuation of the particular keys.

In the present system, the station selecting codes are based on polar-marginal combinations whereby both positive and negative half cycles may function at either of two magnitudes. The positive and negative characteristics of the signal impulses are determined by a pair of oppositely poled dry rectifiers which may be separately connected to the signaling circuit under the action of individual keys, and the marginal characteristic is obtained by effectively including in or excluding from the circuit with either of the dry rectifiers a resistance element. A further feature of the invention, accordingly, resides in a particular design of a four-button key-set having but three spring pile-ups, one of which is associated with each of the dry rectifiers and the third of which controls the resistance element, and in so constructing the key-set that each of the rectifier controlling spring pile-ups may be separately operated by its own individual key, or each may be operated simultaneously with the resistance controlling spring pile-up by a particular one of the two remaining keys of the four-button key-set.

These and other features of the invention will be readily understood from the following detailed description when read in connection with the accompanying drawings in which:

Fig. 1 is a circuit diagram disclosing a fifteen-station key calling system embodying features of the invention;

Fig. 2 is a front view of a four-button telephone subscriber's set with the front face thereof broken away to expose the structural details of the key-set and illustrates the manner in which the three spring pile-ups may be actuated in various combinations by means of four keys;

Fig. 3 is a view of the telephone set shown in Fig. 2 taken along the line 3—3 and looking in the direction of the arrows; and

Fig. 4 is a table showing the contacts and reg-

ister magnets operated and the lines selected for each of the fifteen different combinations of two keys in which the four keys are operable.

Reference will now be made particularly to Figs. 2 and 3 which show the four-button key-set of this invention mounted in the base of a telephone set housing 100. The key-set itself consists of two horizontal mounting plates 101 and 102 which are held in superposed spaced relation by means of the cylindrical members 103 which are tapped at either end to receive the screws 104. This framework is supported on the base 105 by means of two brackets 106 having flanges at either end which abut, respectively, the underside of the upper plate 101 and the inner face of the base 105 and are fixed thereto by screws 107. Each of the plates 101 and 102 is furnished with aligned holes, the two outer holes in the lower plate 102 being slightly larger in diameter than the two outer holes in the upper plate 101, and the two inner holes in the lower plate 102 being slightly smaller in diameter than the corresponding holes in the upper plate 101. The lower plate is provided with a fifth hole of substantially the same diameter as the two outer holes thereof and located midway between the two smaller holes. These holes accommodate the plungers which are controlled by the key buttons as will presently appear.

The two outer plungers 108 are identical in construction and each consists of a main body portion or shank tapered at one end and provided with an integral projection of smaller diameter at the other end which protrudes through its respective hole in the upper plate 101. Each of the plungers 108 carries a rectangular projecting arm 110 which is rigidly fixed to its respective plunger in any convenient manner. The arm 110 of the right-hand plunger 108 projects towards the left whereas the arm 110 of the left-hand plunger 108 projects to the right for a purpose to be explained presently. Each of the plungers 108 has its upper end in cooperative engagement with a manually operable button.

The two inner plungers 112 are substantially identical in design and each consists of an intermediate portion of substantially the same diameter as the shanks of the plungers 108, an integral projection of smaller diameter extending from the upper end thereof and a longer integral portion of still smaller diameter extending from the lower end thereof. The left-hand plunger 112 carries an arm 114 which extends in either direction therefrom in such a manner that the left-hand portion thereof normally rests upon the arm 110 of the left-hand plunger 108. The right-hand plunger 112 carries a substantially S-shaped arm whose right-hand portion normally rests upon the arm 110 of the right plunger 108 and whose left-hand portion is apertured to receive the upper end projection of a short plunger 115. The plunger 115 has its lower end tapered and is provided with an annular shoulder 116 near its upper end which cooperates with the lower plate 102 to confine a coil spring 117 mounted on the shank of the plunger 115. Each of the plungers 108 is also equipped with a coil spring 118 which is confined between the plunger arms 110 and the lower plate 102.

