Oct. 21, 1930. P. NORTON 1,778,768

TELEPHONE RINGING SYSTEM

Filed May 4, 1929 3 Sheets-Sheet 1

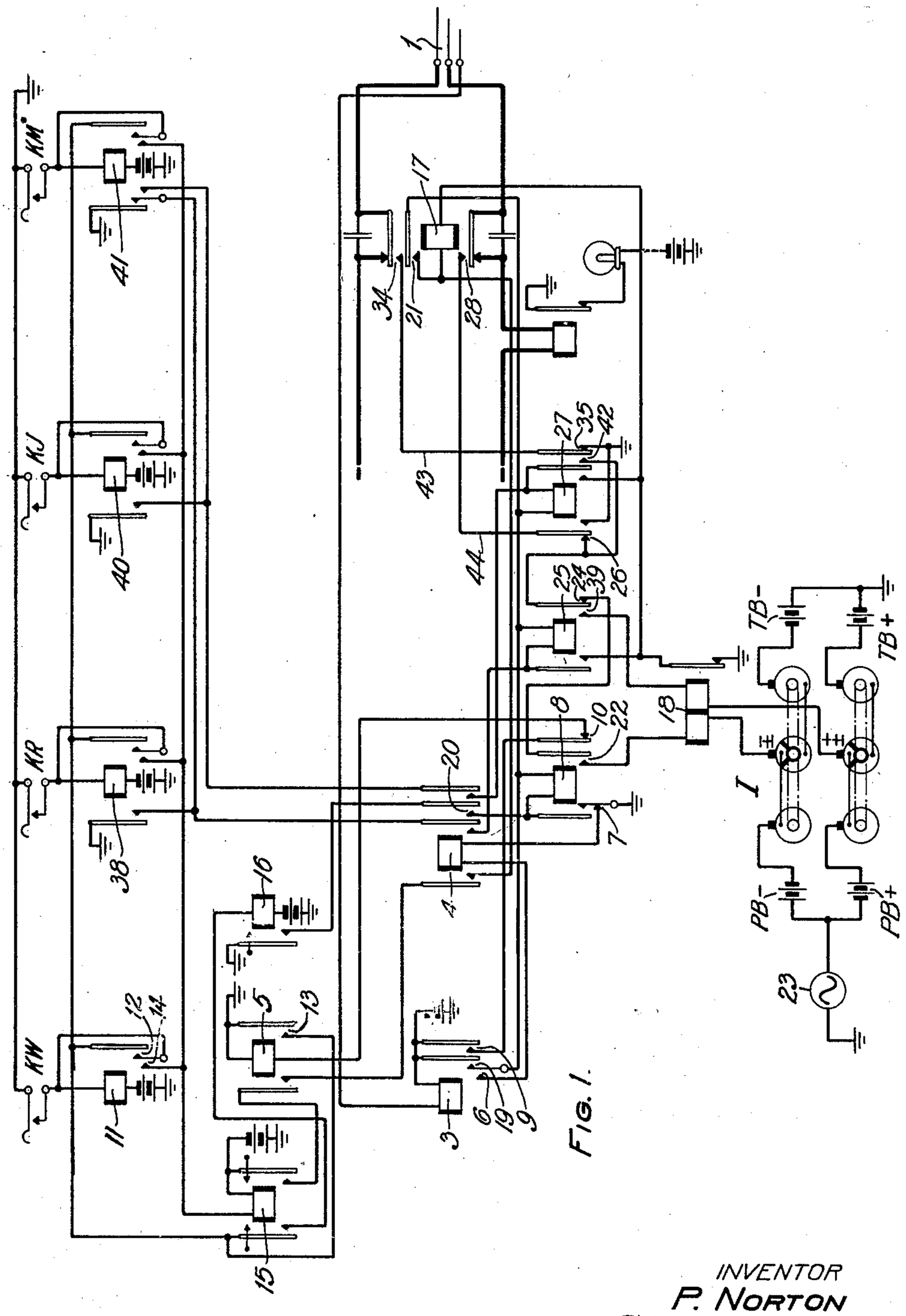

FIG. 1.

