H. D. CURRIER.

HARMONIC SELECTIVE RINGING SYSTEM FOR PARTY LINES.

APPLICATION FILED MAY 5, 1909.

955,253.

Patented Apr. 19, 1910.

2 SHEETS—SHEET 1.

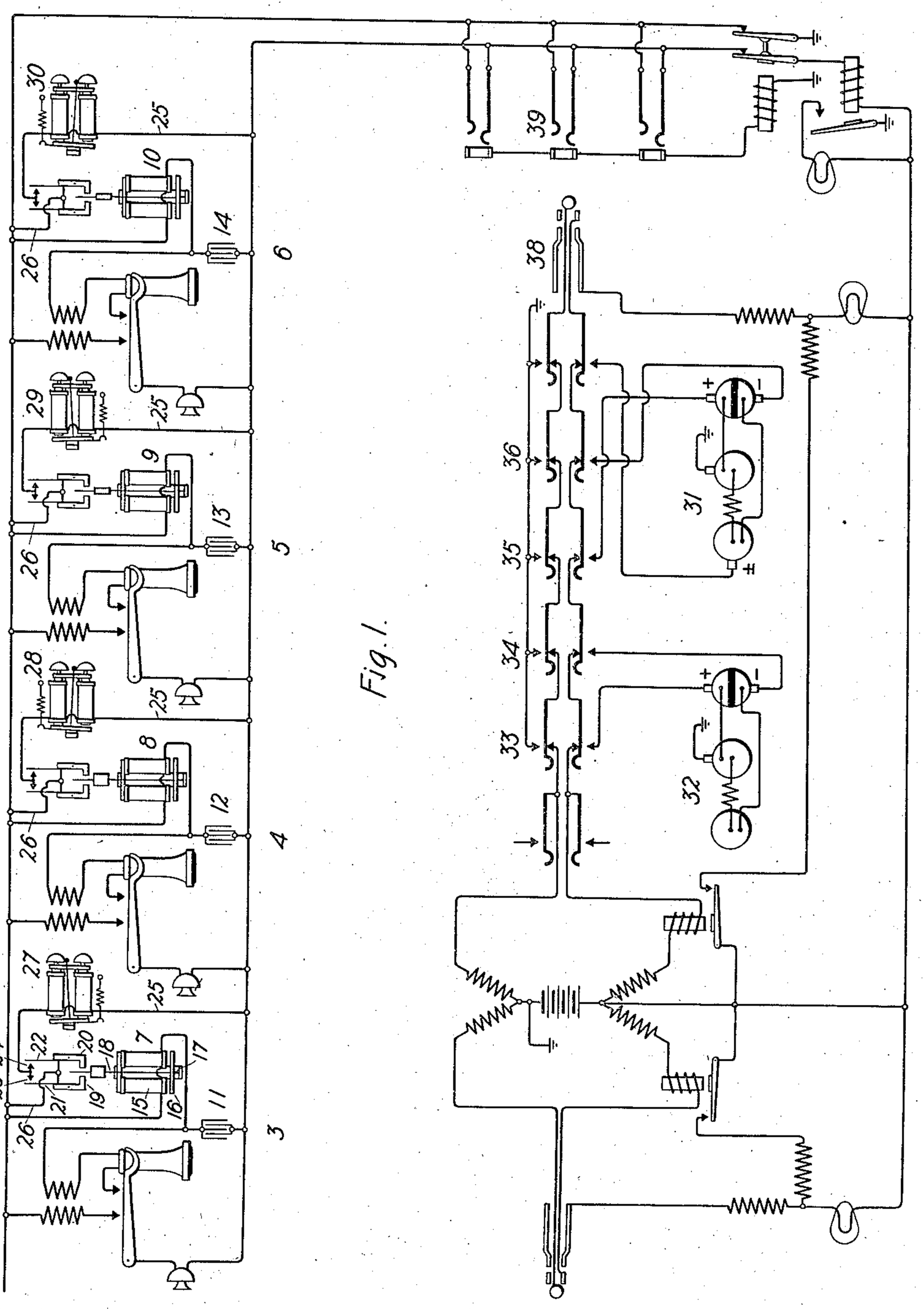

Fig. 1.