On the under surface of the telephone set housing 100 there is secured by screws 119 a trough-like element 120 which is provided with four equispaced holes each of which accommodates a flared bushing 122. The under surface of the housing of the telephone set is provided with five equispaced integral depending arms 123 which, with the flared bushings 122, effect four compartments within each of which a plunger-actuating button is free to move. The buttons, designated 1, 2, 3 and 4, respectively, are each provided with an integral centrally disposed projection at its lower end which is normally in contiguous association with the upper end of a plunger. Each button, near its lower end, is provided with a flange which serves to guide the button in its downward travel in its respective compartment.

The springs 118 normally maintain their respective plungers 108 in raised position, in which positions the shoulders of the shank portions thereof abut the under surface of the plate 101 and the upper ends thereof, by virtue of their engagement with the buttons 1 and 4, respectively, maintain these buttons in the normal unactuated positions illustrated. The spring 117 serves the same purpose in connection with plungers 112 which communicate with the under surfaces of the buttons 2 and 3.

The tapered end of the left-hand plunger 108 serves, when depressed, to actuate a spring pile-up comprising contacts *a* and A; the tapered end of the right-hand plunger 108 serves, when depressed, to actuate a spring pile-up comprising contacts *b* and B; and the short center plunger 115 serves, when depressed, to actuate a spring pile-up comprising the contacts C.

When the key button 1 is depressed, the associated plunger 108 moves downwardly against the action of the corresponding spring 118, disengages its arm 110 from the left portion of arm 114 and causes the contacts *a* to be opened and the contacts A to close. Contacts A and *a* are of the make-before-break type so that the contacts A close before the contacts *a* open. Key button 4, when depressed, moves its corresponding plunger 108 downwardly against the action of spring 118, opens contacts *b* and closes contacts B. When key button 2 is actuated, the arm 114 associated with the left-hand plunger 112 acts upon both the left-hand arm 110 and the upper end of plunger 115 whereupon both the left-hand plunger 108 and the plunger 115 are depressed, the former to operate contacts *a* and A, as described above, and the latter to open contacts C. The key button 3, by virtue of the S-shaped arm carried by the right-hand plunger 112 with which the button 3 communicates, moves both the right-hand plungers 112 and 108 downwardly, the former to open contacts C and the latter to open contacts *b* and to close contacts B. Contacts B and *b*, like contacts A and *a* are of the make-before-break type. When the actuated buttons are released, the springs 117 and 118 operate in an obvious manner to restore the actuated plungers and their corresponding buttons to normal.

It is apparent from the above description that the spring pile-up consisting of contacts *a* and A responds to the depression of either of the buttons 1 and 2 and that when the button 2 is depressed the operation of the contacts *a* and A is accompanied by the operation of contacts C. Similarly the spring pile-up consisting of contacts *b* and B responds to the depression of either of the buttons 2 and 3 and when the button 3 is depressed the operation of contacts *b* and B is accompanied by the operation of contacts C.

Mounted on the outer face of the telephone set housing 100 in back of the buttons are four designation holders 125 each of which carries a numeral 1, 2, 3 or 4 in alignment with buttons correspondingly numbered in Fig. 2.

