July 12, 1938. F. E. WELD 2,123,220

ALTERNATING CURRENT SIGNALING SYSTEM

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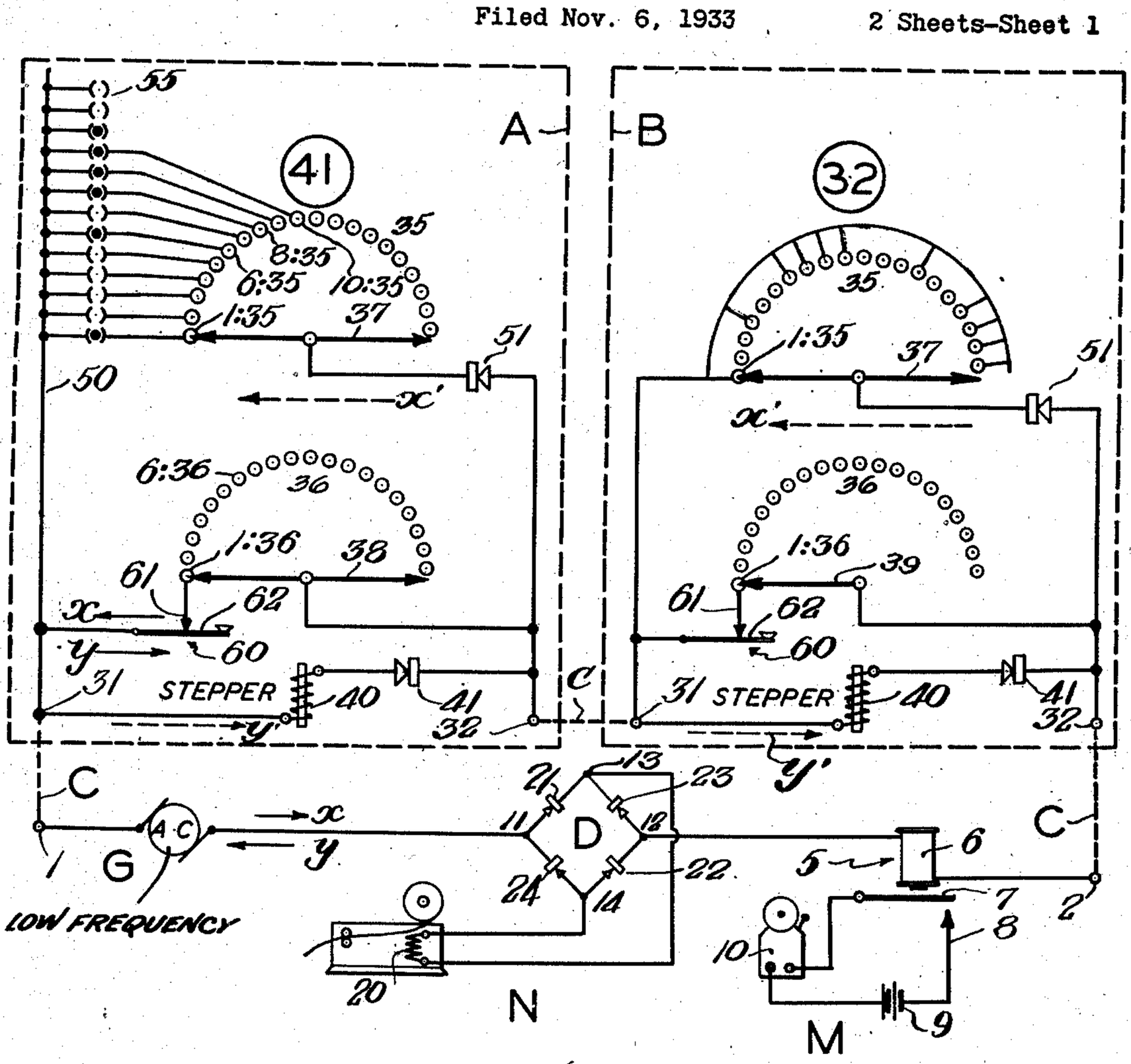


