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SIGNALING APPARATUS

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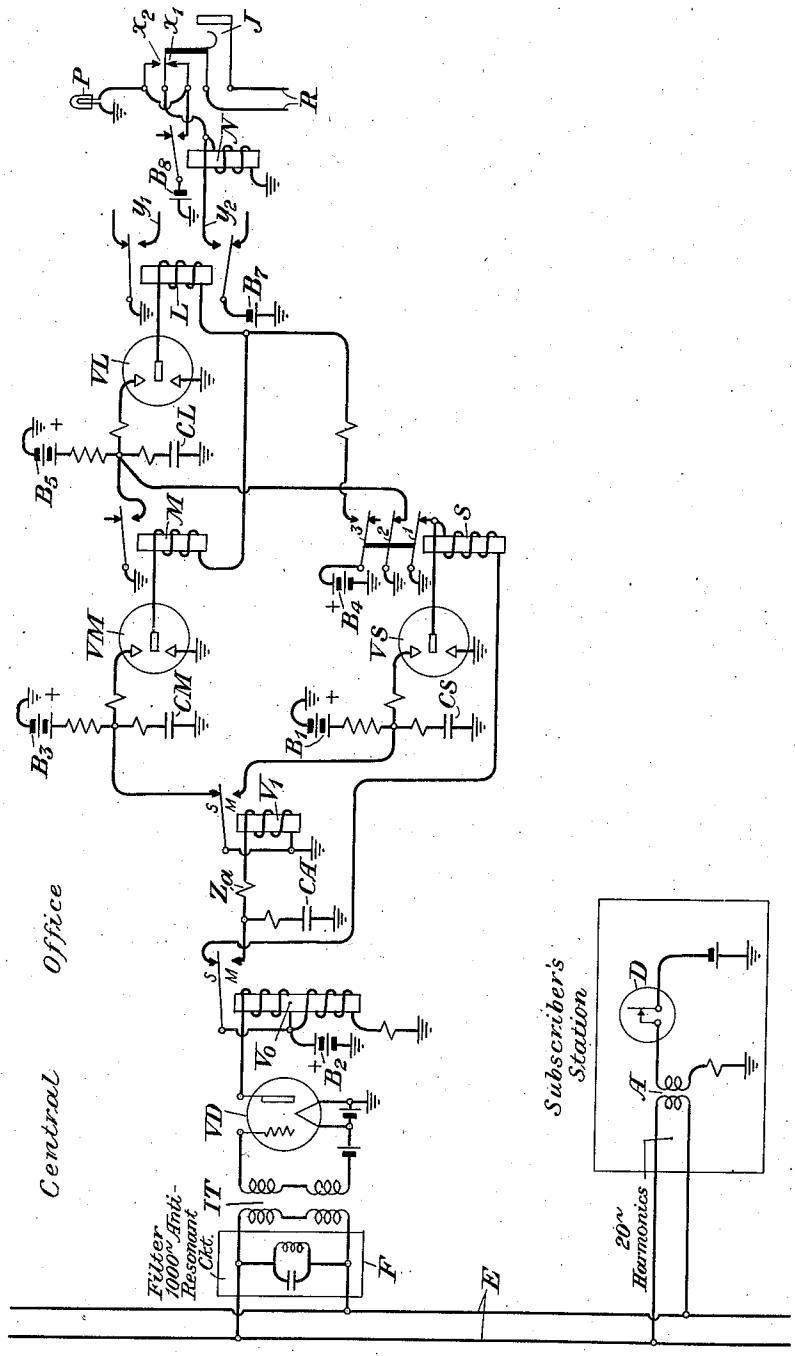

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SIGNALING APPARATUS

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This invention relates to signaling systems and, more particularly, to systems employing apparatus for producing modulated currents to be transmitted to various parties connected to a telephone line for ringing or other purposes.