In Fig. 1 the key-set described above is schematically illustrated at the upper left and the contacts of the three spring pile-ups indicated in Figs. 2 and 3 bear the same designations in Fig. 1. The subscriber's telephone set has housed therein the dry rectifiers 10 and 12 and the resistance element 13 and these elements are connected to the contacts of the three spring pile-ups as shown in Fig. 1. The telephone equipment usually located at a subscriber's station is designated S and as illustrated is normally connected through the loop indicated by the broken lines to armatures of a cut-through relay 14 by way of the normal contacts *a* and *b* of the key-set KS, the back contacts of the said armatures being normally connected to the secondary winding of transformer 15 whose primary winding is connected to the 60-cycle source of current P. When key button 1 is actuated, the contacts *a* are opened causing the disconnection of the subset S, and contacts A are closed to effectively connect the rectifier 10 across the link extending to the source P (assuming the receiver switchhook contacts at S are closed). This connection extends from the inner upper armature of relay 14, conductor 16, normally closed contacts C of the key-set, rectifier 10, closed contacts A of the key-set, normally closed contacts *b* of the key-set, conductor 17 and the middle lower armature of relay 14. When key button 2 is depressed, the connection effected thereby extends from the inner upper armature of relay 14, conductor 16, resistance 13, rectifier 10, closed contacts A, closed contacts *b*, conductor 17, to the middle lower armature of relay 14. When key button 3 is actuated, the connection effected extends from the inner upper armature of relay 14, conductor 16, resistance 13, rectifier 12, closed contacts B, conductor 17 to the middle lower armature of relay 14. When key button 4 is actuated, the resulting connection extends from the inner upper armature of relay 14, conductor 16, closed contacts C of the key-set KS, rectifier 12, closed contacts B, conductor 17 to the middle lower armature of relay 14. The key button 4, when actuated, also opens contacts *b* which disconnects the subset S from the line. It is apparent from the foregoing that the rectifiers 10 and 12 may be selectively included directly in the signaling circuit separately by the actuation of key buttons 1 and 4, respectively, and each may also be included therein in series with resistance 13 by the operation of key buttons 2 and 3, respectively. Depending upon which of the rectifiers 10 or 12 is connected in circuit and upon whether or not the connection includes the resistance 13, the character of the signaling current is determined and may be either positive or negative half cycles of alternating current of either of two magnitudes.

The signal current receiving circuit includes three relays 18, 19 and 20. Relay 18 is a marginal two-winding relay having one winding connected in parallel with each of the windings of relays 19 and 20. The winding of relay 19 is shunted by rectifier 21 and is connected in series with rectifier 22. Similarly, the winding of relay 20 is shunted by rectifier 23 and is connected in series with rectifier 24. Thus relays 19 and 20 will release respectively when different half waves of alternating current from source P are suppressed and irrespective of whether or not the resistance 13 is included in the signaling circuit. Relay 18, however, will release whenever either half cycles are suppressed, provided the resistance 13 is included in the signaling circuit. Relays 18, 19 an 20 control the operation of relays 25, 26 and 27, which in turn, control the register circuit which includes relays 1', 2', 4' and 8'. The armatures of register relays 1', 2', 4' and 8' are so interconnected as to control the operating circuits for the line connecting relays 31 to 45, inclusive, the relays which would be designated 35 to 42, inclusive, having been omitted from the drawings for purposes of simplicity.

In order that a more complete understanding of the operation of the system disclosed in Fig. 1 may be had, a connection originating at the substation S at which the key-set KS is located, and intended for the substation associated with line 11 will be described in detail.

In practice the subscriber's station S would be provided with a card upon which would be listed the names of the subscribers with whom direct connections may be established, and alongside each name would be indicated the combination of keys or buttons that must be actuated to effect a connection to the particular subscribers. As shown on the table of Fig. 4, the key 1 is actuated twice to effect a connection to line 11.

When the subscriber removes the handset from its support at station S and prior to the actuation of any key of the key-set KS both half waves of alternating current from source P flow through the substation equipment in an obvious circuit which includes the normally closed contacts *a* and *b* of the key-set. Relays 18, 19 and 20 would accordingly operate since both half waves are transmitted and the resistance 13 is not included in the circuit. It will be observed that when both relays 19 and 20 are operated at the same time the operating circuit for relay 25 is opened and no signal is recorded. The signaling code is so devised that each station selection requires the transmission of two signal components, either of which may include one or the other polarity of the signaling current but not both polarities. The armatures and contacts of relays 19 and 20 are so interconnected that the simultaneous operation of both relays does not result in false signaling.