Fig. 1

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Fig. 3

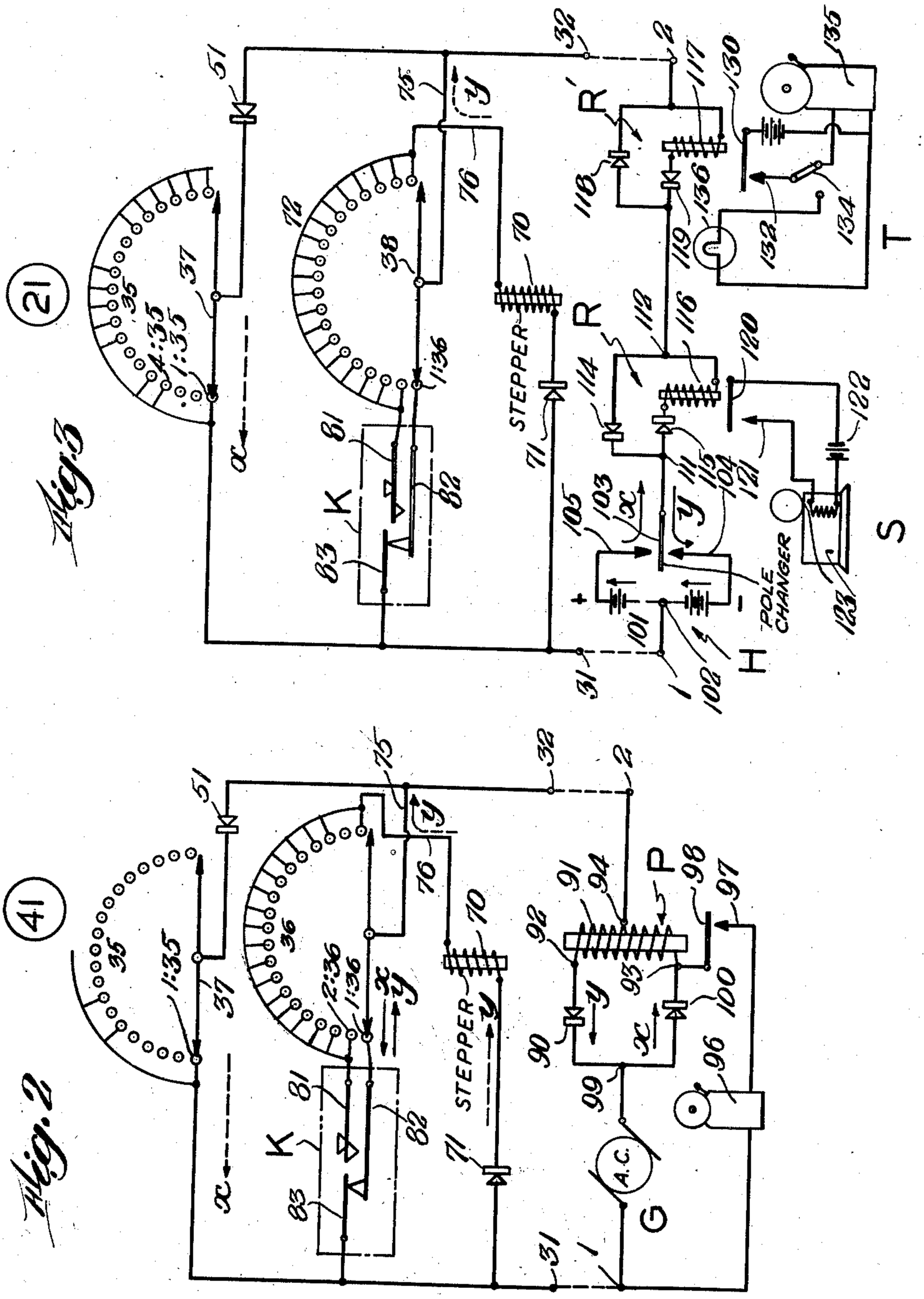


Fig. 4

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# UNITED STATES PATENT OFFICE

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## ALTERNATING CURRENT SIGNALING SYSTEM

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4 Claims. (Cl. 177—360)

This invention relates to signaling systems and more particularly to that type of such systems comprising fire alarm, burglar alarm, and similar installations which employ circuits that are normally closed, signals being transmitted by changing in some manner the normal current flow of the circuit.

