Oct. 17, 1933. A. C. THOMPSON 1,930,631

SIGNALING SYSTEM

Filed March 18, 1932 2 Sheets-Sheet 1

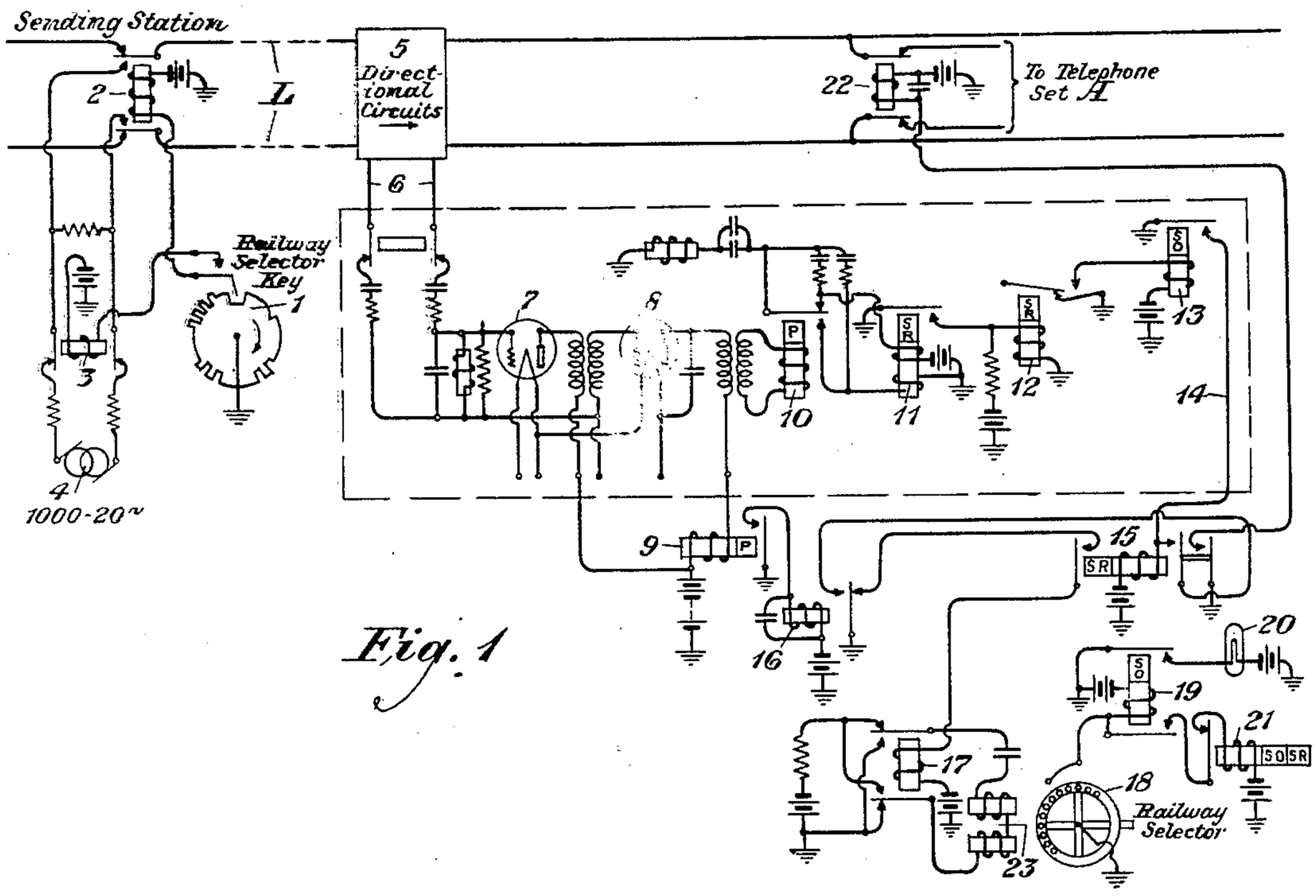

Fig. 1

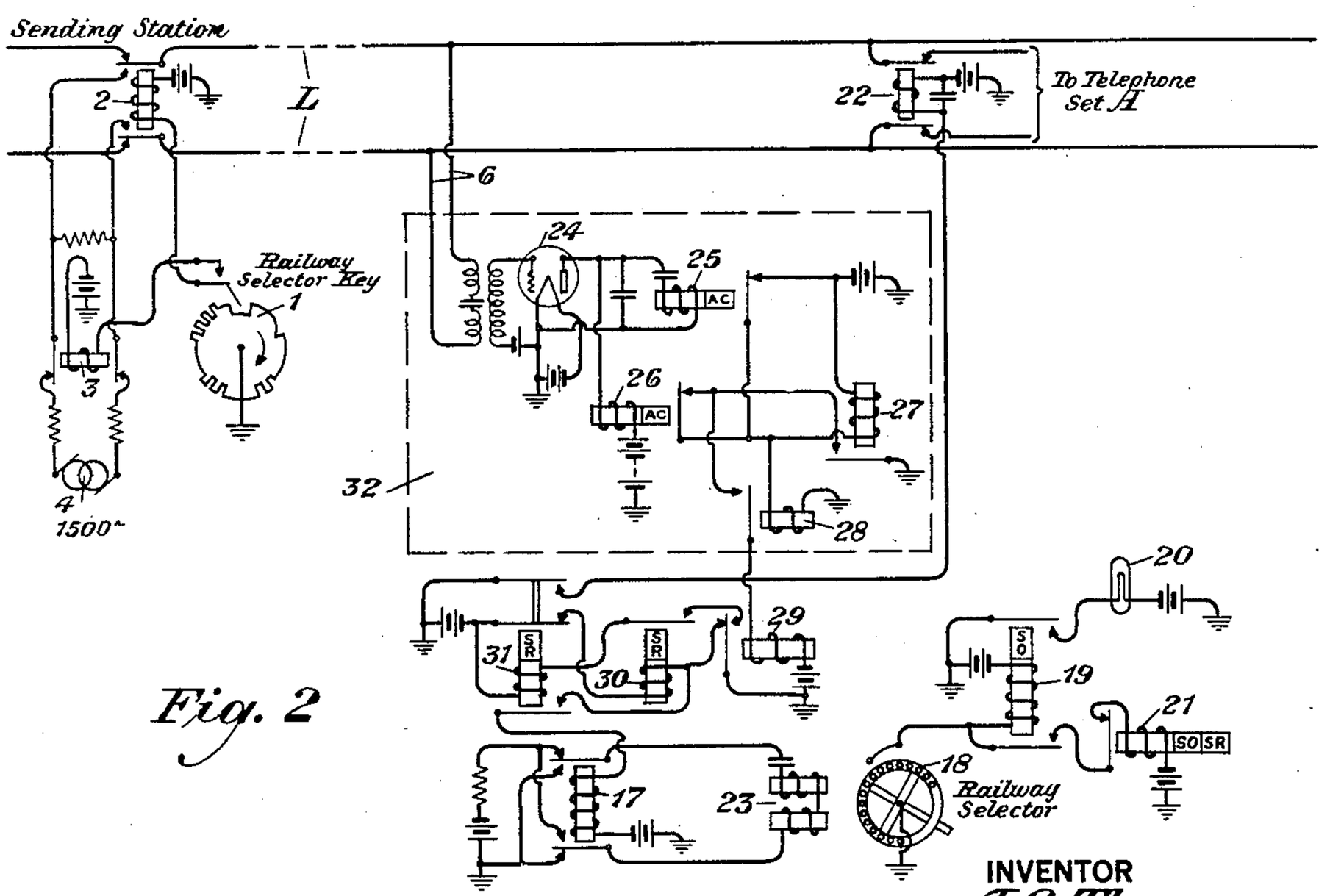

Fig. 2