One form of ringing system in use at present for ringing any one of a plurality of parties connected to a telephone line involves the transmission of a ringing current consisting of a predetermined number of dots and dashes which are simultaneously transmitted to all of the parties, the ringing current being rendered audible at each party's station. The combination of dots and dashes assigned to any one of the parties is different from that assigned to any other party. Each party will therefore hear every ringing signal transmitted over the line to any of the other parties and the only party who will answer the call will be the one whose ringing code has been received. This form of ringing system which may be arranged so that any party may be rung by any one of the other parties or by the central office operator requires all of the parties to listen to all of the codes received so that each party may be ready to respond only to the code assigned to him.

In order to provide a more selective and positive ringing system a novel arrangement has been devised requiring only a standard dial at each subscriber's office and apparatus at the central office to respond to the manipulations of the dial at any subscriber's offices. In the proposed arrangement, each dial may be operated a predetermined number of times, each dial operation being employed to produce a number of clicks or pulses on the telephone circuit, the number of clicks or pulses corresponding to the number dialed. At the central office a predetermined harmonic of the pulses produced by the dial will be selected and caused to operate a relay for an interval of time which is different for the numbers to be dialed. If the number 0 is dialed, for example, the relay will be operated for a longer interval of time than if the number 5 is dialed. The repeated operations of the relay may then be caused to operate a selective circuit for ringing any one of the various parties to the exclusion of all of the other parties.

This invention will be better understood from the detailed description hereinafter following, when read in connection with the accompanying drawing which illustrates the dialing apparatus at each subscriber's station and apparatus at the central office which will respond to the dial operations. The drawing shows only the dial or signaling apparatus, but the apparatus for producing speech or like signals as well as apparatus for responding to the speech or like signals will not be shown.

Referring to the drawing, one of a number of subscribers' stations is shown including, among other things, a dial D having a contact which is shown in its normal or closed position. The subscriber's station is connected by a telephone circuit E to the central office. At the central office there is located a filter F, a vacuum tube amplifier VD, a relay V_0, one of the windings of which is connected to the plate circuit of the vacuum tube VD, a relay V_1 which is connected to one of the contacts of the relay V_0 through a circuit including a condenser CA and a resistor Z_a, and two parallel circuits which are connected to the two contacts of the relay V_1. One of these parallel circuits includes a condenser CS, a gas tube VS, and a relay S. The other parallel circuit includes a condenser CM, a gas tube VM, a relay M, a condenser CL, a gas tube VL and a relay L. The winding of relay L is also connected to one of the contacts of the relay S which is in the other parallel branch. The upper terminal of condenser CL is connected to another of the contacts of relay S. Relay L may be employed to control a relay N.

When the dial D at the subscriber's station is operated in the usual way for dialing, let us say, numbers 5 or 0, the arrangement will act in response to the dial operations to energize the winding of the relay L at the central office, the relay L being operated for either of the numbers dialed. The circuit may be adjusted so that the operation of the relay L when the digit 5 is dialed will take place for an interval of time as, for example, two-tenths of a second. The relay L will be operated for about seven-tenths of a second when the digit 0 is dialed.

When dialing No. 1, for example, the primary circuit of transformer A will be opened once and closed once by the contacts of dial D. Upon the opening of this primary circuit, a surge of current traverses the primary of transformer A, and a similar and second surge traverses the primary of transformer A upon the closure of the primary circuit. Each of the two surges of current in the primary of transformer A will produce a complete and independent pulse of current in the secondary of transformer A. Thus by dialing No. 1, two complete pulses of current will be transmitted by transformer A to line E. Hence by dialing No. 5, ten complete pulses of current will be transmitted over line E. Furthermore,

by dialing No. 0 (which is the equivalent of dialing a No. 10) twenty complete pulses of current will be transmitted over line E. These pulses of current are, of course, not pure sine waves, but transients. As the dial D is of the type which is generally timed to produce these twenty pulses in about one second, the transients produced and transmitted over line E occur at the rate of twenty per second. Similar transients are produced upon dialing any other number. However, the number of transients produced and transmitted over line E will simply be twice the number dialed by dial D. Hence when dialing No. 5, ten transients will be produced and transmitted over line E, and these ten transients will occur within about one-half of a second.