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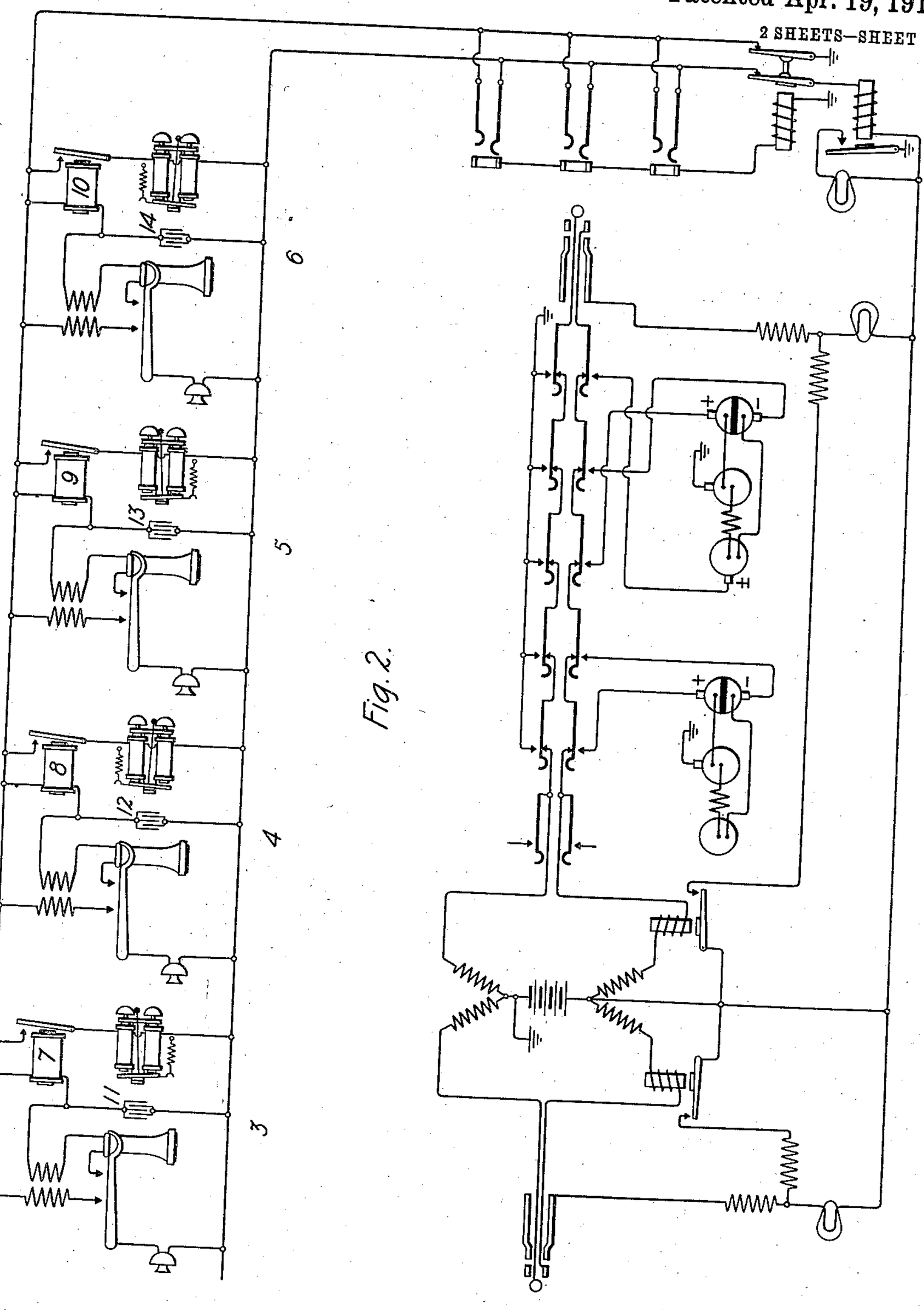

Fig. 2.

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UNITED STATES PATENT OFFICE.

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HARMONIC SELECTIVE-RINGING SYSTEM FOR PARTY-LINES.

955,253. Specification of Letters Patent. **Patented Apr. 19, 1910.**

Application filed May 5, 1909. Serial No. 494,084.

To all whom it may concern:

Be it known that I, HIRAM D. CURRIER, citizen of the United States, residing at Bloomfield, in the county of Essex and State of New Jersey, have invented a certain new and useful Improvement in Harmonic Selective-Ringing Systems for Party-Lines, of which the following is in full, clear, concise, and exact description.

