

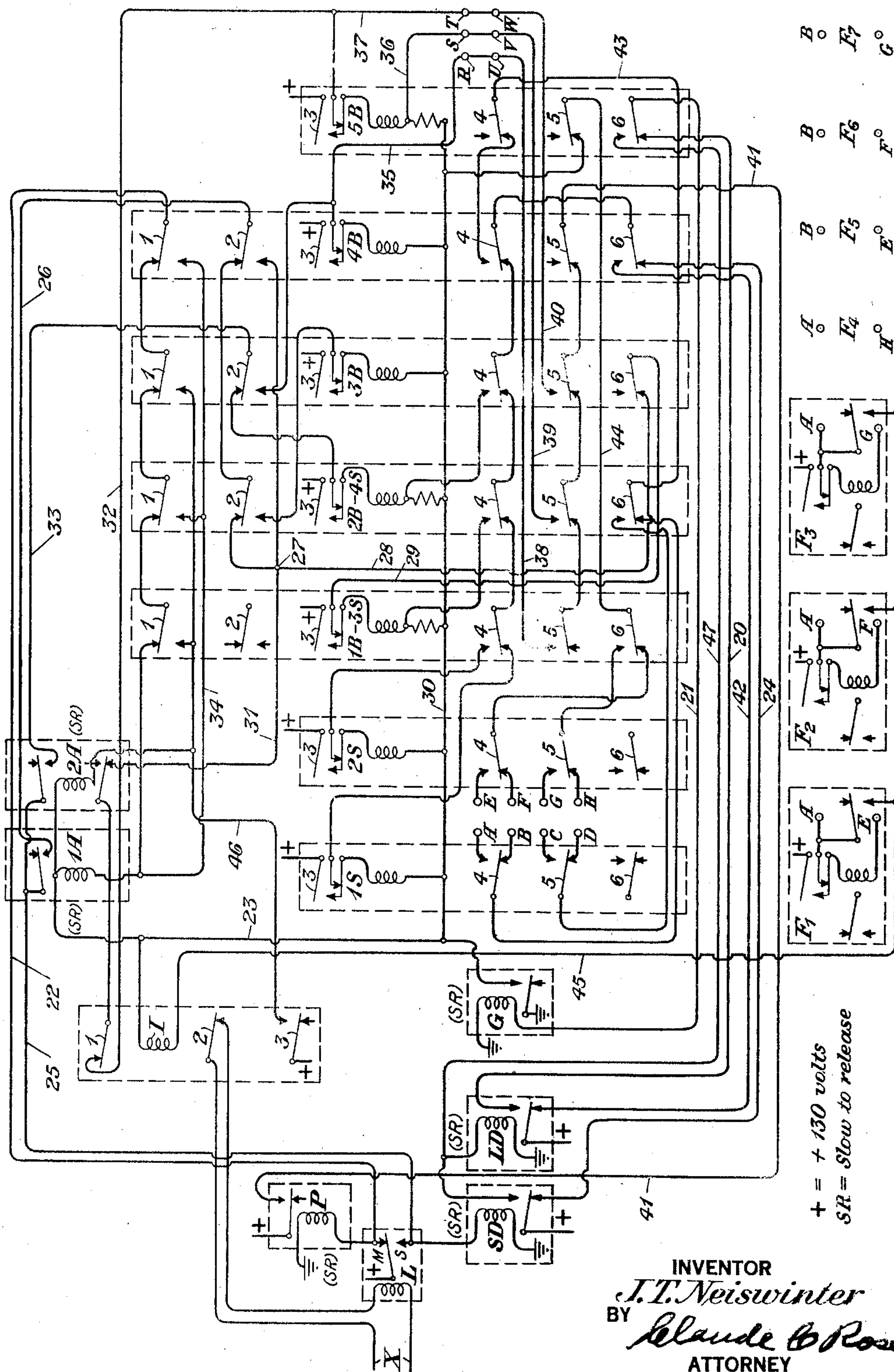
Nov. 16, 1943.

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2,334,575

SELECTIVE SIGNALING SYSTEM

Filed Jan. 8, 1941



UNITED STATES PATENT OFFICE

2,334,575

SELECTIVE SIGNALING SYSTEM

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Application January 8, 1941, Serial No. 373,574

4 Claims. (Cl. 177—353)

This invention relates to a selective signaling system and, more particularly, to such systems in which a code consisting of dots and dashes may be used to effect the selective operation.

One of the objects of the invention is to produce a selective signaling circuit employing a dot-dash type of code which may be transmitted over a manual telegraph circuit or a teletypewriter circuit without any substantial possibility of interference due to the transmission of ordinary Morse signals in the former case, or of teletypewriter code combinations in the latter instance.