The filter F at the central office may comprise one or more anti-resonant circuits similar to the one shown, the anti-resonant circuit or circuits being tuned to, for example, 1000 cycles—which may be considered to be the fiftieth harmonic of the pulses produced by the dial. The filter F will transmit the 1000 cycle harmonic to the tube VD to be amplified thereby. The upper winding of relay V_0 which is a polar relay will receive the 1000 cycle current which is interrupted at the 20 cycle rate by the dial contact and the armature of the relay V_0 will therefore operate and release at the 20 cycle rate in accordance with the 1000 cycle current which traverses its winding.

Thus the relay V_0 will operate and release once for each dial click or pulse. Inasmuch as two clicks or pulses are produced for each unit of the number dialed, as already stated, the relay V_0 will operate twice for each unit of the number dialed. It will be shown hereinafter that the circuit interconnecting the armature of relay V_0 and the winding of relay L is set up so that the dial clicks or pulses may operate the relay L for different intervals of time, the intervals depending upon the number dialed. The interposed circuit is also arranged so that speech and other extraneous voltages will be unable to actuate the relay L.

During the idle condition of the circuit the contact of the dial D is closed and no current will be flowing over the telephone circuit E. Relay V_0 will be held released by the bias current continually traversing the lower winding of relay V_0, the armature of relay V_0 resting upon its contact S as shown in the drawing. No current will be flowing through the winding of the relay V_1, its armature also resting against its contact S. The condenser CS will, however, be charged to the voltage of the battery B_1. This voltage will be higher than that required to ionize the gas between the input or control electrodes of the tube VS and, hence, the gas between these electrodes will be ionized. The relay S will be energized by the flow of current from battery B_2 through a circuit completed through the armature and contact S of relay V_0, the winding of relay S, the armature designated 1 of relay S and its make contact and ground. With the winding of relay S energized, ground will be connected to the anode of tube VS by armature 1 of relay S and, hence, no current will flow through the output circuit of tube VS. The operation of relay S transfers the flow of current from battery B_2 (through the winding of relay S) to ground so that this current will not traverse tube VS. Thus the time during which tube VS carries current is reduced and hence the life of the tube is enhanced.

During the idle condition of the circuit, moreover, the upper terminal of condenser CM will be connected to ground through the armature and back contact S of relay V_1 and, hence, this condenser will be discharged. Therefore, the gas tube VM will be deionized. The relay M, which has its winding in series with the anode of the tube VM, will then be unoperated, as shown. The condenser CL will be discharged because its upper electrode will be connected to ground through the armature 2 of relay S and its make contact. With condenser CL discharged, the tube VL will be deionized and, therefore, the relay L will be released. Relay N will also be released and lamp P extinguished. Both tubes VM and VL are deionized for the further reason that plate voltage from battery B_4 cannot reach these tubes, the circuit from battery B_4 being opened at the contact of armature 3 of relay S.

