Dec. 18, 1923. 1,478,008

J. B. HARLOW

SIGNALING SYSTEM

Filed July 5, 1919 2 Sheets-Sheet 1

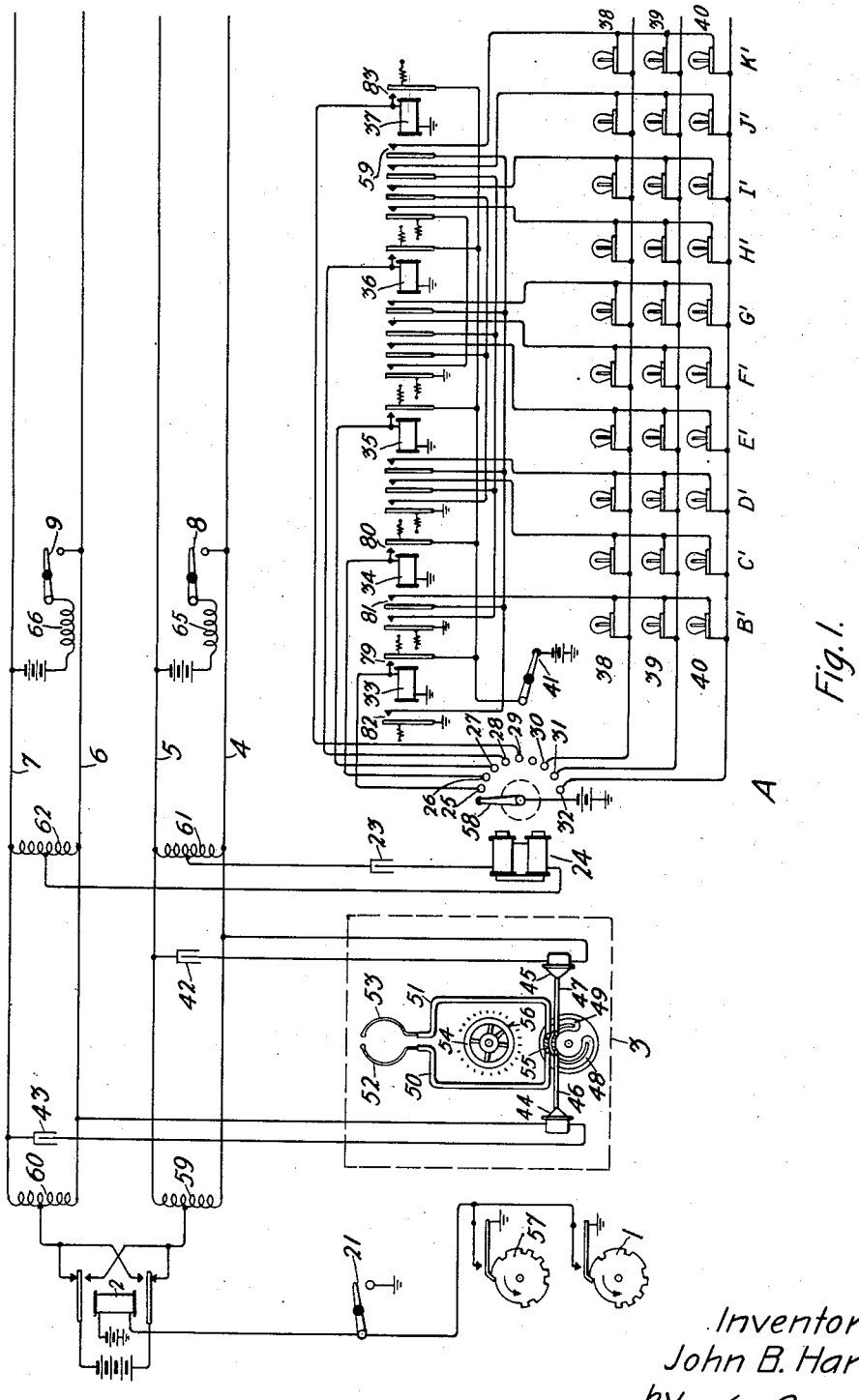


Fig. 1.