The main object of the present invention is to provide a signaling system of this kind which is extremely simple and therefore inexpensive and yet reliable, employs alternating or otherwise fluctuating current and utilizes this current, in a peculiar manner, with the aid of unidirectional conductors, for the automatic despatching and the manifestation of code signals. Other objects are to provide such a system which employs alternating current in its normally closed signal circuit, but permits the use of direct current as well as alternating current signal manifestation apparatus, to provide a signal system of this character utilizing in its signal transmission devices or alarm boxes, conventional telephone selector switches, and in addition thereto only a few simple and inexpensive elements as key switches and rectifier cells, permitting the setting up and changing of the code number allotted to each box in a simple manner merely involving the changing of a few electric connections, and using conventional signal manifesting devices.

In another aspect, the invention proposes a signaling system with a transmission circuit normally supplied with current impulses changing their direction at regular intervals, the signals being despatched by causing the suppression of preselected current impulses representing code signals.

Still another feature of the invention is an alarm box which does not employ the conventional code wheel for forming code signal numbers, but a selector switch connecting a switch element step by step with a series of contacts, the signals being formed in a purely electrical manner with the aid of these contacts, which makes their selection and change especially easy. Signal transmission is also initiated by purely electrical means. It is, therefore, evident that the new system involves a radical departure from the conventional design of fire alarm systems with their delicate and complicated alarm box mechanisms.

These and other objects and characteristics of my invention will be apparent from the following description which illustrates its genus and various concrete embodiments thereof. The description refers to drawings with three figures representing connection diagrams of circuits according to the invention.

Referring to Fig. 1, C is a signal circuit or line serially including a number of alarm boxes represented by devices A and B and leading to terminals 1 and 2 of a central station. G is a generator furnishing alternating current of low frequency, for example two to five cycles per second. It is understood that, although an alternating current generator is preferably used, any device providing regularly changing current impulses, as for example pole changers, may be employed.

A signal manifesting device of very simple construction is indicated at M, comprising an alternating current relay 5 with magnet 6, armature switch member 7 and contact 8, contacts 7 and 8 being part of a circuit including battery 9 and gong 10. Magnet 6 attracts armature 7 as long as it is supplied with alternating or pulsating current, or during any half wave period when current flows for a short time in either direction. It drops its armature during any period when a half wave or current impulse, of either direction is omitted.

Another type of signal manifesting device is shown at N, where D is a rectifier bridge with four terminals 11, 12, 13, 14, and four rectifier cells 21, 22, 23, 24, terminals 11 and 12 being connected in the signal circuit and terminals 13 and 14 supplying in well known manner unidirectional current to a manifesting device of conventional design, for example a tape recorder 20.

Alarm box A has two terminals 31 and 32 to which three circuits, hereinafter referred to as transmitting circuit, maintenance circuit, and actuating circuit, are connected. The alarm box has further a conventional stepper switch of the telephone selector type with two contact banks or selector units 35, 36 over which play two double armed wipers 37, 38, respectively, which are mechanically or otherwise interconnected and actuated in unison by actuator magnet or stepper 40. This magnet is of the well known type which advances its wipers one step for each deenergization. Magnet 40 is connected in series with a unidirectional conductor, for example a rectifier cell 41, which conducts current substantially only in the direction indicated by the arrow of its symbol, magnet 40 and rectifier 41 forming the actuating circuit.