My invention relates to selective signaling systems, more particularly to systems in which the signal receiving devices are tuned to respond only to periodically varying currents of definite frequency, the object being to provide an improved system in which several signals may be selectively controlled with the minimum number of separate sources of current.

The invention will be especially applicable to telephone systems, and makes it possible, for example, for the operator to selectively signal any one of four stations on a party line, by using one of two ringing generators supplying currents of different frequency, and without the use of ground branches from the limbs of the metallic telephone circuit.

In my invention a bell or other signal responsive to current of one polarity is so associated with a line at each of two stations thereon as to be normally inoperative, the bells or signals at the two stations being, however, reversely connected in their respective branches. At each of the two stations tuned means are provided adapted, in response to pulsating currents of the same predetermined frequency, to bring the signals at said stations into operative relation to the circuit, whereby that signal adapted to respond to current of the polarity impressed upon line will be selectively operated.

Considered broadly, therefore, my invention provides tuned means whereby two stations equipped with ordinary polarized biased bells may be selectively signaled over a single circuit with current of a single frequency.

Where four or more stations are connected with a single line the stations may, in accordance with my invention, be considered as divided into pairs, each pair being equipped as already described, the means used to control the signal circuits at the two stations of each pair being tuned to respond to current of a predetermined frequency differing from that to which the corresponding means of any other pair is tuned, whereby the frequency of current impressed upon the line determines the pair of signals which shall be brought into operative relation to the circuit and the polarity of the current determines which signal of the pair shall respond.

My invention may be readily understood by reference to the accompanying drawings which show embodiments thereof as applied to telephone signaling systems.

Figure 1 shows my invention as applied to a system in which the tuning of the signal circuit controlling means at the various stations is accomplished mechanically, and Fig. 2 shows my invention as applied to a system in which the tuning is accomplished electrically.

Referring to Fig. 1, a four party telephone line circuit, together with the central office circuits involved in calling a desired station on said line, is shown. In both the substation and central office portions of the diagram the circuits are shown complete with respect to both signaling and talking. The structure and operation of those features of the circuits which relate to talking and central office signaling, being standard and well understood by those skilled in the art, are, however, not herein described in detail.

In the diagram the line shown is equipped at each of the stations 3, 4, 5 and 6 with a relay which preferably is connected in series with a condenser in a branch of the line conductors, the relays at stations 3, 4, 5 and 6 being designated as 7, 8, 9 and 10, respectively, and the condensers as 11, 12, 13 and 14, respectively. In the circuit shown the condensers in series with the relays also constitute elements of the substation talking circuit, but this is not, of course, essential to my invention. The relays 7, 8, 9 and 10 at the respective stations may be of any form adapted to respond to current of a predetermined frequency. In the diagram of Fig. 1 the relays shown are of the mechanically tuned type, based upon the well known principle that a vibrating body as, for example, a reed, has a definite natural frequency, or rate of oscillation, to which it tends to adhere when actuated by periodic forces and to which it is particularly re-

sponsive and efficient if the forces be in tune with its natural period. In the system of Fig. 1 the relays at the respective stations may each comprise a suitable polarized electromagnet 15, adjacent to the poles of which an armature 16 is mounted upon a flat spring 17 or is otherwise so carried as to be subject to a suitable force adapted to hold it in its middle position when at rest and to restore it when in action. A weighted arm 18 carried by the armature 16 lies normally between two pivoted arms 19 and 20, said arms preferably having considerable inertia. Contact springs 21 and 22, which may be carried by the arms 19 and 20, are adapted to engage with coöperating contacts 23 and 24, respectively, when the armature rocks and causes the arm 18 to strike and tilt the arms. With this arrangement of parts it will be readily understood that a relay may be so made and adjusted that the movable element will have any desired predetermined natural period within practicable limits and that, when so made and adjusted, its energization by current of corresponding frequency will cause the armature to respond efficiently and cause the arm 18 to oscillate and alternately strike the arms 19 and 20. As a result of this action, the springs 21 and 22 will be successively forced into engagement with their corresponding contacts 23 and 24, whereby, by virtue of the inertia of said arms 19 and 20, one of the pairs of contacts, 21 and 23 and 22 and 24, will be closed a longer period than the other is open, which pairs being connected in multiple with a branch 25 and 26 leading through the bell, the circuit through said bell will be maintained closed while the relay is in operation.