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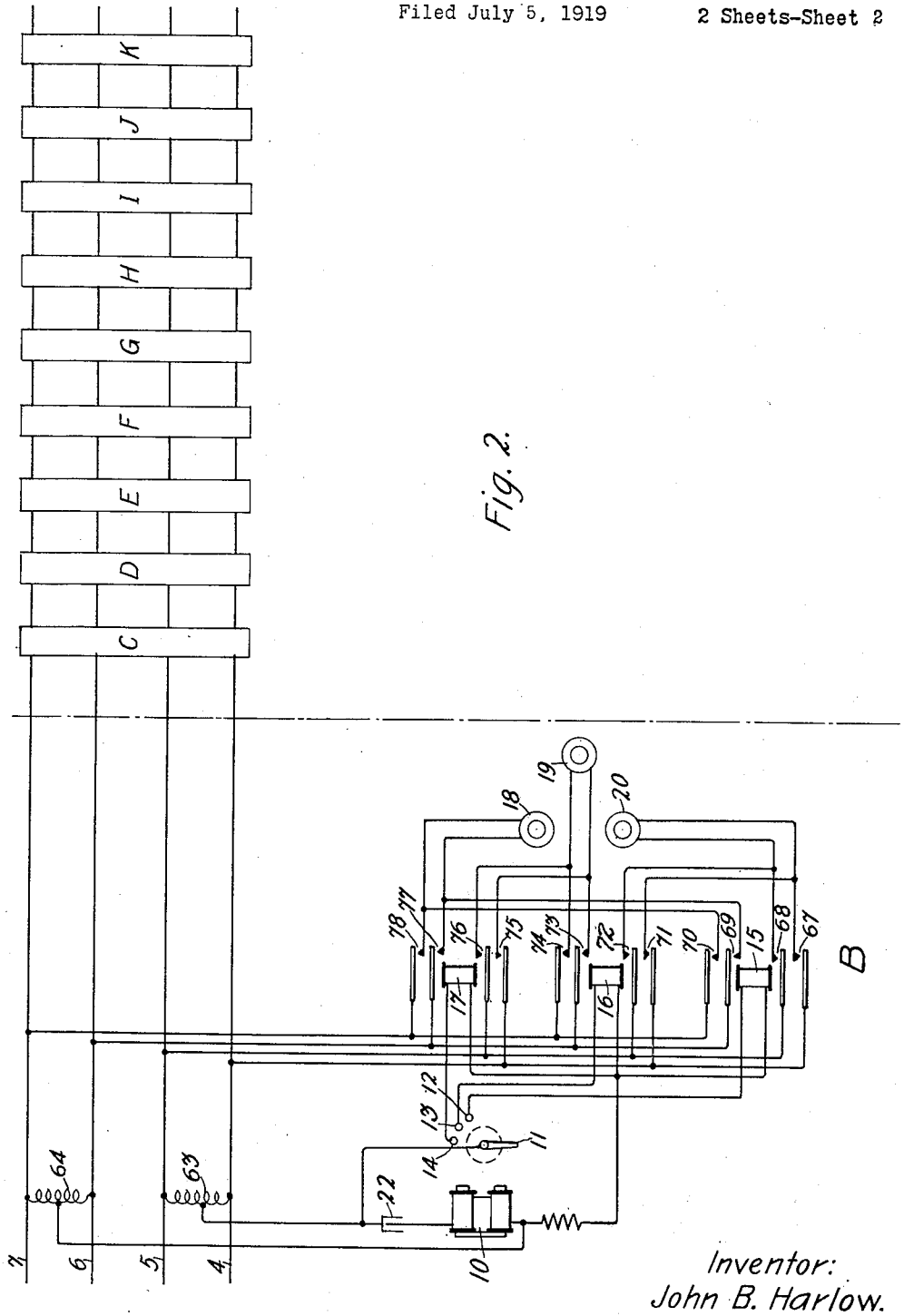


Fig. 2.

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Patented Dec. 18, 1923. 1,478,008

UNITED STATES PATENT OFFICE.

JOHN B. HARLOW, OF UPPER MONTCLAIR, NEW JERSEY, ASSIGNOR TO WESTERN ELECTRIC COMPANY, INCORPORATED, OF NEW YORK, N. Y., A CORPORATION OF NEW YORK.

SIGNALING SYSTEM.

Application filed July 5, 1919. Serial No. 308,755.

To all whom it may concern:

Be it known that I, JOHN B. HARLOW, a citizen of the United States, residing at Upper Montclair, in the county of Essex, State of New Jersey, have invented certain new and useful Improvements in Signaling Systems, of which the following is a full, clear, concise, and exact description.