The contacts of the selector units will be designated by numbers separated by a colon from the numeral of the respective selector unit, 1:35 being, for example, the first contact of unit 35. These selector contacts can be severally connected to selector bus 50, by means of a bank 55 of conventional switching elements etc., herein called set up switches, which may be push button switches, plug connectors, or similar means, two fixed contacts with a connecting block being, for example, shown for each selector contact of Fig. 1. It will be evident that in this manner any desired group of selector contacts can be electrically connected through bus 50 to terminal

31 and the signal line and any code number signal set up in this manner. In the present instance the number "41" is selected for box A, and it is assumed that several groups "41" with appropriate intervals or pauses are set up, the number of possible digits or the number of repetitions being of course dependent upon the number of available selector contacts, of which there may, for example, be sixty. Wiper 37 is in series with rectifier 51, bus 50, one of the set-up switches and one of the selector contacts, these elements forming the transmitting circuit. Rectifier 51 conducts current substantially only in the direction opposite to the direction in which rectifier 41 conducts.

The first contact 1:36 of selector unit 36 is connected to the fixed contact 61 of a starting key 60, whose movable member 62 is joined to bus 50. The other contacts of 36 are electrically disconnected. Starting key 60, contact 1:36 and wiper 38 form the maintenance circuit.

Alarm box B is quite similar to box A, with the difference that the selector contact connections are shown as permanently established, two groups of the code signal "32" being set up. Also, the wiper 39 of the maintenance selector has only one arm which causes a repetition of the signal, as will be explained hereinafter.

It is assumed that in each alarm box of the circuit, the code signal to be despatched therefrom is set up by establishing the appropriate connections between selector units 35 and busses 50, the numbers "41" and "32" being chosen in the present instance for boxes A and B, respectively.

Under normal conditions, the alternating current generated at G passes through line C and the shunting maintenance circuits 31—62—61 (starting key)—1:36—38 (selector unit 36)—32 of the alarm boxes, as indicated by full line arrows $x$ and $y$, substantially no current flowing through the transmitting and actuating circuits and devices N and M being in inoperative condition with the armature of elements of 20 and 5 attracted. If a signal is to be despatched, key lever 62 (for example of box A) is depressed, which interrupts the maintenance circuit. One series of the alternating current half waves is now flowing through the transmitter circuit and the other series through the actuating circuit, in the directions indicated with dotted arrows $x^1$ and $y^1$. During the interval between the first half waves passing through magnet 40, the latter advances its wipers one step, thereby interrupting contact at 1:35 and 1:36. The interruption at 1:36 opens the maintenance circuit so that key 60 can be released immediately without again closing the maintenance circuit. The opening of the transmitting circuit at 1:35 eliminates the half wave series $x^1$ heretofore passing therethrough and forming with the actuator circuit half wave $y^1$ an alternating current maintaining the manifesting means in normal condition. This elimination of the first half wave of series $x$ causes magnet 6 to drop armature 7, establishing contact at 8 and sounding a stroke at gong 10. Similarly, the direct current furnished by rectifier bridge D is interrupted and relay 20 caused to start its tape gear train and to record one impulse. The next half wave omitted at 40 steps the wipers to contacts 3:36 and 3:35, respectively, and causes another recording of one signal impulse, contact 3:35 being also unconnected. In this manner, the wipers are advanced to contacts 6:35 and 6:36, respectively. With wiper 37 at 6:35, magnet 40 continues to advance the wipers, but contact 6:35, being plugged to bus 50, permits one half wave of series $x$ to pass through the transmitting circuit, constituting a full wave with the half wave of series $y$ passing through the actuating circuit, and causing one signal stroke to be omitted. After this pause, one stroke is sounded when wiper 37 is at contact 7:35, whereas strokes are again omitted for contacts 8:35 to 10:35. It will now be evident that any signal set-up at the alarm box can be transmitted in this manner, whereby the number "41" could be repeated after a suitable pause, for example corresponding to four omitted strokes, as indicated for box B, or additional digits could be transmitted if they had been set up after "4" and "1".

After wiper 38 has reached the last contact of selector unit 36, contact is again made at 1:36 by the second wiper arm, and the shunting maintenance circuit reestablished. Substantially no current passes through magnet 40 which therefore stops actuation of the wipers, so that normal condition is reestablished with the starting key 60 closed, wiper 37 at contact 1:35 and wiper 38 at contact 1:36.