Another object of the invention is to provide a selective signaling circuit employing a chain of relays for successively recording the elements of the dot-dash code until the final selection is made.

Another object of the invention is to provide a selective signaling circuit employing a chain of relays in which certain relays of the chain, after having recorded certain elements of a code combination, may be re-employed in connection with the recording of later elements of the same code combination.

Another object of the invention is to provide a selective signaling circuit responding to a dot-dash code but being so arranged that the final selection will not be completed unless a long interval occurs between two predetermined elements of the code. By providing such long intervals between different pairs of code elements, similar selecting apparatus may be employed at several stations, but a final selection will only occur at that station which is responsive to a long interval occurring at a given point in the code combination. This has the effect of enabling a code consisting of a given number of dots and dashes becoming effective to make a total number of selections which is several times greater than the possible number of permutations due to the dots and dashes themselves.

A still further object of the invention is to provide a selective signaling system which may be used in connection with teletypewriter circuits, manual telegraph circuits, signaling circuits for telephone circuits, and circuits for remote control of equipment of all kinds.

The invention may be more fully understood from the following description when read in connection with the accompanying drawing, the figure of which shows a selecting circuit operating in accordance with the invention.

In a circuit arrangement upon which the present invention is an improvement, a selecting ar-

5 rangement was proposed involving a chain of several successive groups of relays, one group corresponding to each element of a dot-dash code. For example, if the code consisted of four elements the selective relay chain involved four sets of relays with three relays in each set. The three relays in each set were known as A, B and S relays. The purpose of the A relays was primarily to prepare a circuit in response to either a dot or a dash to cause the operation of the B relays at the end of the dot or dash. The principal function of the S relays was to distinguish between the dots and dashes of the code combination. The B relays served to switch into the circuit a successive group of relays in the chain when the preceding group had performed their function in connection with the recording of the corresponding code element.

10 The circuit of the present invention is so designed that two A relays perform substantially the functions of the four A relays in the original circuit, and two of the B relays, having executed their switching functions in connection with the first two elements of the code, do double duty by later functioning as S relays in connection with the last two elements of a four-unit code.

15 The circuit of the present invention also differs from the earlier one in that no selection occurs unless a long interval separates two of the code elements of the combination. In a four-unit code, for example, a long separation may take place between the first and second elements of the code, or it may take place between the second and third elements or, again, it may take place between the third and fourth elements. The selecting circuit is so wired at a given station that no selection takes place unless a long separation occurs between two preassigned elements of the code combination. A long separation between any other pair of elements of the code will be ineffective at that given station to produce a selection. Thus the same code, so far as dots and dashes are concerned, may be used to select any one of several different stations without increasing the number of fundamental units in the code. A code consisting of four dots and dashes, for example, would, in accordance with the earlier circuit arrangement, be capable of making sixteen different selections. The selector of the present invention, however, is so arranged that a code combination consisting of four dots and dashes will be able to make forty-eight possible selections depending upon which one of the three separating intervals between the dots and dashes is made a long interval.

Referring to the drawing, at the left the terminal X indicates a transmission line which may be a telegraph line for either Morse or printer operation, a telephone line, or any other type of signaling circuit. This terminal includes a line relay L which responds to marking and spacing signals and thereby controls the selecting operations to be hereinafter described. The armature of this relay is normally on its marking contact. When shifted to its spacing contact it operates a so-called short dash relay SD which, in turn, operates a long dash relay LD. The long dash relay LD in turn closes the circuit of the slow-release relay G which applies a controlled ground to the various relays in the selecting chain about to be described. The relays SD and LD serve to distinguish between ordinary marking signals corresponding to dashes of the code combination, and long closed conditions of the signaling circuit which occur between the transmission of successive codes. In its marking condition the line relay L closes the circuit of a so-called pause relay P which controls the operation or non-operation of the final selecting circuit in accordance with the location of the long pause between two given elements of the code combination.

The selective relays consist of a chain of eight relays which perform the functions of the so-called A, B and S relays, as already described. Two of these are so-called A relays and the other six relays function as B and S relays. Two of these last six relays are designated 1B—3S and 2B—4S, respectively. These two relays perform the functions of the first and second B relays in connection with the first two elements of the code, and relays 3B and 4B perform the functions of the last two B relays in connection with the last two elements of the code. Two of the relays of the group of six, designated 1S and 2S, function to distinguish between dots and dashes of the first two elements of the code, after which the two relays 1B—3S and 2B—4S, which previously functioned as B relays, serve as S relays to distinguish between dots and dashes of the third and fourth elements of the code. The two A relays designated 1A and 2A are operated alternately in response to the four successive dots and dashes of the code to prepare the circuits for the B relays. The latter, it will be recalled, function to switch successive groups of relays in the chain to the controlling circuit operated by the transmission line X. An additional relay designated 5B serves to perform certain switching and other operations under conditions which will more clearly appear hereinafter.