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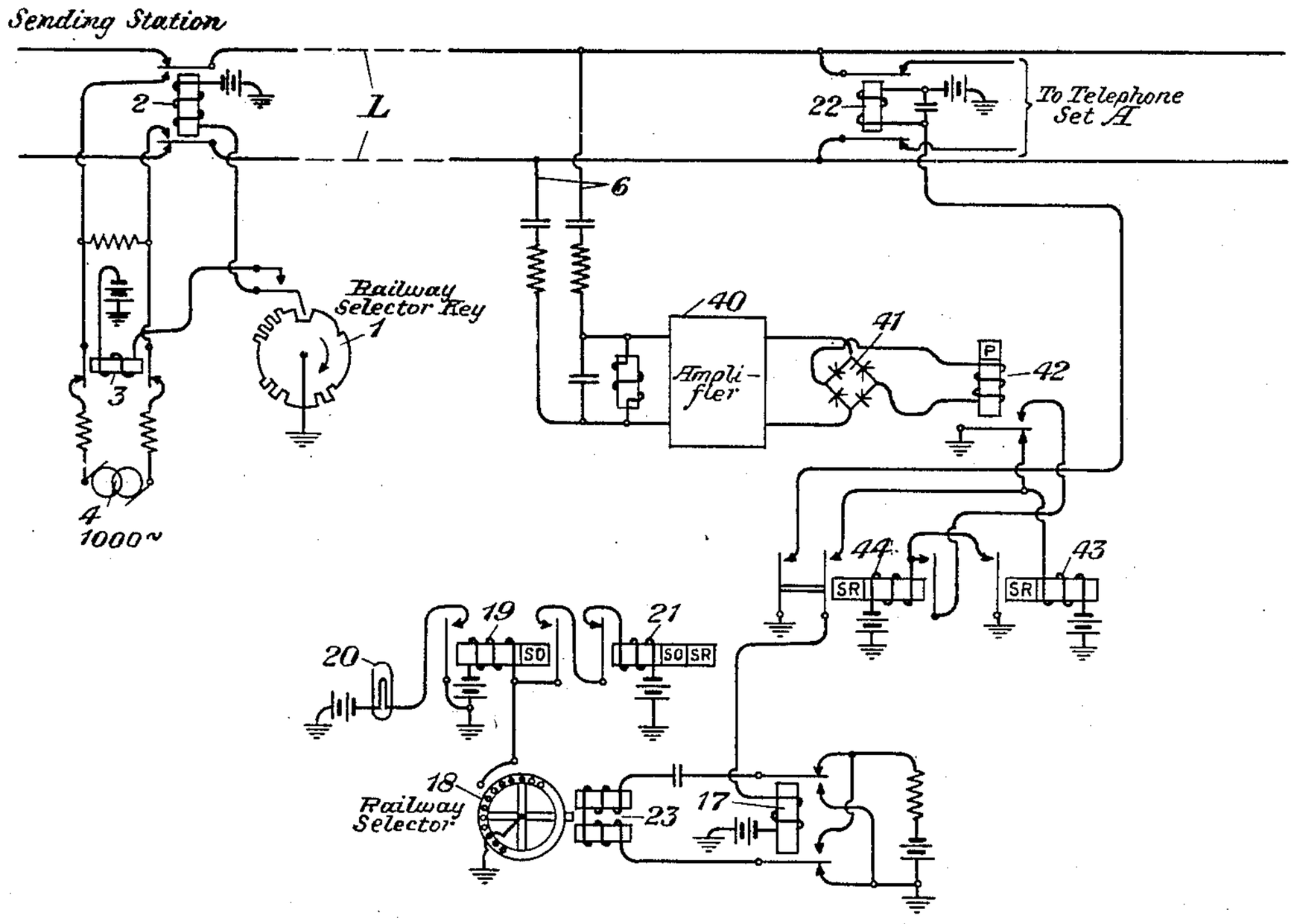

Fig. 3

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SIGNALING SYSTEM

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6 Claims. (Cl. 179—84)

This invention relates to telephone systems, and more particularly to improved arrangements for selectively signaling any desired one of a number of stations connected across a single line in such systems.