Assume now that the dial D of the subscriber's station is rotated in a clockwise direction for dialing any desired digit and that it is then released so that the dial may rotate in a counterclockwise direction to open and close its contact several times depending on the number dialed. As the dial contact opens, it produces a click which interrupts the current flow over the primary winding of transformer A. The interruption of the primary circuit will induce a current in the secondary circuit which is of a frequency dependent upon the constants of the dial apparatus as already stated. With a standard dial the secondary of the transformer of the circuit will have induced therein a 20 cycle current along with its numerous harmonics. The fundamental and all harmonics will be suppressed by the filter F except the fiftieth harmonic which is of 1000 cycles, the latter current being then transmitted to the vacuum tube VD and amplified thereby. The amplified current will flow through the upper or operating winding of the relay V_0. This current will produce a magnetic effect in the upper or operating winding of relay V_0 to overcome the opposing magnetic effect of the biasing current flowing through the lower winding of relay V_0 and thereby cause the armature of the relay to move to its contact M. The closure of contact M by the armature of relay V_0 will then allow current to flow from battery B_2 through the impedance Z_a and through the winding of relay V_1, thereby causing the armature of relay V_1 to close its contact M. At the same time the relay S will become released due to the opening of the circuit between battery B_2 and the winding of relay S at the contact S of relay V_0. Upon the closure of contact M of relay V_1 the upper plate of condenser CS will be grounded and the condenser will then discharge so that the gas between the input or control electrodes of tube VS will become deionized. Moreover, the removal of ground from the upper plate of condenser CM upon the operation of relay V_1 will allow condenser CM to become charged by current supplied by battery B_3. Upon the release of the relay S the positive potential of battery B_4 will be applied through the armature 3 of the relay S and the winding of relay M to the anode of tube VM. However, the charge on condenser CM will not be raised to the value required to ionize the gas between the input electrodes of tube VM unless relay V_1 operates for a longer time than the time required for one click or pulse of a standard dial. Hence relay M will remain unoperated. The release of relay S also removes ground from the upper plate of condenser CL theretofore provided through the armature 2 of relay S, thereby allow-

ing condenser CL also to charge. A positive potential is likewise applied by battery B_4 to the anode of tube VL through the winding of relay L, but for similar reasons tube VL will not be fired and relay L will therefore remain released.

At the termination of the first click or pulse of the dial, current will cease to flow through the primary winding of transformer A and, hence, no current will be transmitted over line E. The absence of current through filter F and through tube VD will cause relay V_0 to release, its armature then returning to its contact S. The current that flows through the upper winding of relay V_0 when no pulse is received by filter F is quite small and insufficient to overcome the biasing effect of the current traversing the lower winding of this relay and hence relay V_0 will remain released. While relay V_0 is released, battery B_2 will be disconnected from the winding of relay V_1, thereby releasing relay V_1, the armature of relay V_1 then closing its contact S. At the same time the positive potential of battery B_2 will be applied to the anode of tube VS through the armature and contact S of relay V_0 and the winding of relay S. As the armature of relay V_1 also leaves its contact M the condenser CS will then be charged by current supplied by battery B_1, but the tube VS will remain deionized because the voltage on condenser CS will be insufficient in the time after the first click or pulse to reach the value required to ionize the gas between the input electrodes of tube VS. Also the condenser CM will be discharged through the circuit provided by the armature and contact S of relay V_1.

As the dial contact becomes closed at the end of the first unit of the number dialed, the dial remaining in rotation thereafter, another click or pulse will be produced. This will result in the transmission through the filter F of a similar 1000 cycle current. The armature of relay V_0 will again move to its contact M and the cycle of events similar to that already described for the opening of the dial contact which produced a like current will be repeated, but this need not be further described. The same series of events will take place with each opening and closure of the contacts of the dial D as the dial rotates in a counter-clockwise direction after it is released. It will be observed, however, that the relay S, though normally operated in the idle condition, becomes released as the dial rotates to close its contact and relay S stays released throughout the movement of the dial.

After a predetermined interval of time as, for example, about three-tenths of a second after the dial D has first opened its contact, the condenser CL will reach a voltage upon charge which is sufficient to ionize the gas within the control gap of the tube VL. This time interval is dependent upon the size of the condenser, the potential of the battery B_5 and other circuit constants. After the tube VL becomes fired the relay L will become operated due to the flow of current from battery B_4 through the circuit established by armature 3 of relay S after relay S has become released. The relay L will remain operated until dial D has come to rest and finally closed its contact.

Upon the operation of relay L, relay N will be operated, current being supplied to the winding of relay N from battery B_7 through the lower armature and its front contact. In operating, relay N becomes locked in its operated position, the locking circuit comprising battery B_8, the upper armature and make contact of relay N, contact X_1 of jack J, the winding of relay N and ground. The armature of relay N may also be used to complete a circuit to lamp P to apprise the operator that the subscriber has signaled her. The operator may then insert her plug into jack J to connect her cord to line R. The insertion of her plug into jack J momentarily breaks the holding circuit for relay N and, therefore, the latter relay releases, extinguishing lamp P. The subsequent reoperation of relay N makes possible a recall signal by re-illuminating lamp P while the operator's plug is still in jack J.