The subscriber next actuates the key button 1 twice in accordance with the instructions printed or otherwise displayed on the card located at the station S. When key 1 is actuated the contacts A are closed and contacts *a* opened. The latter disconnect the subset S and the former connect rectifier 10 in the signaling circuit. Rectifier 10 is so poled as to suppress the positive half cycles and to permit the passage of the negative half cycles only. Thus the relays 18 and 20 hold operated while relay 19 releases. The circuit in which relay 20 holds operated extends from the lower terminal of transformer 15, winding of relay 20, rectifiers 24 and 21, back contact and middle lower armature of relay 14, conductor 17, normal contacts *b*, closed contacts A, rectifier 10, normal closed contacts C, conductor 16, inner upper armature and back contact of relay 14, to the upper terminal of transformer 15. The right-hand winding of relay 18 being connected in parallel with the winding of relay 20 is also energized by the negative half cycles of current and remains operated. Thus the depression of key button 1 causes the suppression of the positive half cycles and the consequent release of relay 19 which operates only on the positive half cycles.

With relay 19 released and relay 20 still operated, slow operating relay 25 operates in a circuit extending from grounded battery, armature and front contact of relay 20, back contact and right-

hand armature of relay 19, winding of relay 25 to ground. Relay 25, at its outer right armature and front contact establishes an obvious operating circuit for relay 27. At its inner left armature and front contact relay 25 completes a circuit extending from grounded battery, left armature and back contact of relay 19, inner left armature and front contact of relay 25, innermost left armature and back contact of relay 26, conductor 50 to ground through the winding of register relay 1'. When relay 27 operated as mentioned above, it established an obvious locking circuit for itself to battery 51 associated with the normal make-before-break contacts of relay 14, and at its outermost armature it furnishes locking battery for register relay 1'. This register relay accordingly, is now operated and locked under control of relay 27 which, in turn, is locked operated under control of relay 14.

When the key 1 of key-set KS restores to normal the contacts A are opened and contacts *a* reclosed. The circuit is thus in the same condition it was in prior to the actuation of key 1 in which both half waves of alternating current traverse the signaling circuit. Thus the positive half waves, being no longer suppressed, cause relay 19 to reoperate while relays 18 and 20 remain operated. The reoperation of relay 19 causes relay 25 to restore its armatures. Relays 27 and 1', however, remain operated, being locked as described above.

When relay 25 restores its outer right armature and with relay 27 locked operated, relay 26 operates in a circuit extending from grounded battery, outer right armature and back contact of relay 25, middle armature and front contact of relay 27, winding of relay 26 to ground. Relay 26 in attracting its two inner left armatures transfers the armature contacts of relay 25 from the windings of register relays 1' and 2' to the windings of register relays 4' and 8' to prepare these relays to register the signal component transmitted when the second key or button is actuated, or in the case being described, to register the signal component transmitted incident to the second operation of key button 1. Relay 26 also locks to battery 51.

When key button 1 is reactuated, the contacts A are again closed and contacts *a* opened. The positive half cycles of current from the source P are again suppressed due to the inclusion of the rectifier 10 in the signaling circuit, so that relay 19 again releases and relays 18 and 20 hold operated. Relay 25 accordingly reoperates. A circuit may now be traced from grounded battery, left armature and back contact of relay 19, inner left armature and front contact of relay 25, innermost left armature and front contact of relay 26, conductor 52, winding of register relay 4' to ground. Relay 4' locks to battery at the outermost armature and front contact of relay 27, which relay 27, as above described, is locked operated to battery 51.