The final selecting operation is under the control of the four S relays, 1S, 2S, 3S and 4S. These four relays provide sixteen different circuit combinations. One of these circuit combinations which involves four dots, may be omitted because it is more likely to occur in Morse operation than any of the others.

Assuming that fifteen of the combinations are used, a final group of one or more relays up to fifteen, designated F₁, F₂, F₃, etc., are connected with their terminals across pairs of terminals of the 1S and 2S relays, these terminals being designated A, B, C and D in connection with the 1S relay, and E, F, G and H in connection with the 2S relay. The manner in which the successive F relays are connected to these terminals is indicated by the corresponding letters associated with terminals of certain of the F relays shown at the bottom of the circuit diagram.

As will appear later, the final circuit to be

completed over contacts of the S relays will not be completed unless the long pause between two of the code elements occurs between a predetermined pair of said code elements. This means that if the circuit arrangement shown is employed in three different stations, and the final selecting circuit is set up by the four S relays at each of these stations, the final selecting circuit will only be completed at that one of the three stations which is wired to respond to a long pause at a particular one of the three possible places where a pause may occur between elements of a given code.

Further details of the circuit will now be understood from the following description of its operation.

Assuming that the circuit X is a telegraph circuit over which marking signals in the form of dots and dashes may be transmitted, and that the circuit is normally closed, the line relay L will have its armature on its marking contact thereby holding the slow-release relay P operated, as shown. When the relay P is operated the circuit controlled by its armature is opened. When relay L is in marking condition relay SD, the relay LD controlled thereby, and the relay G, which is controlled by LD, will be released. All other relays of the system will under these conditions also be released.

In order to send the first marking dot or dash of a code combination, the line circuit X will be momentarily opened so that the armature of the line relay L is momentarily shifted to its spacing contact. This energizes the slow-release relay SD which shifts its armature to its upper contact thereby energizing the slow-release relay LD. The relay LD requires a greater interval to release its armature than the relay SD. The two relays are relatively so designed that SD will hold up its armature during marking signals of less than ordinary dash length (about .1 second) but will fall off if the marking signals attain or exceed this length, while the relay LD will fall off if a marking signal persists over a period of .7 second or more, as will be the case when the circuit is closed at the end of the transmission of a code combination. It might be noted at this point that relay P is sufficiently slow in releasing to hold up its armature during normal pauses between successive marking signals, but releases when an abnormally long pause occurs, as will be described later.

The relay LD upon being energized closes a circuit from battery, over its upper contact, over conductor 20, over the sixth armature of relay 5B in normal condition, over conductor 21, through the winding of slow-release relay G to ground. Relay G upon being energized applies ground to all of the other relays of the circuit including the A, B and S relays. The G relay, being controlled by the long dash relay LD, will remain operated until a long marking signal, that is, one considerably longer than the normal Morse dash, is transmitted over the line circuit. The selecting relays of the circuit will thus have a ground applied to them continually throughout the sending of the code combination into the selector.

The first open or space signal on the circuit serves primarily merely to operate the relay G to supply ground to the selecting relays of the circuit. The mark following this open or space condition, regardless of whether it is a dot or a dash, operates the relay 1A over a circuit from battery, marking contact of relay L, conductor

22, over the number one armatures of relays 4B, 3B, 2B and 1B, in succession, and thence through the winding of relay 1A to conductor 23, and to ground over the front contact of relay G. Relay 1A prepares a path for operation of relays 1B and 5B on the second space, as will be described later. If the marking signal just described is of normal Morse dash length the relay SD will release and operate relay 1S over a circuit from battery, over the lower or normal contact of relay SD, over conductor 24, over the normal number six armature of relay 4B, over the number four armatures of relays 4B, 3B, 2B and 1B in series, to the upper normal armature of relay 1S, and thence through the winding of said relay, to ground over the contact of relay G. If the mark is only of dot length the circuit described will not be completed and the relay S will not be operated for the reason that the slow-release relay SD will not fall off in response to a dot.

The second space, or the space following the first dot or dash, operates relays 1B and 5B. The circuit extends from battery, over the spacing contact of line relay L, over conductor 25, over the make contact of relay 1A, conductor 26, over the normal contacts of the number two armatures of relays 4B and 2B in series, to point 27 where it divides. One branch extends over conductor 28, over the number six armature of relay 3B, over conductor 29, upper normal contact of relay 1B, through the winding of said relay and resistance in series therewith, thence over the grounded bus-bar 30 and over the contact of relay G to ground. The other branch extends from point 27, over conductor 31, over the lower back contact of relay 2A, over the normal contact of the number one armature of relay 1, over conductor 32, over the normal upper contact of relay 5B, through the winding of said relay and resistance in series therewith, to bus-bar 30, and thence over the contact of relay G to ground. Relays 1B and 5B are energized over these circuits, and as the relay 1A is of the slow-release type it holds the circuits of these relays closed until they are operated before it releases.