This invention relates to signaling systems and particularly to such systems employed in the selection of a plurality of stations from a selecting station.

In such systems, especially when a plurality of selectable stations are associated with the same circuit, it is desirable that a positive indication be given at the selecting station identifying the selected station. In case a plurality of selectable devices are associated with each station, it is further desirable that the indicating means at the selecting station also definitely identify the selected device.

It is an object of the present invention to provide a signaling system of this nature in which a common device at the selecting station, operating synchronously with the station and device selecting means, produces signals identifying the selected device and station.

To attain this object in accordance with one feature of the invention, in a system in which electro-responsive switching devices associated with a plurality of stations selectively respond to current impulses transmitted from a selecting station, there is provided a common device responding to the selecting impulses and producing an identifying signal upon the selection of a device at a station by the associated switching device.

This and other features not specifically mentioned above will clearly appear from the following specification and the annexed drawings, Figs. 1 and 2 of which, when placed end to end with Fig. 1 at the left, show one embodiment of the invention.

The invention is shown on the drawings as applied to a system for the detection of the presence of a submarine or other marine vessel, in which system a plurality of stations, each comprising a plurality of detectors are distributed throughout the area under observation, each detector of the system being responsive to mechanical vibrations propagated through the water from the submarine or other vessel. However, it is evident that the invention may be applied to any switching and signaling system in which a plurality of devices located at each of a plurality of stations are individually selectable from a selecting station.

Referring to the drawing, at an observer's station A, which may be located at some convenient point on the shore, there is provided a plurality of multiply connected sending devices, such as 1 and 57, controlling a reversing relay 2, adapted to impress alternating current impulses upon a phantom circuit comprising side or physical transmission line circuits 4—5 and 6—7. Each detecting station B to K inclusive, is provided with apparatus as shown for station B in Fig. 2, comprising a selector 10 of any suitable type adapted to advance step by step in response to closely succeeding impulses of current of reversed polarity. The selectively operated circuit controlling device disclosed in Patent No. 1,343,256, issued June 15, 1920 to Joseph C. Field may be used to advantage in this connection when adjusted to be mechanically retained in any one of a plurality of selectable positions. Each such selector is adapted to be selectively and individually retained in an advanced position with its arm 11 engaging contact 12 upon the cessation of a predetermined series of such closely succeeding impulses impressed upon the phantom circuit, due to the actuation of a particular sending device 1, provided for selecting the associated station. Additional impulses of a similar character in response to the actuation of common switch 21, cause the desired selector to similarly and successively engage its associated contacts 13 and 14. By the engagement of the various contacts, relays 15, 16 and 17 selectively control the association of detectors 18, 19 and 20 in various pairs with the side circuits comprising conductors 4—5 and 6—7 and their associated simplexing coils 59 to 64 of any usual type. These detectors, which may be of any suitable type, responsive to mechanical vibrations propagated through the water to vary the electrical conditions of a circuit may be and preferably are supported in a triangular arrangement by a suitable fixedly positioned tripod or other framework. A selector 24 of a type similar to selector 10 but adjusted to be mechanically retained in several additional

advanced positions, is also associated with the phantom circuit at the observer's station. An arm 58 of selector 24 selectively engaging contacts 25 to 32 inclusive, controls the illumination of detector pair indicating lamps 38, 39 and 40 for each station through the cooperation of locking relays 33 to 37 inclusive, and a locking key 41. Locking keys 8 and 9 supply current through suitable impedance means to the physical line circuits 4—5 and 6—7 respectively, and the current variations produced in such circuits in response to the vibrations of the detectors when associated therewith, are transmitted through condensers 42 and 43 to the windings of receivers 44 and 45 respectively, of binaural observation set 3. The sounds produced in receiver 44 in response thereto are conveyed to the ear piece 52 through serially interconnected air tubes 46, 48 and 50, while the sounds produced in receiver 45 are conveyed to ear piece 53 through serially interconnected air tubes 47, 49 and 51. A hand-wheel 54 controls a movable stop member 55 for adjusting the relatively effective lengths of variable air tubes 48 and 49, the position of such member being indicated by a pointer 56 moving with the hand-wheel.

It is thought that the invention may be more fully comprehended from the following description of the operation of the system shown on the drawing.