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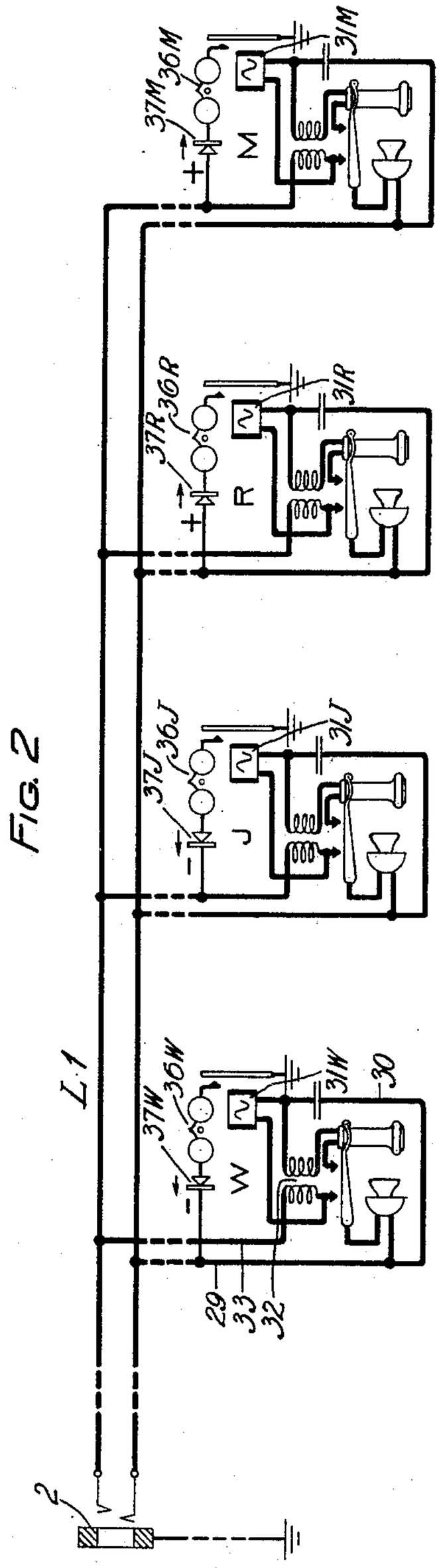