When the dial D closes its contact at the end of its rotation, the relay V_0 will thereafter become released, which in turn will cause the relay V_1 to become released. The relay of relay V_0 will allow the positive potential of battery B_2 to be applied through the armature and contact S of relay V_0 and the winding of relay S to the anode of tube VS. As the charge on condenser CS reaches a sufficient value, the tube VS will become ionized, the ionization occurring after a predetermined interval of time as, for example, about 35 milliseconds after the dial has come to rest. As the tube VS becomes ionized current will flow through the winding of relay S, causing its operation. But as relay S operates, it connects the anode of tube VS to ground through its armature 1 and its make contact. The armature of relay S then opens the circuit between battery B_4 and the anodes of tubes VL and VM, causing both tubes to become deionized. As tube VL becomes extinguished, the relay L will become released and remain released thereafter. Thus the circuit arrangement will be returned to its idle condition.

It will be observed that the arrangement at the central office includes a filter F which is tuned to about 1000 cycles and a network interposed between the filter F and relay L which acts like a 20 cycle filter. This combination of circuits is designed to prevent voice currents from operating the relay L, as will be explained hereinafter. The network interposed between filter F and relay L distinguishes between the series of clicks or pulses produced by dialing the number 5, for example, and the series of clicks or pulses produced by dialing 0, the distinction being based upon the fact that the first series of clicks or pulses—which may be approximately five-tenths of a second long—may operate relay L for, let us say, about two-tenths of a second, while the second series of clicks or pulses—which may last about one second—may operate the relay L for about seven-tenths of a second.

It has been pointed out hereinabove that relay V_1 is operated in response to each operation of relay V_0. The condenser CA is interposed between the armature of relay V_0 and the winding of relay V_1 as already noted. This condenser in discharging holds the relay V_1 operated for a few milliseconds after relay V_0 has released. The value of the hold-over feature is such that if the relay V_0 operates faster than say 25 times per second, the winding of relay V_1 will then receive sufficient current from condenser CA to remain in an operated condition during the repeated releases of relay V_0. For vibrations of the armature of relay V_0 which are slower than about 25 times per second, the relay V_1 will, therefore, follow relay V_0 in its operations. This arrangement, therefore, determines the upper limit of the 20 cycle filter network already described and may fix the upper limit at about 25 cycles or at any other desired value. The circuit following the

relay V_1 will fix the lower limit of the filter network as will be explained hereinafter.

During a continuous succession of dial clicks or pulses, produced by the release of dial D at the proper speed, neither of the condensers CM or CS will be left ungrounded long enough to charge the respective control electrodes of the tubes VM or VS to their ionizing voltages and therefore neither of these tubes will become ionized. Hence, during the succession of clicks or pulses, both relays S and M will be released. Whenever the dial clicks or pulses are slower than some predetermined speed such as, say, 18 per second, the interval between the clicks—during which time the relay V_1 is released—will be long enough to permit the condenser CS to be charged by current from battery B_1 to a voltage sufficient to ionize the control gap of the tube VS. When this happens the relay S will become operated, thereby grounding the condenser CL through the armature 2 of relay S. Hence for clicks or pulses of such a slow rate the relay L will remain released.

The arrangement is thus "tailored" to fit the series of pulses transmitted over the telephone circuit E and applied to the operating winding of relay V_0. Whenever the interval between the clicks or pulses is too long the tube VS will become ionized and prevent relay L from operating. On the other hand, whenever the durations of the clicks or pulses are too long, the tube VM will become ionized and likewise prevent relay L from operating. Whenever the spaces between the clicks or pulses and their durations are both too short—which will be the case for a fast dial or for any low frequency effect induced in the telephone circuit E—the relay V_1 will remain operated and tube VM will become ionized. This will result in maintaining relay L released.