Assuming that it is desired to select station B for observation, sending device 1 is actuated to cause relay 2 to transmit a predetermined series of impulses of current arranged in predetermined groups of closely succeeding reversed current impulses, over a phantom circuit comprising side circuits or physical transmission line circuits 4—5 and 6—7. The first closure of the contact of the sending device causes the operation of relay 2 over a circuit extending from battery, through the winding of relay 2, and the contact of sending device 1 to ground. The opening of the normal contacts of relay 2 interrupts the normal current supply for the phantom circuit and the subsequent closure of the alternate contact supplies current of reversed polarity to the phantom circuit. All station selectors, such as 10, and the master selector 24 advance one step in response thereto due to the receipt of the impulse through associated condensers 22 and 23 respectively. However, the contact of the sending device is maintained closed for a relatively long period, and since none of the selectors is adjusted to be retained in its advanced position, all selectors return to normal. This preliminary set of impulses serves to restore to normal any selector which may have been previously operated. When the spring member of the sending device engages the first notch thereof, the contact is opened to release relay 2 to transmit an impulse of the same polarity over the phanton circuit. As the spring member leaves the engaged notch, the contact is again closed to reoperate relay 2 to transmit another reversed current impulse over the phantom circuit. Due to these two closely succeeding current impulses, all selectors are advanced two steps, and due to their adjustments, selectors 10 at stations B, D, G and K are mechanically retained in such advanced positions although the other selectors 10 restore to normal due to the fact that the sending device contact is maintained closed for a relatively long period in connection with the last impulse. Due to its adjustment, selector 24 simultaneously advances two steps and is mechanically retained in such advanced position with the arm 58 engaging contact 25. Slow operating relay 33 thereupon operates over a circuit extending from battery, through the arm 58 and the engaged contact 25 of the selector 24, and the winding of the relay 33 to ground. Such relay is locked over a circuit extending from battery, through the contact of key 41, contact 79 and winding of relay 33 to ground. The spring member of sending device 1 subsequently engaging and disengaging the next notch of the wheel as before, causes the transmission of two closely succeeding reversed current impulses, the contact of the sending device remaining closed for a relatively long period in connection with the last impulse. As before, all selectors 10 except those at stations B, D, G, and K, advance two steps from their normal positions and immediately restore to normal, while selectors 10 at stations D, G, and K advance two steps from their previously retained positions but since these selectors are not adjusted to be retained at these advanced positions they also return to normal. However, selector 10 at station B being adjusted for this position is individually retained in its advanced position. Selector 24 in response to these impulses also advances two steps, its arm 58 leaving contact 25 upon the first step and engaging contact 26 upon the second step where it is retained. Slow operating relay 34 thereupon operates over a circuit extending from battery, through the arm 58 and the engaged contact 26 of selector 24 and the winding of relay 34 to ground. A locking circuit established from battery, through contact of key 41 and contact 80 and winding of relay 34 to ground maintains such relay in an operated condition.

The continued actuation of the sending device 1 causes the transmission of nine closely succeeding impulses of reversed current over the phantom circuit, the last of such impulses being of relatively long duration. All station selectors 10, except that at station B, advance nine steps from their

normal positions in response thereto and none being adjusted to be retained in such advanced positions all are restored to normal. However, selector 10 at station B is advanced nine steps from its previously retained position and individually retained in such advanced position with its arm 11 within one step of contact 12. Selector 24 is also advanced nine steps from its previously retained position, wherein its arm 58 was in engagement with contact 26, to a mechanically retained position in which its arm 58 is within one step of contact 30, the arm 58 passing over contacts 27, 28 and 29 so rapidly that slow operating relays 35, 36 and 37 associated with such contacts do not operate.

The switch 21 is then closed to operate relay 2 over a circuit extending from battery, through the winding of relay 2 and the switch 21 to ground, thereby transmitting one reversed current impulse over the phantom circuit. Selector 10 at station B in response thereto advances its arm 11 to engage contact 12, in which position it is mechanically retained, thereby bridging relay 15 across the phantom circuit. Such relay operates due to the current supplied from coils 63 and 64 and in closing its contacts 67 and 68 bridges detector 20 across the physical transmission line or side circuit 4—5, and in closing its contacts 69 and 70 bridges detector 18 thereat across the physical transmission line or side circuit 6—7. Other station selectors advance one step and restore to normal without material effect upon the system. Selector 24 also advances one step and is held with its arm 58 engaging contact 30. Lamp B'38 is lighted over a circuit extending from battery, through the arm 58 and the engaged contact 30 of selector 24, the lamp 38 and contact 81 of relay 34 and contact 82 of relay 33 to ground. The illumination of this lamp indicates to the observer that a pair consisting of detectors 18 and 20 at station B has been selected.