When the operation of relay 26 was followed by the reoperation of relay 25 incident to the second operation of key button 1 of the key-set KS a circuit was established extending from grounded battery, inner right armature and front contact of relay 25, outermost left armature and front contact of relay 26, to ground through the upper winding of cut-through relay 14 which is slow-to-operate. Relay 14 operates in this circuit and in attracting its outermost lower armature transfers the battery 51 from the holding circuits for relays 26 and 27 to the holding circuits for register relays 1', 2', 4' and 8'. The contacts controlled by the outermost lower armature of relay 14 are of the make-before-break type so that the locking circuits for the register relays are completed before the locking circuits for relays 26 and 27 are interrupted. Thus the operated register relays 1' and 4' are held operated when the original locking circuits therefor are opened by the release of outermost left armature of relay 27.

With register relays 1' and 4' and cut-through relay 14 operated, an energizing circuit for line connecting relay 31 is completed. This circuit extends from grounded battery, outer upper armature of relay 14, conductor 54, winding of relay 31, conductor 65, back contact and third right armature of register relay 8', front contact and second right armature of register relay 4', back contact and first right armature of register relay 2', front contact and right armature of register relay 1' to ground. Relay 31, in operating, connects the line 11 to the link L, which by way of the first upper and lower armatures of relay 14 and their associated front contacts, is connected to the line extending to the calling station S.

The register relays 1' and 4' which cause the operation of line connecting relay 31 are now held operated under the control of cut-through relay 14 which is now held operated under control of the subscriber's switchhook contacts. This holding circuit for relay 14 may be traced from grounded battery 55, conductor 56 of the link L, front contact and inner upper armature of relay 14, through the telephone circuit at station S, contacts *a* and *b* of the key-set KS, conductor 17, lower winding of relay 14, conductor 57 of link L, to ground at 58.

At the back contact of the inner upper armature and the back contact of the middle lower armature of relay 14, the alternating current source P is disconnected from the line extending to station S and all relays, other than register relays 1' and 4', line connecting relay 31, and cut-through relay 14 are returned to their normal unoperated condition. At the termination of the call the telephone handset at station S is restored to its mounting thus causing the release of relay 14 which, in turn, causes register relays 1' and 4' and the line connecting relay 31 to be deenergized.

It is deemed unnecessary to trace through the operation of the circuits for each of the fifteen connections which may be completed by means of the key-set KS, since the table disclosed in Fig. 4 clearly indicates the key-set contacts operated for each key combination employed; the register relays which respond to such contact operations; and the line selected by the various combinations of register relays operated. It may be well, however, to briefly describe the circuit operations involved in a connection which involves the contacts C of the key-set since such contact operation results in the release of marginal relay 18 of the signal receiving circuit. It will be assumed, therefore, that the subscriber at station S desires to communicate with the party whose station is located on the line 42 and, in accordance with the table of Fig. 4, first operates key 4 and then operates key 3 after having removed the handset from its support.

The operation of key 4 closes contacts B and opens contacts *b*, the former connecting the

rectifier 12 in the signaling circuit and the latter opening one side of the subscriber's substation circuit. As in the previously described case, relays 18, 19 and 20 operate when the handset is removed from its mounting at station S. When key 4 is depressed the contacts B connect the rectifier 12 in circuit, which rectifier is poled so as to suppress the negative half cycles of current from the source P. With the negative half cycles suppressed, the positive half cycles traverse a path extending from the upper terminal of the secondary winding of transformer 15, back contact and inner upper armature of relay 14, conductor 16, normally closed contacts C of the key-set KS, rectifier 12, closed contacts B, conductor 17, middle lower armature and back contact of relay 14, rectifier 22, winding of relay 19, rectifier 23, to the lower terminal of the secondary winding of transformer 15. Relay 19 accordingly remains operated as does also marginal relay 18 whose left winding is connected in parallel with the winding of relay 19. Relay 20, however, releases due to the suppression of the negative half cycles.

Relay 25 now operates in a circuit extending from grounded battery, back contact and armature of relay 20, front contact and right armature of relay 19, winding of relay 25 to ground. Relay 25, operated, performs the same functions performed thereby in the previous description incident to the first operation of key 1. Relay 27 operates and locks to battery 51, and at its outermost armature and front contact supplies locking battery for the register relays 1', 2', 4' and 8'. It will be observed that with both relays 18 and 19 in their operated condition the battery associated with their right and left armatures, respectively, is disconnected from the left armatures of relay 25 so that neither of the register relays 1' and 2' finds an energizing circuit. Thus, no register relay functions incident to the depression of key 4. Relay 27 is held operated as described.