Each of the relays 1B and 5B locks up over its number three make contact. Relay 1B, upon operating, at its number four armature shifts the connection over the number four armatures of the several B relays from relay 1S to relay 2S, thus preparing the circuit for the latter. Relay 1S, of course, remains operated over the make contact of its number three armature. Relay 5B shifts its numbers four, five and six armatures to their upper contacts but no resultant operation takes place at this time.

The second mark operates relay 2A over a circuit from battery, marking contact of line relay L, conductor 22, the number one armatures of relays 4B, 3B and 2B in their normal positions, the number one contact of relay 1B in its operated position, through the winding of relay 2A, over conductor 23, to ground over the contact of relay G. Relay 2A, upon operating, prepares a circuit for the operation of relay 2B upon the succeeding space.

If the second mark is a dot, relay 2S will not be operated, but if it is a dash the relay SD will release and operate relay 2S over a circuit from battery, lower contact of relay SD, conductor 24, the number six and the number four armatures of relay 4B, the number four armatures of relays 3B and 2B, over the upper contact of the number four armature of relay 1B (which has

previously been operated) and thence up over the upper normal contact of relay 2S, through the winding of said relay and resistance in series therewith, to the grounded bus-bar 30, and over the contact of relay G to ground. Relay 2S is operated and locks up.

The third space operates relay 2B over a circuit from battery, spacing contact of line relay L, conductor 25, upper make contact of relay 2A, conductor 33, the normal number two armature of relay 3B, the normal number three armature of relay 2B, through the winding of said relay and resistance in series therewith, and thence over conductor 30, to ground over the contact of relay G. Relay 2A is also a slow-release relay and holds this circuit closed long enough to operate and lock up the relay 2B over said relay's number three armature. It will be noted that the relays 1A and 2A are non-locking relays and are only energized during the marking impulses transmitted over the line and, consequently, it is necessary to make them slightly slow to release in order to give the B relays time to operate before said relays 1A and 2A restore their armatures to normal.

The third marking signal operates relay 1A for a second time over a circuit from battery, over the marking contact of line relay L, conductor 22, the number one armatures of relays 4B and 3B in normal position, the number one armature of relay 2B in its lower shifted position, over conductor 34, through the winding of relay 1A, over conductor 23, to ground over the contact of relay G. The operation of relay 1A prepares a circuit for the operation of relay 3B on the ensuing space.

If the third mark is a dash, relay SD will release and short-circuit the winding of relay 1B—3S over a connection from positive battery, lower contact of relay SD, conductor 24, the normal number six contact of relay 4B, the normal number four contacts of relays 4B and 3B, the normal number four contact of relay 2B in its upper position (relay 2B being operated) to the lower terminal of the winding of the relay 1B—3S. As its upper terminal is also connected to positive battery, the winding of relay 1B—3S, which we may now call relay 3S, is accordingly de-energized. Said relay is thereby unlocked and released so that its armatures four, five and six are shifted to their lower position, that is, the position shown in the drawing.

It will be noted that the contacts associated with the number six armatures of the relays 1B and 2B are connected to the number four and five armatures of relays 2S and 1S, respectively. Consequently, after said relays 1B and 2B have served their purpose as B relays, they may be operated, or not operated, as the case may be, in response to the third and fourth marking signals, respectively, to take part in the determination of the final selecting circuit, as will appear later. These two relays are in their operated position when it comes time for their use as S relays, this being due to the fact of their previous use as 1B and 2B relays. It is therefore necessary that a marking dash be used to release them while a dot results in their remaining in the operated position. This is just opposite to the procedure used for relays 1S and 2S. For example, if the third mark was merely a dot, the short-circuit connection above described over the lower contact of relay SD would not be completed because the armature of the relay SD would not fall off. Consequently, the relay

1B—3S (now relay 3S) would remain locked up.

The fourth space, that is, the space following the third marking signal, operates the relay 3B over a circuit from battery, space contact of line relay L, conductor 25, make contact of relay 1A, conductor 25, the number two armature of relay 4B in its normal position, the number two armature of relay 2B in its operated or lower position, through the number three normal contact of relay 3B, the winding of said relay, and over conductor 30 to ground over the contact of relay G. Relay 3B is locked up and at its number one armature prepares a circuit for the operation of relay 2A, while at its number four armature it prepares a circuit to short-circuit the winding of relay 2B—4S which will now function as relay 4S.