When voice currents reach the telephone circuit it will happen in practically all cases that the pause between the syllables will be long enough to cause tube VS to become ionized. On the other hand, one of the syllables of the speech currents may be so prolonged as to cause the tube VM to become ionized before the interval of time such as three-tenths of a second, which is required to elapse before relay L operates. In either case relay L will not become operated.

It has been shown hereinabove that with each operation of the dial the relay L will be operated for an interval of time which is either long or short depending upon the number dialed. If the dial were operated four times, for example, the relay L will then be operated four times and in each case the duration of the operation of relay L will depend upon the number dialed. Thus the dial may be successively operated to produce any desired combinations of long and short pulses.

The condenser CM and tube VM in the upper branch of the arrangement are employed to prevent currents derived from the clicks or pulses from operating relay L if these currents last longer than about 20 milliseconds. The condenser CS and tube VS in the lower branch of the arrangement are employed to prevent pulses derived from the clicks or pulses from operating relay L if the intervals between the clicks or pulses last longer than about 35 milliseconds. Relay L is thus protected against all pulses except those derived from suitable dial clicks from which 1000 cycle current interrupted about 20 times per second is derived.

When relay L is operated the upper make contact of this relay will be connected to ground through the upper armature of the relay and at the same time the lower make contact of the relay will be connected to a battery B_7 through the lower armature of the relay. Hence, each operation of relay L may be employed to apply voltage over a selecting or switching circuit (not shown) which may be connected to conductors y_1—y_2, the voltage being applied for an interval of time depending upon the length of the operation of relay L. In the latter situation relay N and its related circuits may be omitted. Apparatus for responding to any such series or combination of three, four, or more pulses—which may be any desired combination of long and short pulses—are shown and described in applicant's copending applications, Serial Nos. 373,573 and 373,574, filed January 8, 1941, and Serial No. 399,782, filed June 26, 1941, now respectively, Patents 2,334,574, 2,334,575 and 2,300,003 and the selecting or switching circuit there shown may be considered as part of this specification. The selecting or switching circuit will be connected to conductors y_1 and y_2.

The arrangement of this invention may therefore be used either to respond to dial clicks or pulses to operate relays L and N and illuminate lamp P to apprise the central office operator that a call is being transmitted or (without relay N and lamp P) to apply voltage a number of times to conductors y_1 and y_2 to produce pulses to operate a selective circuit for connecting the subscriber to any one of a plurality of different lines. In either case the control of the circuit is practically entirely exercised by the subscriber in manipulating the dial.

While this invention has been shown and described in certain particular embodiments merely for the purpose of illustration, it will be understood that the general principles of this invention may be applied to other and widely varied organizations without departing from the spirit of the invention and the scope of the appended claims.

What is claimed is:

1. In a signaling system, the combination of a pulsing device, a source of direct current, a transformer having its primary winding connected in series with said source of current and said pulsing device, means responsive to the operation of said pulsing device to produce in the secondary winding of said transformer a series of pulses of alternating current of a frequency which is harmonically related to the number of current spurts produced by said pulsing device in the primary winding of said transformer, one pulse of said alternating current being produced in the secondary winding by the interruption of the flow of current from said source in the primary winding and another pulse by the reconnection of said source to said primary winding, means responsive to the pulses of alternating current in the secondary winding to produce a pulse of direct current, said latter means including means to prolong the pulse of direct current so that its length corresponds to the number of alternating current pulses in the secondary winding, and a translating device responsive to said pulse of direct current.