One form of telephone service consists in the leasing of telephone circuits to subscribers who wish to have the exclusive use of the facilities. Such cases frequently involve the bridging of a number of stations on a single circuit and it then becomes necessary to provide means for calling in the various points when they are wanted. One method for accomplishing such signaling has been by the use of selector mechanisms, known as railway selectors, which were developed in connection with the design of train dispatching circuits. As heretofore used it has been necessary to use telegraph channels to transmit the signals for these selectors, which made their use rather expensive. It is the primary object of the arrangements of the invention to provide means whereby the railway selector mechanisms, or other suitable types of selecting devices may be operated in conjunction with telephone signaling circuits of the voice frequency type. This is accomplished by associating the switching mechanism with a plurality of relays having a timed relationship in their operation with respect to each other, together with regular telephone signaling circuits of the voice frequency type, which are well known in the art, for controlling said relays. Accordingly, with the arrangements of the invention, it is not necessary to utilize telegraph or other D. C. channels to transmit the code signals, or to provide repeating devices at intermediate repeater points. Other objects and features of the invention will appear more fully from the detailed description hereinafter given.

The invention may be more fully understood from the following description, together with the accompanying drawings, in the Figures 1, 2 and 3 of which the invention is illustrated. Fig. 1 is a circuit diagram showing a preferred form of the invention. Figs. 2 and 3 are modifications of the invention. Similar reference characters have been utilized to denote like parts in all of the figures.

In Fig. 1 is shown a line L to which may be connected a plurality of telephone stations. For example, the telephone set A is shown connected to the line over the contacts of relay 22. In order to selectively signal these stations, there is provided at the sending station a railway selector key 1. Under control of this key and the relays 2 and 3, signaling impulses from the source 4 may be applied to the line L. In this instance the source 4 may supply 1000-cycle current interrupted at a frequency of 20 cycles. At each of the telephone stations connected to the line there would be provided a directional circuit 5 and a circuit 6 connected to the apparatus shown within the dotted lines, which is the 1000-cycle-20-cycle voice frequency ringer. The directional circuit 5 is well known in the art and is designed to allow signals to be transmitted over the line to circuit 6 from the sending station shown and to additional ringers in the same direction. The directional circuit 5 is of the type shown in U. S. Patent 1,755,243 issued April 29, 1930 to G. Crisson. However, it will substantially prevent signals coming over the line in the opposite direction from affecting the ringers. Its primary object is to prevent interference with the ringers of reflected currents. This ringer, together with the relays 9, 16, 15 and 17, would control the railway selector 18 in accordance with the code impulses transmitted over the line. The selector 18 would operate an indicating device, such as lamp 20, at the telephone set A.

The railway type selectors utilized in the arrangements of the invention are arranged to operate on three groups of impulses occurring at a 3½-cycle rate with about one second between the groups of impulses. An impulse is obtained each time the sending key 1 makes or breaks the interrupting contact, that is, a "make" and "break" will cause the selector to take two steps. In this type of selector a total of 17 impulses having the right number in each group of three are usually required to cause the selector to step to the final position and bring in a signal. If the correct number of pulses in each group is not received, the selector will return to normal. After the 17 impulses have been received, the selector remains on the last step until a final impulse is received to restore it to normal. In the usual case the final impulse is obtained from the sending end after a 2-second ringing interval, but in the present circuit arrangements it is obtained locally and the indication at the station is continued for a longer period under the joint control of the telephone set and a local timing circuit.

The operation of the arrangements of Fig. 1 is as follows: To send a signal the handle of the railway selector key is given a quarter turn and then released, which causes the code wheel of the key 1 to revolve once. As soon as the code wheel begins to turn, relay 2 will be operated and