Key 8 is then closed to supply current to detector 20 over a circuit established from battery, through conductor 5, contact 68 of relay 15, the current-varying device of detector 20, not shown but which may be of any suitable character, contact 67 of relay 15, conductor 4, the contact of key 8 and retardation coil 65 to the other side of battery. Key 9 is also closed to complete a similar circuit for detector 18 from battery, through conductor 7, contact 70 of relay 15, the current-varying device of detector 18 contact 69 of relay 15, conductor 6, the contact of key 9 and retardation coil 66 to the other side of battery.

The current variations produced in such circuits in response to the vibrations of detectors 18 and 20 flow through condensers 43 and 42 to the windings of receivers 44 and 45 respectively, of observation set 3. Stop member 55 is then adjusted by means of hand-wheel 54 to vary the relatively effective lengths of air tubes 48 and 49 until the observer, listening binaurally to the sounds conveyed from the receivers 44 and 45 and emitted from ear pieces 52 and 53 in response to the vibrations of the detectors, receives the impression that the source of sound is straight ahead. The position of pointer 56, in relation to its associated graduated scale when this adjustment has been secured, indicates the angular relation of the observed source of vibration to a base line joining the responsive members of detectors 18 and 20.

Switch 21 is then opened, releasing relay 2 to transmit a single reversed current impulse over the phanton circuit and through condenser 22, thereby causing selector 10 at station B to advance one step, its arm 11 disengaging contact 12 and subsequently engaging contact 13. Relay 15 at station B is released to disconnect detectors 18 and 20 from the side circuits, and relay 16 being bridged across the phantom circuit is operated due to the current present in such circuit, the closure of contacts 73 and 74 thereof bridging detector 19 across the physical line 6—7 and the closure of contacts 71 and 72 thereof bridging detector 20 across physical line 4—5. Other station selectors advance one step and restore as before.

Selector 24 also, in response to the single impulse, advances one step whereby arm 58 disengages contact 30 to extinguish lamp B'38 and subsequently engages contact 31 to cause the lighting of lamp B'39 over a circuit established from battery, through arm 58 and engaged contact 31 of selector 24, lamp 39, contact 81 of relay 34 and contact 82 of relay 33 to ground. The illumination of lamp B'39 indicating that detectors 19 and 20 at station B have been selected, the observer then proceeds, as previously described, to binaurally observe the sounds produced by receivers 44 and 45 in response to the vibrations of the selected detectors. The operating circuits for the detectors are similar to those previously described for detectors 18 and 20 except for the substitution of the contacts of relay 16 for those of relay 15.

The position of pointer 56 indicating the angular relation of the source of vibrations to a base line joining detectors 19 and 20 at station B having been noted, switch 21 is closed. Relay 2 operates to transmit a single reversed current impulse over the phantom circuit. Selector 10 at station B advancing one step in response thereto causes arm 11 to disengage contact 13 and to subsequently engage contact 14, releasing

relay 16 to disconnect detectors 19 and 20. Relay 17 being bridged across the phantom circuit by the engagement of contact 14 operates due to the current in the phantom circuit, the closure of contacts 77 and 78 of such relay bridging detector 18 across the physical line 6—7 and the closure of contacts 75 and 76 thereof bridging detector 19 across physical line 4—5. The operating circuits for detectors 18 and 19 are similar to those previously described for detectors 18 and 20 except for the substitution of the contacts of relay 17 for those of relay 15. As before, other station selectors advance one step and restore to normal. Selector 24 also advances a single step, whereby arm 58 disengages contact 31, extinguishing lamp B'39 and subsequently engages contact 32, lighting lamp B'40 over a circuit extending from battery, through arm 58 and engaged contact 32, the lamp 40, contact 81 of relay 34, and contact 82 of relay 33 to ground. The illumination of lamp B'40 indicating that detectors 18 and 19 at station B have been selected, the observer, as previously described, binaurally observes the sound produced in receivers 44 and 45 in response to the vibrations of the selected detectors. The position of pointer 56, indicating the angular relation of the source of vibration to a base line joining detectors 18 and 19 at station B having been noted, switch 21 is opened. Relay 2 in releasing transmits a single reversed current impulse over the phanton circuit to release selector 10 at station B and selector 24. The other selectors are advanced one step in response thereto but also return to normal. Key 41 is then momentarily released to release relays 33 and 34, and upon its subsequent closure, the system is in condition for further selections.