2. In a signaling system, the combination of a dial having a contact which may be repeatedly opened and closed, a source of direct current voltage, a transformer having its primary winding connected in series with said dial and said

source of voltage so that a plurality of spurts of current may flow in the primary winding with each operation of said dial, means responsive to the repeated opening and closing of the contact of said dial to derive from said spurts of current a series of pulses of alternating currents in secondary winding of said transformer the number of which is a multiple of the number of contact openings and closures, the frequency of said alternating currents being harmonically related to the number of said spurts of current produced by said dial device, means responsive to the pulses of alternating current in the secondary winding to obtain a single pulse of direct current of a duration which corresponds to the number of alternating current pulses, and apparatus controlled by said pulse of direct current.

3. In a signaling system, the combination of a dial having a contact which may be repeatedly opened and closed, a source of unidirectional voltage, a transformer having its primary winding connected in series with said source of voltage and said dial so that a plurality of spurts of current will traverse the primary winding with each operation of said dial, means responsive to the repeated operations of said dial to derive from said spurts of current a plurality of groups of pulses of alternating current of a frequency which is a harmonic of the number of said spurts of current per second, a pulse of alternating current being produced in the secondary winding of said transformer by the interruption of the flow of current from said source of voltage to said primary winding and another pulse being produced in said secondary winding by a reconnection of said source of voltage to said primary winding, means responsive to each group of pulses of alternating current to obtain a pulse of direct current, and a circuit controlled by said pulse of direct current.

4. In a signaling system, the combination of a dial having a contact which may be opened and closed during each operation of the dial, a source of unidirectional voltage, a transformer having its primary winding connected in series with said dial and said source of voltage so as to produce a plurality of spurts of current in the primary winding of said transformer with each operation of said dial, each operation of said dial opening and closing said contact one or more times, means responsive to the repeated operations of said dial to produce in the secondary winding of said transformer a plurality of groups of pulses of alternating current of a frequency which is harmonically related to the number of said spurts of current per second, a pulse of alternating current being produced in the secondary winding upon the interruption of the flow of current from said source of voltage through the primary winding of said transformer and another of said pulses being produced in the secondary winding of the transformer by the resumption of the flow of current from said source through the primary winding of said transformer, the number of pulses of alternating current in each group being determined by the number of times the dial contact is opened and closed in each operation of the dial, means responsive to each group of pulses of alternating current to produce a pulse of direct current of a length which corresponds to the number of alternating current pulses in the group, and a circuit over which said pulses of direct current may be transmitted.

5. In a signaling system, the combination of a dial having a contact which may be opened and closed one or more times during each operation thereof, a source of unidirectional voltage, a transformer having its primary winding connected in series with said source of voltage and said dial so as to produce a plurality of spurts of current in the primary winding of said transformer with each operation of said dial, said spurts of current in the primary winding of said transformer producing a plurality of pulses of alternating current in the secondary winding of said transformer, a pulse of alternating current being produced in the secondary winding of said transformer upon each interruption of the flow of current from said source through said primary winding and another pulse being produced upon each reconnection of said source with said primary winding, means for obtaining from said pulses of alternating current in the secondary winding of said transformer pulses of a predetermined harmonic of said alternating current in the voice frequency range, and means responsive to the pulses of said harmonic current to obtain a pulse of direct current of a length which is proportional to the number of pulses of the harmonic current.

6. In a signaling system, the combination of a dial having a contact which may be opened and closed one or more times during each operation thereof, a source of unidirectional voltage, a transformer having a primary winding connected in series with said dial and said source of voltage so as to produce a plurality of spurts of current in the primary winding of said transformer with each operation of said dial, said spurts of current in the primary winding of said transformer producing a plurality of pulses of alternating current in the secondary winding of said transformer, a pulse of alternating current being produced in the secondary winding with each opening of the circuit of said source of voltage and said primary winding and another pulse of alternating current being produced in the secondary winding with each reconnection of said source of voltage and said primary winding, means for obtaining from said pulses of alternating current in the secondary winding of said transformer pulses of a predetermined harmonic of said alternating current within the voice frequency range, means responsive to the pulses of said harmonic current to obtain a pulse of direct current of a length which is proportional to the number of pulses of harmonic current, and a circuit controlled by said pulse of direct current.