Referring to box B, it will now be evident that due to the fact that wiper 39 has only one arm, the signal "32" will be repeated four times instead of two times, that is, until the wiper 39 reestablishes contact at 1:36. By causing wiper 39 to rotate slower than wiper 37 by means of reduction gearing or by any equivalent means, the signals can be repeated any number of times, until 39 makes contact at 1:36.

The modification according to Fig. 2 is in principle similar to that of Fig. 1. There are a transmitting, a maintenance, and an actuating circuit with a stepper magnet 70 moving its wipers 37 and 38 one step forward either upon each attraction or each retraction of its armature. Unit 35 is connected exactly as in Fig. 1. The first and second contacts 1:36 and 2:36, respectively, of unit 36 are electrically joined to contacts 81 and 82 of the starting key K, and the remaining contacts are connected to contact 2:36 as indicated in Fig. 2. The key K is of the make before break type, that is, upon depressing contact 81, connection is first established between 81 and 82 and then broken between 82 and 83. Contact 83 is connected to terminal 31 and wiper 38 to terminal 32 through lead 75. In series with magnet 70 is connected rectifier 71 conducting current as indicated, the other magnet terminal leading through 76 to the interconnected contacts of selector unit 36.

The receiving station has again a generator G, but is otherwise somewhat modified. A relay P has a magnet 91 with two end terminals 92 and 93 and an intermediate terminal 94. Terminals 92 and 93 are connected to the generator through rectifier cells 90 and 100, respectively, which conduct current in opposite directions. Between terminals 1 and 93 are connected in series a gong 96, a fixed contact 97 and an armature contact 98, the latter being attracted by magnet 91 if current flows in both winding halves of the latter. If the transmitting circuit is interrupted at wiper 37 current will flow only in the direction indicated by the arrow $y$ and relay P will be deenergized during each half cycle in which the current flow (in the direction indicated by the arrow $x$) is interrupted by wiper 37. During each such deenergization of relay P, its armature 98 drops and makes contact with 97. This closes a circuit through the gong 96 so that the gong is actuated by the half

wave flowing from the generator G through circuit G—99—100—93—98—97—96—1—G in the direction indicated by the arrow *x*, one stroke being sounded for each such half wave.

Under normal conditions, contacts 82 and 83 close a direct path for alternating current from 1 through 31—83—82—1:36—38—75—32 to 2. When K is depressed, 81 and 82 establish a circuit from 31 through 71—70—76—72—81—82—38—75 to 32. When shortly afterwards contact is broken at 82 and 83, the half wave series *y* can flow through magnet 70, termination of which thereupon shifts the wipers one step on to contacts 2:35 and 2:36 respectively. This establishes a circuit 31—71—70—76—72—38—75—32 and interrupts the key circuit at 1:36 so that the key can now be released without reclosing the maintenance circuit. Magnet 70 now advances the wipers step by step, until the second arm of wiper 38 makes contact at 1:36 when the other arm leaves the last contact of 36 and the circuit is restored to normal condition. As explained in connection with Fig. 1, the contact arrangement of unit 35 eliminates as many half waves of series *x*, flowing in the direction permitted by rectifier 51, as contacts of selector 35 are open. For each such omission the windings of magnet 91 are deenergized, switch 98 drops and closes the gong circuit. It is evident that this arrangement permits operation of the manifesting device 96 with alternating current directly derived from the generator, and therefore rather powerful, whereas the half wave series operating relay magnet 10 of Fig. 1 is comparatively weaker, since its circuit includes the entire outer signal loop.

The modifications according to Figs. 1 and 2 operate in such a manner that each half cycle of the alternating current effects one code manifestation, so that the alternating current frequency must be rather low in order to obtain well distinguishable signals. The modification according to Fig. 3 permits the utilization of alternating current sources of higher frequency, or of pole changers or similar devices. In this figure the alarm box arrangement is the same as in Fig. 2 with the only difference that, in selector circuit 35, there is not only one unconnected contact for each code signal unit or stroke, but a plurality of such contacts, for purposes which will presently become evident.