The fourth marking signal operates the 2A relay over a circuit from battery, marking contact of the line relay L, conductor 22, the number one armature of relay 4B in its normal position, the number one armature of relay 3B (now operated) in its lower position, through the winding of relay 2A, and over conductor 23 to ground over the contact of relay G. Relay 2A upon being operated prepares a circuit for the operation of relay 4B upon the space following the fourth marking signal. If the fourth marking signal is a dash, slow relay SD releases and completes a short-circuit for the winding of relay 2B—4S (now 4S) from battery, over the lower contact of relay SD, conductor 24, the number six armature of relay 4B, the number four armature of relay 4B in its lower normal position, the number four armature of relay 3B in its upper position, to the lower terminal of the winding of relay 4S. The upper terminal of said winding being also connected to positive battery, relay 4S is accordingly released so that its number four, five and six armatures are in their lower positions. If, however, the fourth marking signal was merely a dot, the short-circuit connection would not have been completed and relay 4S would remain operated.

The transmission of the fourth marking signal completed the combination which sets the four selecting relays 1S, 2S, 3S and 4S. However, the completion of the final selecting circuit depends upon certain other conditions which will be described later.

The space following the fourth marking signal, that is, the fifth space, causes the operation of relay 4B over a circuit from battery, spacing contact of line relay L, conductor 25, upper make contact of relay 2A, conductor 33, the number two armature of relay 3B in its shifted or lower position, the normal contact of the number three armature of relay 4B, through the winding of said relay, and over conductor 30 to ground over the contact of relay G. Relay 4B locks up and shifts its armatures with the result that at its number four and number six armatures it connects the lower contact of the LD relay to the selecting armature of the 4S relay, except for a possible opening in the circuit at the number four armature of relay 5B. This relay, it will be remembered, was operated along with the relay 1B during the space following the first marking signal and, depending upon certain conditions, may be operated at this time. No final F relay can now be operated if the 5B relay is in the operated condition, even though a combination has been set up on the four selecting relays 1S to 4S, inclusive.

As has already been stated, whether the selec-

tion determined by the four S or selecting relays becomes effective or not depends upon a fairly long pause between two of the marks. It is only when this long pause occurs between a particular pair of the marking signals that the selecting circuit will be finally completed after the four marks have been transmitted. This pause, when it comes, causes the slow-release relay P to release between two of the marking signals. The effect of this pause will now be described.

It will be noted that certain lugs or terminals R, S and T are connected, respectively, to conductors 35, 36 and 37, while three other lugs or terminals U, V and W are connected, respectively, to conductors 38, 39 and 40. With cross connections between these lugs, as shown, the circuit is arranged so that the selection will be completed if a long pause occurs between the second and third mark of the combination or, in other words, at the time of the third space.

It will be recalled that at this time relays 1B and 2B have been operated. Consequently, when the relay P fell off during this long third space, battery was connected over its back contact, over the conductor 41, over the number five armatures of relays 4B and 3B in their lower positions (said relays had not yet been operated), and over the number five armature of the relay 2B in its upper position, over conductor 29, thence to lugs V and S, over conductor 36 to the lower terminal of the winding of relay 5B. The winding of relay 5B was accordingly short-circuited and said relay released its armatures.

The release of relay 5B, as the result of the long pause between the second and third marks of the signal combination, results in its number four armature being shifted to its lower position to prepare the final selecting circuit for a selected one of the F relays. Consequently, when the line circuit is again closed, after the space following the fourth marking signal, and remains closed for an appreciable length of time, say more than .7 second, so that the slow-release relay LD has had time to fall off, the final selecting circuit will be completed.

Assuming that the selection consisted of four marking dashes with a long pause between the second and third dash, an operating circuit for the relay F₁ will be completed from battery, over the lower contact of the relay LD, conductor 42, the number six armature of the relay 4B in its upper position, the number four armature of said relay in its upper position, the number four armature of relay 5B in its lower or released position, conductor 43, the number six armature of relay 4S in its lower position (relay 4S having been released by the fourth dash), the number four armature of relay 1S in its upper position, terminal A, normal upper contact of relay F₁, through the winding of said relay, the terminal E, over the number four armature of relay 2S in its upper position, the number six armature of relay 3S in its lower position (relay 3S having been released as a result of the third dash), over conductor 44, the number five armature of relay 5B in its lower position, to grounded bus-bar 30 and over the armature of relay G to ground. The relay F₁ at its upper front contact completes a locking circuit through its winding to ground over the circuit previously traced from terminal E. The functions performed by relay F₁ upon operating, will be discussed later.