7. In a signaling system, the combination of a subscriber's station, a central office, and a line interconnecting said subscriber's station and said central office, the subscriber's station including a dial having a contact which may be opened and closed one or more times during each operation thereof, a source of unidirectional voltage, and a transformer having its primary winding connected in series with said source of voltage and said dial so as to produce a plurality of spurts of current in the primary winding of said transformer with each operation of said dial, the secondary winding of said transformer being connected to said line, said spurts of current in the primary winding of said transformer producing in the secondary winding of said transformer pulses of alternating current of a frequency which is harmonically related to the rate at which said spurts of current are produced in the

primary winding of said transformer, the number of pulses of alternating current being determined by the number of times the contact of said dial is opened and closed during any operation thereof, said pulses of alternating current being transmitted over said line to the central office, said central office including means responsive to received pulses of alternating current to obtain a pulse of direct current of a length which is proportional to the number of pulses of alternating current, and a circuit controlled by said pulse of direct current.

8. In a signaling system, the combination of a dial having a contact which may be opened and closed any desired number of times, means responsive to each opening and closing of the dial contact to produce two pulses of alternating current, first and second condensers, means for charging the first condenser to a predetermined voltage whenever each pulse lasts longer than a predetermined interval of time, means for charging the second condenser to a predetermined voltage when the intervals between the pulses exceed a predetermined interval of time, a circuit to which voltage may be applied, and means for preventing said voltage from being applied to said circuit whenever the charge on either of said condensers reaches said predetermined value.

9. In a signaling system, the combination of a dial having a contact which may be opened and closed any desired number of times, means responsive to each opening of said dial contact to produce a pulse of alternating current, means responsive to each closure of the dial contact to produce another pulse of alternating current, first and second condensers, means for charging the first condenser to a predetermined voltage whenever any pulse lasts longer than a predetermined interval of time, means for charging the second condenser to a predetermined voltage whenever the intervals between the pulses last longer than a predetermined interval of time, a translating device, means for operating said translating device only when the voltages on said condensers do not reach the predetermined values, and means for preventing the operation of said translating device whenever the voltage on either condenser exceeds the predetermined value.

10. In a signaling system, the combination of a device having a contact which may be opened and closed any desired number of times, means responsive to the operation of said device to produce a plurality of pulses of alternating current, first and second condensers, first and second gas tubes which are controlled by said first and second condensers, respectively, means for charging the first condenser to a predetermined voltage whenever any one of the pulses lasts longer than a predetermined interval of time and for firing the first gas tube, means for charging the second condenser whenever the intervals between pulses exceed a predetermined interval of time and to fire the second gas tube, a translating device, means for operating said translating device in response to said pulses of alternating current, and means for preventing the operation of said translating device whenever either of the gas tubes has been fired.

11. In a signaling system, the combination of means for producing a predetermined number of direct current pulses in regular succession, a transformer having its primary winding connected in series with said pulse producing means, a pulse of alternating current being produced in the secondary winding of said transformer from each direct current pulse together with the harmonics of said alternating current, a line connected to the secondary winding of the transformer for transmitting said alternating current pulses and the harmonics, a filter for selecting from the received pulses only those pulses which are of a predetermined harmonic of the alternating current to the exclusion of all other currents, a relay, means for actuating said relay in response to the receipt of said selected harmonic, and means interposed between said filter and said relay to prevent the operation of said relay in response to currents other than pulses of the selected harmonic.

12. The combination of means for producing alternating current interrupted at regular intervals, first and second condensers, first and second gas tubes controlled respectively by said condensers, means responsive to the length of each pulse of alternating current to charge said first condenser, means for firing said first gas tube when the charge on said first condenser exceeds a predetermined value, means responsive to the interval between successive pulses of alternating current to charge said second condenser, means for firing said second gas tube when the charge on said second condenser exceeds a predetermined value, a translating device, means responsive to the pulses of alternating current to operate said translating device, and means responsive to the firing of either gas tube for preventing the operation of said translating device.

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