FIG. 2

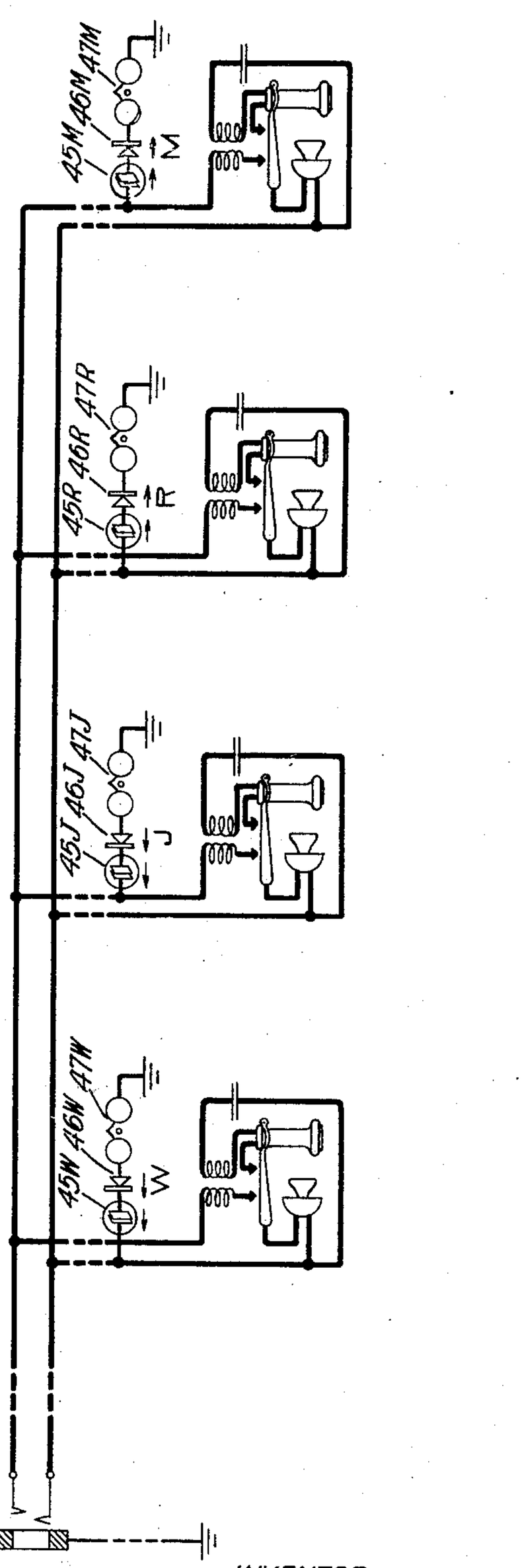

FIG. 3

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FIG. 4.

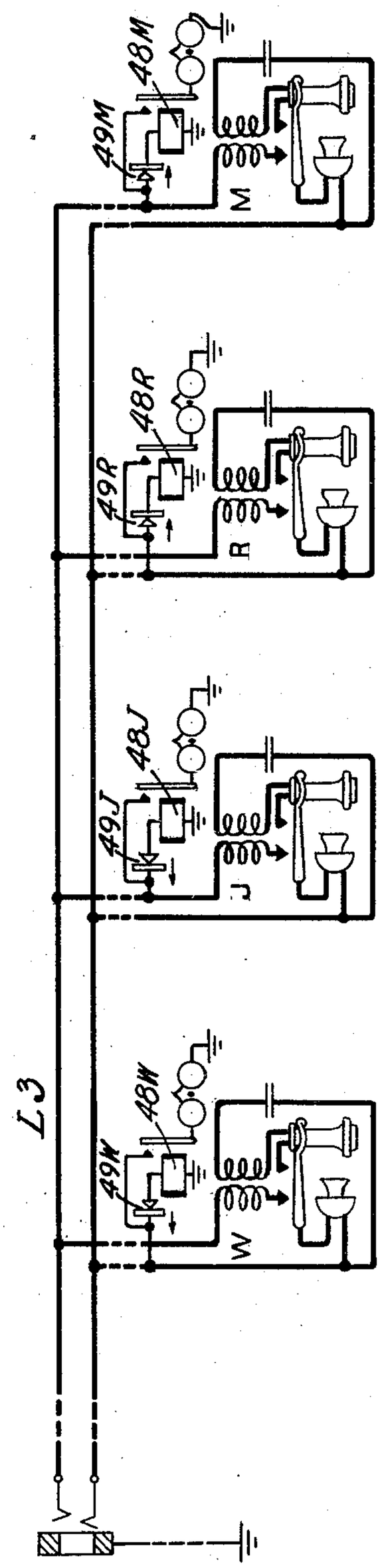
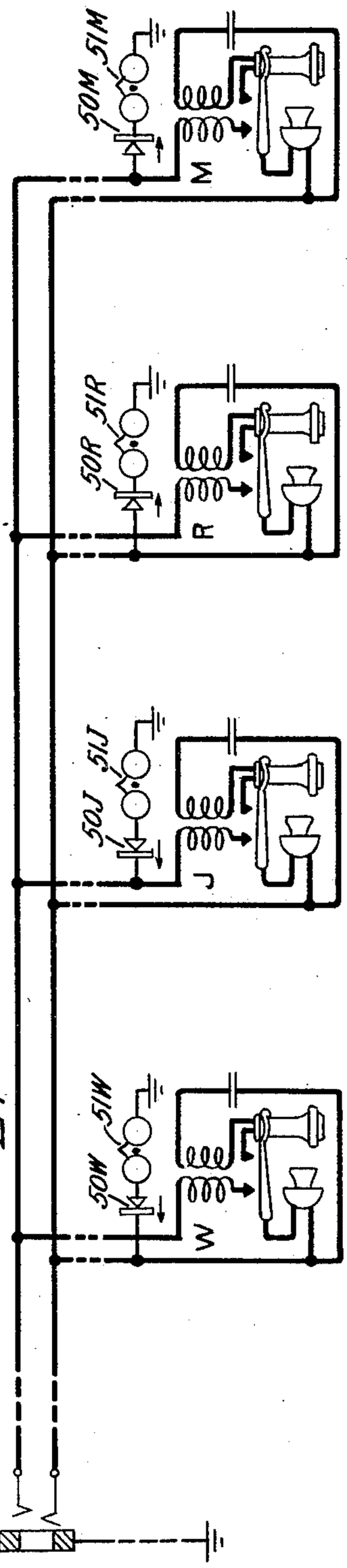