It will be noted that the circuit is so arranged that if the long pause which releases the relay P had occurred between the first and second marks, or between the third and fourth marks,

instead of between the second and third marks, no release of the relay 5B would occur as the short-circuiting connection over lugs V and S would not have been completed. Accordingly, no F relay would have been selected. For example, if the pause had occurred between the first and second marks only, the relays 1B and 5B of the B relays would have been operated first. After an interval the relay would have released and caused the operation of relay 4B. The circuit for said relay 4B would have extended from battery, over the back contact of relay P, conductor 41, the number five armatures of relays 4B, 3B and 2B in their lower positions, the number five armature of operated relay 1B in its upper position, over conductor 38, lugs U and R, over conductor 35, normal contact controlled by the number three armature of relay 4B, through the winding of said relay to the grounded bus-bar 30, and over the contact of relay G to ground. The operation of relay 4B at this time, by opening the normal contact of its number five armature, prevents any subsequent long pauses from completing the short-circuit over conductor 39 and lugs V and S, so that the relay 5B is not released. No final selecting circuit for an F relay can therefore be completed.

On the other hand, if the long pause had occurred between the third and fourth marks of the signal combination, relays 1B, 2B and 3B would have been operated at this time and relay 5B would also have been operated unless, by chance, it had already been released by an unintended pause between the second and third marks. The pause between the third and fourth marks of the signal combination would have caused relay P to fall off and close a circuit from battery, over its back contact, conductor 41, the number five armature of relay 4B in its lower position, the number five armature of relay 3B in its upper or operated position, over conductor 40, lugs W and T, over conductor 37, and thence over the upper normal contact of relay 5B, through the winding of said relay to ground, over the grounded bus-bar 30 and the make contact of relay G. The final selecting circuit for the F relay would, therefore, be held open at the fourth and fifth armatures of relay 5B and no selection would take place.

It is obvious from the foregoing that the pause in the signal combination must occur only between the second and third marks of the signal to cause a selection with the lugs R, S, T, U, V and W wired as shown in the diagram. Any other location of the pause, or the use of two or more long pauses, will result in the 5B relay either remaining operated or being operated, thus preventing any selection of an F relay. The circuit can be arranged to operate on a pause between the first and second mark, or between the third and fourth mark, by changing the cross connections between the lugs R, S, T and U, V, W. By using such alternative connections at the selectors of other stations, the total number of possible selections may be increased to three times the number which would normally result from the four selecting marking signals.

Assuming that four marking signals and a properly located pause have been transmitted, the sending operator may defeat the final selection by transmitting a dot instead of a long marking signal after the space following the fourth marking signal of the code combination. A dot sent at this time will operate the relay 1A over a circuit from battery, over the marking contact of

the line relay L, conductor 22, the number one armature of relay 4B in its lower operated position, conductor 34, the winding of relay 1A, over conductor 23, and to ground over the contact of relay G. During the ensuing space, relay 5B is operated over a circuit from battery, space contact of line relay L, conductor 25, the make contact of relay 1A, conductor 26, the number two armature of relay 4B in its lower position, conductor 31, the lower back contact of relay 2A, the normal contact of the number one armature of relay I, conductor 32, upper normal contact of relay 5B, through the winding of said relay and resistance in series therewith, to ground over the grounded bus-bar controlled by the contact of relay G. The operation of relay 5B will again defeat the final selection.

Let us return now to the selected relay F₁, which, it will be recalled, was operated and locked up as a result of the transmission of four dashes with a long pause between the second and third dash. As a result, the right-hand armature of relay F₁ completes a circuit for relay I from battery over the back or lower contact of relay LD, conductor 42, upper contact of the number six armature of relay 4B, upper contact of the number four armature of relay 4B, lower contact of the number four armature of relay 5B, conductor 43, lower contact of the number six armature of relay 4S, upper contact of the number four armature of relay 1S, terminal A, and thence over the make contact of the right-hand armature of relay F₁ to conductor 45, through the winding of relay I, to ground over the armature of relay G. The relay operates and at its number two armature opens the telegraph circuit X. This causes the relay L to release.

This would normally operate the relay 5B over a circuit from battery, the spacing contact of the line relay L, the conductor 25, the make contact of relay 1A (which would have been operated by the preceding closed circuit condition), over conductor 26, the lower make contact of the number two armature of relay 4B, conductor 31, the lower back contact of relay 2A, the number one armature of relay I, conductor 32, the normal upper contact of relay 5B, through the winding of said relay to ground over the bus-bar 30 and the contact of relay G. This circuit is held open by the relay I, however, at its number one armature, and the release of the relay L, therefore, does not operate the relay 5B. The release of said relay L, however, operates the relays SD and LD with the result that the latter removes the battery connection from the relay I over the circuit previously traced. Relay I, accordingly, releases.