When the key 4 is released both half cycles of current are again free to traverse the signal receiving circuit and relays 18 and 19 remain operated and relay 20 reoperates. Relay 25 accordingly releases its armatures, causing relay 26 to operate in a circuit from grounded battery, outer right armature of relay 25, middle armature and front contact of relay 27, winding of relay 26 to ground.

Relay 26, at its right armature and front contact locks to battery 51, and at its two inner left armatures transfers the left contacts of relay 25 from register relays 1' and 2' to register relays 4' and 8' whereby the latter two relays become available to register the signal component transmitted incident to the operation key 3 of the key-set.

The operation of key 3, as described earlier in the specification and as schematically shown in Fig. 1, causes contacts C to open, contacts B to close, and contacts *b* to open. Contacts *b* open one side of the subscriber's subset connection, contacts B connect the rectifier 12 in the signaling circuit, and contacts C remove the short from resistance 13. Thus the negative half cycles are suppressed and the positive half cycles continue to flow but at reduced magnitude due to the inclusion of the resistance 13 in the circuit. Relays 18 and 20 accordingly release, the former due to the fact that the current value of the positive half cycles is reduced beyond that required to maintain the relay operated.

Relay 25 operates as before. A circuit may now be traced from grounded battery, armature and back contact of relay 18, outer left armature and front contact of relay 25, middle left armature and front contact of relay 26, conductor 60, winding of register relay 8' to ground. Relay 8' operates in this circuit and locks to battery at the outermost armature and front contact of relay 27. Cut-through relay 14 operates in the manner previously described and performs the same functions ascribed to it hereinbefore, which functions include the completion of a substitute locking circuit for register relay 8'.

With relays 8' and 14 operated, line connecting relay 45 operates in a circuit extending from grounded battery, outer upper armature of relay 14, conductor 54, winding of relay 45, outermost right front contact and armature of register relay 8', outermost right back contact and armature of register relay 4', outer right back contact and armature of register relay 2', back contact and right armature of register relay 1' to ground. Relay 45 connects the line 43 to the link L which, as a result of the operation of relay 14, is connected to the line extending to the calling station S. The remainder of the circuit operations are identical to those described in connection with the seizure of line 11.

If desirable, each of the buttons 1, 2, 3 and 4 of the key-set may be provided with a separate spring for maintaining it in its normal unoperated position. When such individual springs are provided the buttons 1 and 4 will remain in their normal positions where their respective plungers 108 are depressed incident to the actuation of buttons 2 and 3, respectively.

It is to be understood that no attempt has been made to illustrate instrumentalities which may be employed in signaling the called line or for tripping the ringing current incident to the response of the called party since such devices and their control are well known in the art and do not constitute a part of the present invention. It is also understood that the relay 14 may take other forms and may be included in the line circuit in a manner different from that illustrated where relatively long line loops are encountered.

What is claimed is:

1. In a signaling system in which a station designation is characterized by a two-interval code signal consisting of two distinct components, each of which may comprise positive half cycles of either of two intensities or negative half cycles of either of two intensities, the combination of a line, a source of alternating current, means for connecting said source to said line to cause said line to be traversed by positive and negative half cycles of a particular intensity, and a designation transmitter comprising a plurality of manually operable keys, contact sets fewer in number than said keys, a rectifier connectable to said line by one of said contact sets, when operated, to suppress positive half cycles from said line, a rectifier connectable to said line by another of said contact sets, when operated, to suppress negative half cycles from said line, a resistance connectable in series with either of said rectifiers by a third of said contact sets to alter the intensity of the unsuppressed half cycles, an operating device for each of said first two contact sets, and a pair of operating devices for said third contact set, the operating device for each of said first two contact sets being mechanically coupled to a different one of the operating devices for said

third contact set and each of said operating devices being operable by a different one of said keys.