signaling current will be applied to the line for about a second before the code interruptions begin. These code interruptions will begin when the selector key mechanism revolves further causing the intermittent operation of relay 3 and the intermittent disconnection of source 4 from the line. The signaling current initially applied to the line for about a second before the code interruptions begin will be transmitted as follows: over line L, directional circuit 5, circuit 6, amplifier 7, and through the detector 8. The current in the output of detector 8 will intermittently operate the polar relay 9 and thus cause the relay 16 to operate. The relay 9 will follow the 20-cycle interruptions of the 1000-cycle signaling current but the relay 16 will remain operated because it has a slow-release characteristic due to the condenser bridged across it. The signaling current in the output of the detector tube 8 will operate relay 10, which in turn will operate the slow-release relay 11. It is pointed out that when the armature of relay 10 is on its upper contact battery connected to the upper winding of relay 11 will charge up the condensers in circuit with said winding and the retardation coil shown. This charging circuit is completed over the upper contact and armature of relay 10. When the armature of relay 10 is on its lower contact these condensers will discharge through the lower winding of relay 11. Both windings of relay 11 are so poled that the charging and discharging currents will cause it to operate. The relay 11 is made slow releasing so that it will remain operated between the pulses of current produced during the charging and discharging of the condensers. The inclusion in the charging and discharging circuits of relay 11 of the retardation coil shown will, in effect, tune the circuit arrangements to 20 ~. Accordingly, the relay 10 must be operated at approximately 20 ~ by the signaling current from source 4 in order to operate relay 11. If the relay 10 should be operated at some other frequency by currents caused by actual speech or other interfering tones, the charging and discharging currents in relay 11 would not build up values sufficiently large enough to operate relay 11. This is one of the important features of the ringer apparatus (shown within the dotted lines) which prevents its operation on currents caused by actual speech or by any other currents except the specific voice frequency signaling currents for which it is designed. The operation of relay 11 will short circuit the slow-release relay 12 and cause it to release. This in turn will cause the operation of the slow-operate relay 13 which will apply ground to conductor 14 and operate slow-release relay 15. Relay 15 will lock up over its right-hand inner contact and the contact and armature of relay 16. The slow-release characteristic of relay 12 and the slow-operate characteristic of relay 13 provide a time interval to prevent false operation of the ringer on voice currents in addition to the preventive means referred to above. The ringer shown within the dotted lines is well known in the art.

When the selector key 1 and the associated relay 3 now interrupts the signaling current to send code impulses, the relay 16 will operate and release in accordance with the code being transmitted and each time it releases will apply ground over its right-hand contact and over the contact of slow-release relay 15 to the winding of relay 17 and battery. This causes relay 17 to operate in accordance with the transmitted code impulses and to apply reversals to the magnet 23 of selector 18 and cause it to step in accordance with the code. It is pointed out that relay 15 has a slow-release characteristic sufficient to cause it to hold over the breaks between the groups of pulses. If the proper code has been sent so that the selector has stepped to the seventeenth position, the relay 19 will be operated. This will close a circuit for the indicating lamp 20 at station A. Relay 19 will lock up over the contact of slow-operate, slow-release relay 21. After a certain interval the relay 21 will release and cause relay 19 to release and thus extinguish lamp 20. Relay 19 might also be released when the subscriber answers if desired. The aforementioned operation of relay 15 will also close a circuit over its outer right-hand contact to operate relay 22 and disconnect telephone set A from the line during the signaling operation. Relay 19, furthermore, should be made slow-operating to prevent its operation in case the selector should be stepped through the seventeenth position thereon instead of stopping there. After the signaling has ceased, relay 15 will release and send an additional impulse to relay 17 to cause the release of selector 18. As has been heretofore pointed out, the operation of the selector on voice or other interfering currents is prevented by requiring the initial transmission of a regular ringing signal to cause the operation of the ringer shown within dotted lines before the selector circuits are energized.

In Fig. 2 is shown a modification of the invention. In this arrangement the generator 4 furnishes continuous 1500-cycle signalling current instead of 1000-cycle current interrupted at a frequency of 20 cycles as in Fig. 1. The 1000-cycle-20-cycle ringer of Fig. 1 is replaced in Fig. 2 by the ringer 32 shown within the dotted lines. This ringer is old in the art and is shown in U. S. Patent 1,711,651 to H. M. Pruden and comprises an amplifier 24, in the output circuit of which are connected the alternating current relays 25 and 26. These relays are voice frequency relays and relay 25 is sharply tuned to respond to the signaling frequency, while relay 26 is broadly tuned so as to respond to other currents which are present in the voice range but not to the signaling current. For example, the signaling current has been taken as 1500 cycles and relay 25 is accordingly tuned to this frequency. Relay 26 might then be tuned to a broad band around 1000 cycles. When the railway selector key 1 is operated and signaling current is transmitted over the line, the relay 25 will be operated. This removes a short circuit from the winding of relay 27 and causes it to operate. The short-circuit may be traced as follows: from the upper end of winding of relay 27, over contact and armature of relay 25, to the lower end of winding of relay 27. The operation of relay 27 will apply ground from its armature and contact over the contact and armature of relay 26 to the winding of relay 28, thus short circuiting the winding of relay 28 and causing it to release. The release of relay 28 causes ground to be applied from the contact and armature of relay 27 over the contact and armature of relay 28 to the winding of relay 29 and battery, thus operating relay 29. The relay 29 stays operated as long as the signal is applied. This is because relay 28 is short-circuited and released by the operation of relay 27 while the signal is applied. When relay 29 is operated the circuit for slow-release relay 30