The release of the relay I does not close a circuit over its spacing contact for the relay 5B as previously traced over the armature of relay 1A in its upper position, conductor 26, the number two armature of relay 4B in its lower position, the lower armature of relay 2A, and over the number one armature of relay I to the upper normal contact of relay 5B. This circuit is defeated by the fact that the relay I, during its operated condition, completed a circuit from battery over a conductor 46, through the winding of relay 2A, and over conductor 23 to ground over the contact of relay G. The relay 2A, being slow to release, at its left-hand armature holds open the circuit just traced for the relay 5B until the line relay L is again energized by the falling off of the relay I. Relay L at its spacing contact

opens the circuit of the relay 5B at another point, thus holding it open after the relay 2A falls off, and so maintaining it until the relay I again operates.

When the relay L re-operates as a result of the release of relay I, relays SD and LD are again released, and the latter once more operates the relay I to re-open the telegraph circuit. This action continues, causing a steady series of opens and closes on the telegraph circuit which indicates to the sender of the combination that the selector has operated an F relay. This signal also serves to indicate to others on the circuit that someone has operated the selector and is waiting for the called office to answer. It will be understood, of course, that the left-hand armature of a selected relay, such as relay F₁, may be used to operate a signal or perform some other function to notify the called party that a signal has been received at his station.

In order to release the selector and restore it to normal, it is only necessary to break the telegraph circuit at any point. This could be done, for example, at the called office when the attendant there answers by means of a key, not shown, thus holding open the telegraph circuit at a time when both the relay I and the relay 2A are released. Under these circumstances the circuit from the spacing contact of the relay L to the relay 5B is completed. The circuit for the relay 5B extends from battery over the spacing contact of the line relay L, over conductor 25, over the make contact of relay 1A (which was operated during the preceding closed circuit condition), over conductor 26, the number two armature of relay 4B in its lower position, conductor 31, the left hand back contact of relay 2A (which was released when relay I was released), the back contact of the number one armature of relay I, conductor 32, and thence to ground over the circuit previously traced through the winding of the relay 5B.

The operation of the relay 5B at its number five armature breaks the ground connection for locking up the selected relay F₁ which connection, it will be remembered, extended from the terminal E, over the number four armature of relay 2S in its upper position, the number six armature of relay 3S in its lower position, the number five armature of relay 5B, and thence to the grounded bus-bar. This circuit being open at armature five of relay 5B, the relay F₁ is released thus extinguishing the signal at the called office. The release of relay F₁ at its right-hand contact opens the circuit of the relay I which now remains de-energized. The various selecting and switching relays will also be released in the following manner:

The marking signals heretofore considered have not been long enough to cause the release of slow-release relay G which supplies ground for all of the relays of the selector. If, however, after the telegraph circuit has been opened, as just described, it is again closed and permitted to remain closed for approximately one second or longer, the relay G will be released. The circuit of the relay G, it will be noted, is controlled over the number six armature of the relay 5B, so that if the relay 5B is operated, the circuit of relay G may be completed over conductor 41 and the upper contact of relay SD. Therefore, when the line is closed and the relay SD releases, it opens the circuit of the relay G, and, after an interval, said relay permits its armature to fall off. If, on the other hand, the relay 5B is not operated, the

circuit of the relay G is completed over the lower contact of the number six armature of the relay 5B and over conductor 20 to the upper contact of the relay LD. Under these circumstances, the falling off of the relay LD will open the circuit of the relay G and, after an interval, its armature will fall off and remove the ground from the grounded bus-bar, thus releasing all of the selecting relays of the circuit. The circuit is now in normal condition with only line relay L and relay P operated.

It will also be noticed that during signaling the circuit of the relay G is at all times completed either over the make contact of the relay SD or over the make contact of the relay LD, depending upon whether or not relay 5B is energized. Consequently, if at any time during the sending of a combination, the line circuit is closed for approximately one second, or more, both relays SD and LD will fall off, and relay G will release and clear the circuit.

The purpose of using both the SD and LD relays is to provide for the operation of an S relay on a short mark during a combination, and to require a long mark at the end of the combination to operate the selected F relay. This serves to prevent the false operation of an F relay by the fifth marking signal of a normal Morse combination. During the sending of a signal combination the SD relay controls the operation of the S relays, but when the relay 4B operates at the end of the combination, it transfers the selecting circuit for the F relay to be finally selected through contacts of the S relays from the SD relay to the LD relay. During the time that the LD relay controls the final selecting circuit the G relay is also under its control. However, after the relay 5B has operated, which occurs for the final time after a fifth short mark has been sent into the selector (because it is desired to defeat the selection of the F relay), the control of the G relay is transferred back to the SD relay, which reduces the time for the selector to clear out.

The inclusion of the LD relay in the circuit during the period of the acknowledgment signal, has the effect of increasing the interval between the clicks of the signal. This makes the signal more pleasant to listen to than one with a series of fast clicks.