2. In a signaling system in which station identifying code signals are characterized by two sequentially transmitted signal components each comprising positive or negative half cycles of alternating current of either of two magnitudes, the combination of a station, a line extending therefrom, a source of alternating current associated with said line, and a signal transmitter at said station comprising a pair of oppositely poled rectifiers, a separate set of contact springs for controlling the connection of each of said rectifiers to said line, a resistance, a single set of contact springs for effectively including said resistance in series with either of said rectifiers, a manually operable key for each of said first sets of contact springs, and a pair of individually manually operable keys for said last set of contact springs, each key of said pair of keys being mechanically coupled to a different one of said first keys whereby the operation of either of said pair of keys results in the operation of said resistance controlling contact springs and also of a particular one of said rectifier controlling contact springs.

3. The combination in a signaling system of a line, a source of alternating current, a station on said line, means at said station for connecting said source of current to said line whereby both positive and negative half cycles of alternating current from said source traverse said line at full intensity, means at said station for selectively suppressing the positive and negative half cycles of said source and for altering the intensity of the unsuppressed half cycles comprising a first rectifier, a second rectifier, a resistance, a spring pile-up having a normally open contact connected to one terminal of one of said rectifiers, a spring pile-up having a normally open contact connected to one terminal of the other of said rectifiers, a spring pile-up having normally closed contacts each connected to a different terminal of said resistance, the other terminals of said rectifiers being permanently connected to one terminal of said resistance whose other terminal is connected to one of the conductors of said line and each of said first two spring pile-ups having a contact normally connected to the other conductor of said line, means individual to each of said spring pile-ups for effecting their operation, a key for each of the operating means of said first two spring pile-ups, and a pair of individually operable keys for the operating means of said third spring pile-up, the operating means of each key of said pair of keys being mechanically coupled to the operating means of a different one of said first two keys, whereby the operation of one of said pair of keys actuates the operating means of said third spring pile-up and also the operating means of one of said first spring pile-ups.

4. The combination in a code transmitter for use in a selective signaling system in which code signals are characterized by two signal components each consisting of either positive or negative half cycles of either of two intensities derived from an alternating current source, of means including a first set of contact springs for positively characterizing a signal component, means including a second set of contact springs for negatively characterizing a signal component, means including a third set of contact springs for determining the intensity of a signal component, a depressible operating device for each of said first two sets of contact springs, a pair of depressible operating devices for said third set of contact springs, means mechanically coupling the operating devices of said first and second sets of contact springs individually with a different one of said pair of operating devices so that the depression of either one of said pair of operating devices results in the simultaneous depression of the corresponding operating device of said first or second set of contact springs and the depression of either of the operating devices of said first or second set of contact springs is ineffective to cause the depression of the corresponding one of said pair of operating devices, and manually operable means individual to each of said operating devices for causing the depression thereof.

5. A code transmitter of the push-button type for transmitting fifteen different two-component signals incident to the depression of any one button twice or of any two buttons successively, comprising only three sets of signal-characterizing contact springs, only four push buttons, an operating member for each set of contact springs, the operating member for each of a first two of said sets of contact springs being operable directly by a different one of said four buttons, a pair of depressible devices each operable directly by a different one of the remaining two buttons, and means carried by each of said depressible devices for effectively coupling the operating member of the third set of contact springs and the operating member of a different one of the other set of contact springs, whereby the operation of either of said depressible devices by its corresponding button causes the simultaneous operation of an operating member of one of said first two sets of contact springs and the operating member of said third set of contact springs, and whereby the operation of a button corresponding to either of the operating members of said first two sets of contact springs causes only the operation of the said corresponding operating member and of the set of contact springs corresponding thereto.

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