The station has a current supply, in this embodiment a pole changer of conventional design with battery 101 having an intermediate terminal 102, an oscillating switch member 103 and two contacts 104 and 105 connected to the negative and positive poles respectively of the battery and alternately reached by member 103.

The receiving devices may be of various design, and may be either connected for direct actuation by the main line current supply or may be actuated from a separate or local current supply by means of a main line relay. In either event, rectifier cells should be connected in series and in parallel with the winding of the magnet in the main line circuit, as follows: Between terminals 111 and 112 of the main signaling circuit are connected in parallel a rectifier cell 114 conducting current substantially only in the indicated direction and a second rectifier cell 115 conducting current in the other direction and in series with the winding 116 of relay R. This connection of rectifier cells in series and parallel with the winding 116 permits energization of this winding by the series of half wave impulses which flow in the direction of the arrows *x*. The parts are of such relative construction that the armature 120 is held in attracted position throughout an uninterrupted series of such half wave impulses, but retracts in response to the omission of any impulse from such a series.

The armature member 120 may control manifesting apparatus of various types. For example, a recorder 123 may be connected in series with a battery 122, armature 120 and contact 121 of relay R, as shown at S in Fig. 3, so that, upon each retraction of armature 120, the recorder 123 will operate in well known manner.

The relay R' of Fig. 3 has a rectifier cell 119 connected in series with winding 117 and a rectifier cell 118 connected in parallel with said cell 119 and winding 117. This arrangement is similar to that for relay R, except that the rectifier cells 118 and 119 are so connected as to permit energization of winding 117 by the series of half wave impulses which flow in the direction of the arrows *y*, instead of *x*. The parts of relay R' and the associated rectifiers are of such relative construction that armature 130 is held in attracted position throughout an uninterrupted series of such half wave impulses, but retracts in response to the omission of any impulse from such a series. and is, in this respect, similar to relay R, except that it is energized by half wave impulses flowing in the opposite direction.

The armature member 130 of relay R' may control manifesting apparatus similar to that provided for relay R, as shown at S in Fig. 3, or, a bell 135 and lamp 136 controlled by switch 134 may be provided as shown at T in Fig. 3. With this arrangement, when armature 130 drops, a circuit is closed through either the bell 135 or the lamp 136, depending upon the positioning of switch 134, in well known manner.

From the foregoing it will be apparent that the manifesting apparatus controlled by relay R will respond to each stroke of the signal transmitted, while the manifesting apparatus controlled by relay R' will respond only to interruption of the actuating impulses such as would occur in the event of a broken line wire or failure of the current supply to the circuit. In other words, the apparatus at S comprises signal manifesting means while that at T comprises trouble manifesting means.

The circuit according to Fig. 3 functions as follows: Under normal conditions, both half wave series pass through circuit

31—83—82—1:36—38—75—32

as described for Fig. 2. In the receiving station armatures 116 and 117 are maintained in attracted position by the respective half wave series permitted to pass through rectifiers 115 and 119. Upon depressing key K, the half waves of series *y* passing through rectifier 71 advance the wipers, as described before. Considering now, for example, receiver S, when wiper 37 contacts at 2:35 and 3:35, only the respective half wave series *y* flows in circuit

1—31—71—70—76—72—38—75—32—2—117—119—112—114—111—103—104—102—1.

This circuit does not include coil 116 so that armature 120 drops and effects manifestation of one code unit. Upon wiper 37 reaching contact 4:35, a circuit for the other half wave series *x* is established as follows:

1—102—105—103—111—115—116—112—118—2—32—51—37—4:35—31—1.

This circuit again energizes coil 116 and lifts

armature 120. The brushes of wiper 37 should be of the make before break type, so that this circuit is maintained until wiper 37 reaches unconnected contact 6:35, whereupon series *x* is again eliminated and coil 116 again deenergized effecting a signal manifestation at 123. It will be evident that the stroke intervals can be adjusted in accordance with the current frequency by leaving unconnected, and connecting, at 35, any desirable number of consecutive selector contacts. It will also be evident that by connecting an appropriately large number of consecutive contacts representing pauses (for example 4:35 and 5:35, and 8:35 to 12:35 of Fig. 3) these pauses can be adjusted in any desirable manner, independently of the frequency of the current supply.