The dot and dash combinations of the selector, with their associated letters on a Morse code basis, are given in the following table:

1.	—	—	—	—	M	M
2.	—	—	.	—	M	A
3.	—	—	.	.	M	I
4.	—	—	—	.	M	N
5.	.	—	—	—	A	M
6.	.	—	.	—	A	A
7.	.	—	.	.	A	I
8.	.	—	—	.	A	N
9.	.	.	—	—	I	M
10.	.	.	.	—	I	A
11.	.	.	.	.	I	I
12.	.	.	—	.	I	N
13.	—	.	—	—	N	M
14.	—	.	.	—	N	A
15.	—	.	.	.	N	I
16.	—	.	—	.	N	N

With a selector connected to operate when there is a pause between the first and second marks of the combination, the various combinations on a Morse code basis would be as follows:

TS, TD, TF, TU, TG, TV, TK, T5, ES, ED, EF, EU, EG, EV, EK, E5.

With a selector connected to operate when the pause occurs between the third and fourth marks, the combinations would be:

ST, DT, FT, UT, GT, VT, KT, 5T, SE, DE, FE, UE, GE, VE, KE, 5E.

It is possible, of course, to use only three instead of four marks for a selector combination. On this basis, eight combinations could be obtained by using a pause between the first and second marks, and eight more by using a pause between the second and third marks. A selector operating on this basis could work on the same circuit as one designed for four marks without either interfering with the other.

It will be obvious that the general principles herein disclosed may be embodied in many other organizations widely different from those illustrated, without departing from the spirit of the invention as defined in the following claims.

What is claimed is:

1. In a signaling system, a signaling circuit over which a selective signaling code consisting of a fixed number of units comprising dots and dashes may be sent, a selective apparatus including selecting relays adapted to be successively connected to said signaling circuit as successive units of said selective signaling code are transmitted, switching relays successively operating after each code unit has been received to switch a succeeding selecting relay to said signaling circuit, means whereby certain of said switching relays after having performed their switching function are used as selecting relays and whereby they are at the proper time switched to said signaling circuit by other of said switching relays to perform their selecting function, means whereby each selecting relay may determine part of a final selection in accordance with whether the corresponding signal unit is a dot or a dash, and means to complete said final selection.

2. In a signaling system, a signaling circuit over which various selective signaling codes each consisting of the same fixed number of units may be sent, each code unit being either a dot or a dash and the ratio of the number of dots to the number of dashes in different codes being variable, so that the total number of codes possible will be 2^n where n is the number of code units in each code, a selective apparatus including selecting relays one corresponding to each unit of the code, adapted to be successively connected to said signaling circuit as successive units of said selective signaling code are transmitted, switching relays successively operating after each code unit has been received to switch a succeeding selecting relay to said signaling circuit, means whereby certain of said switching relays after having performed their switching function are used as selecting relays and whereby they are at the proper time switched to said signaling circuit by other of said switching relays to perform their selecting

function, means whereby each selecting relay may determine part of a final selection in accordance with whether the corresponding signal unit is a dot or a dash, means to complete said final selection by sending an abnormally long dash following the completion of the selective signaling code, and means whereby the person sending any selective signaling code may defeat said final selection by sending a dot after a pause of any length following the last unit of the code.

3. In a signaling system, a signaling circuit over which a selective signaling code consisting of a fixed number of units comprising dots and dashes may be sent, a selective apparatus including selecting relays adapted to be successively connected to said signaling circuit as successive units of said selective signaling code are transmitted, switching relays successively operating after each code unit has been received to switch a succeeding selecting relay to said signaling circuit, means whereby certain of said switching relays after having performed their switching function in connection with earlier units of a selecting signaling code combination are used as selecting relays in connection with later elements of a code combination and whereby they are at the proper time switched to said signaling circuit by other of said switching relays to perform their selecting function, means whereby each selecting relay may determine part of a final selection in accordance with whether the corresponding signal element is a dot or a dash, and means to complete said final selection.

4. In a signaling system, a signaling circuit over which a selective signaling code consisting of a fixed number of units comprising dots and dashes may be sent, a selective apparatus including selecting relays adapted to be successively connected to said signaling circuit as successive units of said selective signaling code are transmitted, switching relays successively operating after each code unit has been received to switch a succeeding selecting relay to said signaling circuit, means whereby certain of said switching relays after having performed their switching function in connection with earlier units of a selecting signaling code combination are used as selecting relays in connection with later elements of a code combination, and whereby they are at the proper time switched to said signaling circuit by other of said switching relays to perform their selecting function, means whereby each selecting relay may determine part of a final selection in accordance with whether the corresponding signal element is a dot or a dash, means to complete said final selection by sending an abnormally long dash following the completion of the selective signaling code, and means whereby the person sending any selective signaling code may defeat said final selection by sending a dot after a pause of any length following the last unit of the code.

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