will be broken and it will release. A circuit will then be completed as follows: from ground, armature and contact of relay 29, contact and armature of relay 30, winding of slow-release relay 31, to battery, thus operating relay 31. When relay 31 operates, the circuit for relay 17 will be completed over the armature and contact of relay 31 and the armature and contact of relay 29. Relay 29 will follow the code impulses or interruptions transmitted over the line and hence cause relay 17 to follow these code signals. The relay 17 will accordingly apply reversals to magnet 23 and cause the selector 18 to step ahead in accordance with the code signals. The slow-release characteristic of relay 31 will cause it to hold over the breaks between the groups of signal impulses. The operation of selector 18 will in a manner similar to that heretofore described with respect to Fig. 1, operate the indicating device 20 at station A. Speech currents on the line will cause the operation of relay 26 and even though relay 25 should also operate, it can have no effect since, with relay 26 operated, the ground from relay 27 will not short circuit relay 28 and relay 28 will not release. Relay 30 is utilized to provide a slight delay in the operation of the circuits so as to afford an additional safeguard against false operation.

In Fig. 3 is shown a further modification of the arrangements of the invention. It is pointed out that in the arrangements of the invention heretofore described, the ringers utilized, which are well known in the art, include rather elaborate provisions for protection against false signals. There is considerable discrimination, however, against false signals inherent in the railway selectors themselves and it may be found that this will permit the use of simpler arrangements in the signaling circuits. Such simplified arrangements are shown in Fig. 3.

In Fig. 3 there is provided at each station on the line a circuit 6 including an amplifier 40 and a rectifier 41, which may be of the copper oxide variety. In the output of the rectifier would be provided the polar relay 42 which would respond to and follow the code signal impulses. The operation of relay 42 would release slow-release relay 43 and operate slow-release relay 44. A locking circuit for relay 44 would be completed over its right-hand contact and the upper contact of relay 42. The slow release characteristics of relay 44 will cause it to hold over between the groups of pulses in the signaling code. Ground will now be applied to relay 17 over the left-hand inner contact of relay 44 and the contact and armature of relay 42, thus operating relay 17 in accordance with the code signal impulses. The railway selector 18 and the associated indicating circuits will then operate in a manner similar to that heretofore described.

It is pointed out that while specific signaling frequencies have been referred to in connection with the signaling currents utilized, these frequencies are for purposes of illustration only and other types of signaling currents may be used. Accordingly, while the invention has been described as embodied in certain specific arrangements which are deemed desirable, it is understood that it is capable of embodiment in many and other widely varied forms without departing from the spirit of the invention as defined by the appended claims.

What is claimed is:

1. A transmission line having a plurality of stations connected thereto, transmitting mechanism for applying to said line calling signals consisting of a series of impulses within the voice frequency range and having arbitrarily chosen characteristics and grouped in accordance with a predetermined code, signal responsive means at each of said stations actuated only by voice frequency signal impulses having said arbitrarily chosen characteristics but not by other impulses such as those caused by actual speech, selective switching mechanism at each of said stations controlled by said signal responsive means, and indicating devices at each of said stations each operated by the selective switching mechanism individual to said station.