Assuming that it is desired to observe the operation of detectors 18, 19 and 20 at station K, the proper sending device such as 57 is actuated. This sending device, after producing one non-effective impulse as before, transmits two closely succeeding reversed current impulses followed, after a relatively long period, by eight closely succeeding impulses which are likewise followed after a similar relatively long period by three closely succeeding impulses. As before, all selectors advance one step in response to each impulse and in response to the first group of closely succeeding impulses selectors 10 at stations B, D, G and K are mechanically retained in their advanced positions, while the other station selectors restore to normal. The second group of eight impulses advances all non-retained station selectors a corresponding number of steps from normal. Selectors at stations E, F and H being adjusted for such series of impulses are retained in their advanced positions, while the selectors at stations C, I and J restore to normal. Selectors 10 at stations B, D, G and K are advanced eight steps from their previously maintained positions. However, selectors at stations B, D and G not being adjusted to be retained at this position are restored to normal. In response to the last group of three impulses, all station selectors 10 advance three steps from their normal or previously retained positions respectively. However, selector 10 at station K is individually adjusted to be maintained in this position, all other selectors restoring to normal. As described in connection with the selection of station B, the arm 11 of selector 10 at station K is then maintained within one step of the associated contact 12.

As before, in response to the first group of two closely succeeding impulses, selector 24 advances until its arm 58 rests upon contact 25, thereby operating locking relay 33 as previously described. In response to the second series of eight impulses, the arm 58 of selector 24 passes over contacts 26, 27 and 28 so rapidly that the associated slow operating relays 34, 35 and 36 do not operate and rests upon contact 29 to cause the operation of slow operating relay 37 over a circuit established from battery, through arm 58 and engaged contact 29 of selector 24 and the winding of relay 37 to ground. Such relay is locked over a circuit extending from battery, through the contact of key 41, contact 83 and winding of relay 37 to ground. As previously described, switch 21 is then opened and closed to transmit suitable impulses over the phantom circuit for associating detectors 18, 19 and 20 at station K in various pairs with the physical lines 4—5 and 6—7 and the response of such detectors is binaurally observed through the medium of the observation set 3. The pairs under observation are indicated in each instance, as previously mentioned, by the lighting of lamps K'38, K'39 and K'40 over obvious circuits including contact 59 of relay 37 and contact 82 of relay 33, which circuits are completed upon the engagement of arm 58 with contacts 30, 31 and 32 respectively.

Selector 10 at station K and selector 24 at station A are then released by the proper operation of the switch 21, and relays 33 and 37 are released by the momentary opening of key 41 as previously described. Other stations may be selected and the detectors thereat subjected to observation as desired, the detailed description of the operation followed in the selection of such other stations being omitted since the above-mentioned instances may be considered as typical.

While it is understood that many other arrangements of grouped impulses may be employed, the following table represents one

set of codes which may be used for selecting the stations of the system shown on the drawings, the locking relays which operate, controlled by the selector 24, being indicated in each instance.

Station.	Code.	Relays.
B	2—2—9	33 and 34
C	4—2—7	34 " 35
D	2—4—7	33 " 35
E	6—2—5	35 " 36
F	4—4—5	34 " 36
G	2—6—5	33 " 36
H	8—2—3	36 " 37
I	6—4—3	35 " 37
J	4—6—3	34 " 37
K	2—8—3	33 " 37

It is evident that with the present invention the operator at one station of a multiple station system may automatically receive an identifying signal for each of a plurality of devices which may be selected at a plurality of stations.

What is claimed is:

1. In a signaling system, a plurality of interconnected groups of sound responsive devices, means for selectively controlling any group of sound devices and also any pair of devices of any group, a plurality of signaling devices, and switching means the operation of which is initiated by the group selection and completed by the selection of said sound responsive devices in pairs to selectively operate said signaling devices to indicate the particular sound responsive devices selected.