The winding 117 of relay R' is normally energized by the half wave series *y* through the following circuit:

1—31—83—82—1:36—38—75—32—2—117—119—112—114—111—103—104—102—1.

When key K is pressed, the half wave series *y* flow through the stepper magnet winding 70 instead of through the key as hereinbefore explained in detail, and the flow of such half wave series through winding 117 is therefore maintained throughout signal transmission as well as during inactivity of the circuit.

However, should the current path for the half wave series *y* be interrupted, as by a break in either of the line wires connecting terminals 1—31 or 2—32, or should the alternating current supply to the circuit fail, then relay R' will drop its armature 130 and thereby give a warning signal by means of either the bell 135 or lamp 136.

It should be understood that the present disclosure is for the purpose of illustration only and that this invention includes all modifications and equivalents which fall within the scope of the appended claims.

I claim:

1. In a signaling system of the character described, in combination a signal circuit, serially including an alternating current source, signal transmitting means, and signal manifesting means responsive to omission of any half waves from said alternating current source, said transmitting means comprising a selector switch with a series of selector contacts, a maintenance contact, a wiper for said contact series, a second wiper for said maintenance contact and an actuator having a stepping magnet operable by alternating half waves from said source for advancing said wipers one step in response to each such half wave flowing therethrough, an actuating current path serially including said magnet in said signal circuit and means for substantially excluding from said actuating current path current flow in one direction, a maintenance current path including in series a key switch, said maintenance contact and said maintenance contact wiper, and a transmitting current path including in series certain predetermined and interconnected selector contacts, said selector contact wiper and means for substantially excluding current flow in the other direction, said maintenance and transmitting current paths being connected in parallel with said actuating current path.

2. In a signaling system of the character described, in combination a signal circuit, an alternating current source, signal transmitting means and signal manifesting means in series therein, said transmitting means comprising a selector switch with a series of selector contacts, a series of maintenance contacts, a wiper for each contact series and an actuator advancing said wipers one step upon each current impulse passing therethrough thereby to render ineffective certain of the current impulses from said source in accordance with a predetermined code, a maintenance current path including in series a key switch, the first contact of said maintenance contact series and said maintenance contact wiper, an actuator current path including in series said actuator, the interconnected remaining contacts of said maintenance contact series, a maintenance switch contacting with said first contact upon opening of said key switch and means for substantially excluding current flow in a certain direction through said actuator, and a transmitter current path including in series certain predetermined and interconnected selector contacts, the selector contact wiper and means for substantially excluding from said transmitter current path current flow in the other direction, said paths being connected in parallel between the signal circuit terminals of the transmitting means, and said manifesting means being differentially responsive to combinations of effective and ineffective current impulses in different directions.

3. A signal transmitter comprising a selector switch with a series of selector contacts, a series of maintenance contacts, a wiper for each contact series and an actuator advancing said wipers one step upon each current impulse passing therethrough, a maintenance current path including in series a key switch, the first contact of said maintenance contact series and said maintenance contact wiper, an actuator current path including in series said actuator, the interconnected remaining contacts of said maintenance contact series, a maintenance switch contacting with said first contact upon opening of said key switch and means for substantially excluding current flow in a certain direction through said actuator, and a transmitter current path including in series certain predetermined and interconnected selector contacts, the selector contact wiper and means for substantially excluding therefrom current flow in the other direction, said paths being connected in parallel.

4. In a signaling system of the character described, in combination a signal circuit normally closed and in series therein a source of current impulses alternating in opposite directions, signal transmitting means eliminating certain impulses of one direction in accordance with a signal code, and signal manifesting means comprising in parallel two magnet windings each in series with unidirectional conductors passing current substantially only in opposite directions, and a manifesting circuit including in series said source, a signal receiver, a switch and one of said unidirectional conductors, said switch being normally held open by said magnet windings and closed incidental to omission of an impulse of said direction.

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