My invention will be more readily understood if the stations on the line be conceived to be divided into pairs. For example, in the case of the four party line under consideration stations 3 and 4 may be considered as constituting one pair and stations 5 and 6 another. The relays at the stations constituting a pair would with my invention be tuned to the same frequency, which frequency would be unlike that to which the relays at any other pair of stations would be tuned, so that current of a predetermined frequency impressed upon the line would cause the completion of the bell circuits at the two stations where the relays are so tuned as to respond thereto.

At the stations 3, 4, 5 and 6 signals 27, 28, 29 and 30, respectively, are provided, which signals may be ordinary polarized biased bells, said bells being connected at each station in the branch circuit 25 and 26 controlled by the relays thereat. The bells at the stations of a pair, as, for example, stations 3 and 4, would be reversely associated with the line with respect to their polarity, that is bell 27 would be so connected as to be responsive only to negative pulsating current passing through it from one limb of the line, and bell 28 would be so connected as to be responsive to positive pulsating current from the same limb.

Referring to the central office portion of the system of my invention 31 and 32 are any suitable sources of pulsating current, the sources shown diagrammatically being the well known ringing generator adapted to supply pulsating current of positive or negative character. The system shown being a four station system, two frequencies of current are required which, for purposes of illustration, may be assumed to be sixteen cycles per second for signaling stations 3 and 4 and fifty cycles per second for signaling stations 5 and 6. Generator 31 would, therefore, be adapted to supply positive and negative sixteen cycle current and generator 32 be adapted to supply positive and negative fifty cycle current.

33, 34, 35 and 36 are keys or switches in the operator's connecting circuit whereby when the plug 38 is inserted in the jack 39 of the desired line signaling current of frequency and polarity adapted to selectively operate the signal at the desired station may, by the operation of the proper key, be impressed upon the line.

The operation of the system of my invention is as follows: Let it be assumed that the relays 7 and 8 are adapted to respond to pulsating current having a frequency of sixteen cycles per second, and that the bells 27 and 28, respectively controlled by said relays, are respectively adapted to respond to negative and positive currents only. Also let it be assumed that the relays 9 and 10 are adapted to respond to pulsating current having a frequency of fifty pulsations per second, and that the signals 29 and 30, respectively controlled by said relays, are respectively adapted to respond to negative and positive currents only. With the system shown the central office operator having received a call for station No. 3 would insert the calling plug 38 into the jack 39 of the line and depress key 36, thereby opening the circuit of the tip and ring strands of the calling cord and impressing negative pulsating current from generator 31 upon the line, which current would flow out upon the ring side of the line, pass through the relay branches at all the stations, and return over the tip side of the line to ground at the key. The relays 9 and 10, at stations 5 and 6, not being adapted to respond to sixteen cycle current, no change in the circuit conditions at these stations would occur. The relays 7 and 8, being adapted to respond to sixteen cycle current, would operate and close the circuits of the bells 27 and 28, thereby allowing a portion of the current to flow through said bells. The bells 27 and 28 be-

ing polarized biased bells so associated with the line that the former responds to negative current only and the latter to positive current, bell 28 will be unaffected by the flow through it of the negative current and bell 27 will be the only one of the four bells associated with the line to respond to the depression of key 36. Thus the selective operation involved in signaling a given station of the system of my invention may be regarded as comprising two progressive steps, the first of which is the response of the relays at two stations, and the consequent completion of the bell circuits thereat, whereby the pair of stations, one of which is the desired station, is selected; and the second of which is the response of that bell of the selected pair adapted to operate on current of the polarity used, whereby the desired station of the selected pair is signaled.

If the call were for station No. 4 the operator would depress key 35 thereby impressing current upon the line of the same frequency as in the case just described, but of positive polarity as a result of which the operations referred to above as constituting the first stage of the selective process would be identically as already set forth, the second stage, however, differing in that the use of positive current would result in the actuation of bell 28 instead of bell 27. It will be understood that although, for convenience of discussion the operation is described as made up of two stages, there would, in actual practice, be no distinct stages, the bell at the desired station responding promptly to the depression of the proper key.