2. In a selective signaling system, a line circuit, a selecting station and a plurality of way-stations associated therewith, a plurality of sound responsive devices at each way-station, means at the selecting station for selectively impressing successive alternating current impulses upon the line, a selector at each way-station responding to such impulses and locking upon the receipt of a predetermined number and arrangement of impulses, means responsive to additional impulses to select and render effective an associated sound responsive device, and means at the selecting station to identify the device selected.

3. A selective signaling system comprising a line circuit, a selecting station and a plurality of way stations associated with said line circuit, means at the selecting station for supplying current of alternate polarity to the line, a step-by-step selector at each way station responsive to such impulses, a plurality of electrical devices at each way station selectively controlled thereby, a step-by-step selector at the selecting station controlled by said impulses, and an identifying signal controlled by said step-by-step device at the selecting station to indicate the particular way station and the particular devices selected.

4. In a signaling system, a signaling circuit, a receiving station including a signal receiving means associated therewith, a plurality of transmitting stations also associated with the circuit, a plurality of signal transmitters at each transmitting station, means at the transmitting stations controlled by code impulses impressed upon the signaling circuit to selectively associate signal transmitters with the circuit, and means at the receiving station also responsive to said code impluses to identify the particular transmitting station and the particular signal transmitter selected.

5. In a selective signaling system, an electric circuit interconnecting a selecting station and a plurality of selectable stations, means at the selecting station for transmitting current impulses over said circuit, an electromagnetic step-by-step selector at each selectable station responsive to such current impulses received over the circuit to advance into any one of a plurality of predetermined positions, an electromagnetic step-by-step selector at the selecting station also responsive to such current impulses, two groups of contacts for the second mentioned selector selectively engaged by a contact arm thereof, relays controlled by the engagement of the arm with the contacts of one group for preparing circuits to be completed by the subsequent engagement of the arm with contacts of the second group, and signaling means controlled by such circuits for identifying the position occupied by the simultaneously operated selectable station selector.

6. In a selective signaling system, an electric circuit interconnecting a selecting station and a plurality of selectable stations, means at the selecting stations for transmitting current impulses over said circuit, an electromagnetic step-by-step selector at each selectable station responsive to such current impulses received over the circuit to advance into any one of a plurality of predetermined positions, an electromagnetic step-by-step selector at the selecting station also responsive to such current impulses, two groups of selectively attained advanced positions for the second mentioned selector, and signaling means controlled by the advancement of such selector into a position of one group followed by the advancement thereof into a position of the second group to identify the position occupied by the selectable station selector simultaneously advanced to one of its predetermined positions.

7. In a selective signaling system, an electric circuit interconnecting a selecting station and a plurality of selectable stations, means at the selecting station for transmitting current impulses over said circuit, an electromagnetic step-by-step selector at each selectable station responsive to such current impulses received over said circuit to advance into any one of a plurality of prede-

termined positions, an electromagnetic step-by-step selector at the selecting station also responsive to such current impulses, a group of selectively attained advanced positions for the selector at the selecting station, a relay selectively operated and locked upon the selector remaining in any position for a predetermined period, a plurality of signaling means, circuits selectively prepared for such signaling means by the cooperation of successively operated relays, another group of selectively attained positions for the second mentioned selector, and means controlled thereby for completing the circuits for the signaling means to produce signals identifying the predetermined position occupied by the simultaneously advanced selectable station selector.

8. In a signaling system, a plurality of interconnected groups of devices, means for selectively controlling any group of said devices and also any pair of devices of any group, a plurality of signaling devices, and switching means controlled by said selecting means to selectively operate said signaling devices to indicate the group and devices selected.

9. In a selective signaling system, a line circuit, a selecting station and a plurality of way stations associated with the line, means at the selecting station for supplying successive alternating current impulses to the line, a step by step selector at each way station responsive to the received impulses, a plurality of electrical devices at each way station selectively controlled thereby, a plurality of signaling devices at the selecting station, and switching means at the selecting station controlled by said impulses to selectively operate one of said signaling devices to indicate the way station and the electrical device selected thereat.

10. In a selective signaling system, a line circuit, a selecting station and a plurality of way stations associated therewith, a plurality of devices at each way station, means at the selecting station for selectively impressing successive alternating current impulses upon the line, a selector at each way station responding to such impulses to select various of said devices located thereat, and means at the selecting station to identify the way station selected and the devices selected thereat.

In witness whereof, I hereunto subscribe my name this 2nd day of July A. D., 1919.

JOHN B. HARLOW.