2. A transmission line having a plurality of stations connected thereto, transmitting mechanism for applying to said line calling signals consisting of a series of impulses within the voice frequency range and having arbitrarily chosen characteristics and grouped in accordance with a predetermined code, signal responsive means at each of said stations actuated only by said voice frequency signal impulses having said arbitrarily chosen characteristics but not by other impulses such as those caused by actual speech, selective switching mechanism at each of said stations, a relay chain initially energized upon the functioning of said signal responsive means and adapted to repeat the code signals transmitted over said line to said selective switching mechanism to operate it in accordance with said code signals, and indicating means at each of said stations each controlled by the selective switching mechanism individual to said station.

3. A transmission line having a plurality of stations connected thereto, transmitting mechanism for applying to said line calling signals consisting of a series of impulses within the voice frequency range and having arbitrarily chosen characteristics and grouped in accordance with a predetermined code, signal responsive means at each of said stations actuated only by said voice frequency signal impulses having said arbitrarily chosen characteristics but not by other impulses such as those caused by actual speech, a first relay associated with said signal responsive means and operating in accordance with the code impulses transmitted over said line, a second relay energized upon the functioning of said signal responsive means, a locking circuit for said second relay completed over the contact of said first relay, said second relay having a slow release characteristic enabling it to hold over breaks between the groups of pulses of said code signals, selective switching mechanism, an operating circuit for said selective switching mechanism completed over a contact of said slow release relay and a contact of said first relay, and indicating means at each of said stations each controlled by the selective switching mechanism individual to said station.

4. A transmission line having a plurality of stations connected thereto, transmitting mechanism for applying to said line calling signals consisting of a series of impulses within the voice frequency range and having arbitrarily chosen characteristics and grouped in accordance with a predetermined code, signal responsive means at each of said stations actuated only by said voice frequency signal impulses having said arbitrarily chosen characteristics but not by other impulses such as those caused by actual speech, a first relay associated with said signal responsive means and operated in accordance with the pulsations of the signaling current and with the code im-

pulses of said signaling current transmitted over said line, a second relay having a slow release characteristic enabling it to hold over the pulsations of the signaling current and to follow the code signal impulses, selective switching mechanism, an operating circuit for said selective switching mechanism completed over a contact of said second relay when released and controlled by the operation of said relay in accordance with the code signal impulses, and indicating means at each of said stations each controlled by the selective switching mechanism individual to said station.

5. A transmission line having a plurality of stations connected thereto, transmitting mechanism for applying to said line calling signals consisting of a series of impulses within the voice frequency range and having arbitrarily chosen characteristics and grouped in accordance with a predetermined code, signal responsive means at each of said stations actuated only by said voice frequency signal impulses having said arbitrarily chosen characteristics but not by other impulses such as those caused by actual speech, a first relay associated with said signal responsive means and operated in accordance with the code impulses transmitted over said line when said signal responsive means operates in accordance with said code impulses, a second relay having a slow release characteristic enabling it to hold over the breaks between groups of pulses comprising said code signal impulses, a circuit controlled by said first relay for operating said second mentioned relay, said circuit being completed over the contact of another slow release relay to introduce a delay between the operation of said second relay by said first relay, selective switching mechanism, an operating circuit for said selective switching mechanism completed over a contact of said second relay when operated and controlled by the operation of said first relay in accordance with the code signal impulses, and indicating means at each of said stations each controlled by the selective switching mechanism individual to said station.

6. A transmission line having a plurality of stations connected thereto, transmitting mechanism for applying to said line calling signals consisting of a series of impulses within the voice frequency range and having arbitrarily chosen characteristics and grouped in accordance with a predetermined code, and means at each of said stations responsive to said voice frequency code signals, each of said responsive means comprising a circuit selective at said signaling frequency and including an amplifier, a rectifier, and a relay adapted to follow in its operation the code signals transmitted over said line, a slow release relay released upon the operation of said first relay, a third relay operated by said first relay upon the release of said second mentioned relay, said third relay having a slow release characteristic enabling it to hold over breaks between the groups of pulses comprising said code signals, selective switching mechanism, an operating circuit for said selective switching mechanism completed over a contact of said third relay and controlled by the operation of said first relay, and indicating means at each of said stations each controlled by the selective switching mechanism individual to said station.

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