If the call were for station No. 5 the operator would depress key 34, thereby impressing fifty cycle negative current upon the line as a result of which, relays 9 and 10 would respond and complete the circuits of bells 29 and 30, relays 7 and 8 remaining inactive by reason of their not being adapted to respond to current of the frequency used. Bell 29 being so connected with the line as to respond to negative current, and bell 30 being reversely connected, the former would alone operate.

If the call were for station No. 6 the operator would depress key 33, thereby impressing fifty cycle positive current upon the line to which relays 9 and 10 and bell 30 would alone respond, as will be readily understood from the description already given.

In Fig. 2 my invention is shown embodied in a system in which the signal circuit controlling means is electrically tuned, in a manner, for example, such as disclosed in a patent to Pupin, No. 707,007, August 12, 1902. In the system shown in this figure, which is generally similar to that shown in Fig. 1 and differs only in the method of tuning, the relays 7, 8, 9 and 10 are ordinary relays. The inductance of each of these relays, however, and the capacity of the associated condenser are so related that the bridge circuit in which they are included is electrically tuned, so that the relay in any particular bridge circuit will respond only to current of the proper frequency. That is to say, in the system shown, the inductance of the relays 7 and 8 at the stations 3 and 4 is so related to the capacity of the condensers 11 and 12, respectively, that the relays will respond only to pulsating current having a frequency of sixteen cycles per second. In a similar manner the circuits at the substations 5 and 6 are so arranged that the relays 9 and 10 will respond only to pulsatory current having a frequency of fifty cycles per second. The method in which this electrical tuning is accomplished, since it is well known in the art, need not be discussed at length, but it should be understood that my invention contemplates the use of either mechanically or electrically tuned means, or any combination of mechanical and electrical tuning which may be desired.

In the description of my invention the current used has been referred to as pulsating current having a frequency expressed in cycles per second. The term "pulsating" is herein used in its broad and usual sense as a current in which the average of the instantaneous values of the wave throughout a period or cycle is other than zero, as distinguished from alternating current in which said average is zero. In accordance with this definition of terms it will be understood that my invention contemplates the use of any pulsating current as, for example, not only pulsating current derived from a generator of the type shown diagramatically in the accompanying drawings, wherein, during a portion of the period, no current is delivered from the source, but current of any pulsating nature as, for example, current produced by superposing varying current upon constant current such as may be derived from an alternating current generator in series with a battery in which case the alternations are of unequal value.

Having described my invention, I claim:

1. The combination with a line, of signals at different stations on said line adapted to respond respectively to currents of different polarity, an electro-responsive device at each station, responsive only to current of predetermined frequency, for controlling the circuit of the signal at said station, the devices at the two stations being responsive to currents of the same frequency, a source of current for operating said devices and signals, and switches for impressing said current upon the line.

2. The combination with a line, of a relay, responsive only to current of predetermined frequency, at each of a plurality of stations on said line, the relays at two of the stations

being adapted to respond to currents of one frequency and the relays at another two stations being adapted to respond to currents of another frequency, a signal at each station controlled by the relay at said station, the signals, at each of said two stations, being adapted to respond respectively to currents of different polarity, sources of current for operating the relays and signals, and switches for impressing said current upon the line.

3. The combination with a line, of a mechanically tuned relay, responsive only to current of predetermined frequency, at each of four stations on said line, the relays at two of said stations being adapted to respond to currents of one frequency, and the relays at the other two stations being adapted to respond to currents of another frequency, a signal in a branch of the line at each station, the signals at each of said two stations being adapted to respond respectively to currents of different polarity, sources of current for operating the relays and signals, and switches for impressing said current upon the line.

4. The combination with a telephone line, of a relay, responsive only to current of predetermined frequency, at each of four stations on said line, the relays at two of said stations being adapted to respond to currents of one frequency and the relays at the other two stations being adapted to respond to currents of another frequency, a bell at each station in a normally open branch of the line controlled by the relay at said station, the bells, at each of said two stations, being adapted to respond respectively to currents of different polarity, sources of current for operating the relays and bells, and switches for impressing said current upon the line.

In witness whereof, I, hereunto subscribe my name this 4th day of May A. D., 1909.

HIRAM D. CURRIER.

Witnesses:

EDGAR F. BEAUBIEN,

IRVING MACDONALD.