FIG. 5.



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UNITED STATES PATENT OFFICE

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TELEPHONE-RINGING SYSTEM

Application filed May 4, 1929. Serial No. 360,476.

This invention relates to telephone systems and more particularly to four-party full selective ringing systems.

An object of the invention is to reduce the ringing current required for systems of this character.

Another object is to reduce interfering or cross-ringing currents thereby making it unnecessary to place a strong tension on the bias springs of each ringer.

The above objects are attained in four-party selective ringing systems, employing positive and negative pulsating current and in which the ringers are normally disconnected from the line and connected thereto in response to application of ringing current to the line, by combination with such a system of means for preventing the ringing current from flowing through more than one ringer at a time.

A preferred arrangement employs a copper-oxide rectifier in series with each of the four ringers of a standard four-party selective ringing system which are poled to pass current only in the direction which will operate the associated ringer.

An alternative arrangement is to substitute direct current relays for the alternating current relays used in the present system, connecting two of the relays between one side of the line and ground and two between the other side of the line and ground, and inserting rectifiers in series with the relays instead of the ringers.

A third scheme is to eliminate the relays and connect the ringers directly to the line through a rectifier and a low voltage breakdown tube in series.

Another scheme is to connect the ringers to the line as in the third scheme in series with a rectifier only, eliminating the discharge tube.

The invention will be understood from the following description and drawing in which:

Fig. 1 represents the calling end of a machine ringing cord circuit arranged for four-party full selective signaling employing pulsating current.

Fig. 2 represents a well known four-party selective ringing system employing positive and negative pulsating ringing current in which properly poled uni-directional devices or rectifiers are added in series with the ringers.

Fig. 3 represents a modification of the invention in which the relays of Fig. 2 are eliminated and the ringers permanently connected to the line in series with a rectifier and a low voltage discharge device.

Fig. 4 is another modification of the invention in which direct current relays are substituted for the alternating current relays of Fig. 2, but in a different manner.

A further modification is shown in Fig. 5 in which the discharge devices of Fig. 3 are eliminated and the ringer permanently connected to the line in series with a rectifier only.

Referring to Fig. 1 of the drawing, which shows only such essential details as are necessary for an understanding of the method of applying selective ringing current to lines arranged in accordance with the present invention, 23 is a source of alternating ringing current of any desired frequency, for example 20 cycles, which is selectively supplied to contacts of the ringing relay 17 through either the polarizing battery PB− or PB+, corresponding brushes of the interrupter I, windings of relay 18 and contacts of relays 8, 25 and 27 as determined by the setting of the individual party ringing keys KW, KR, KJ and KM. Fig. 2 represents, as before mentioned, a subscriber's line equipped with four four-party selective ringing subscribers' sets arranged to operate on pulsating ringing current which sets have been modified, from the standard arrangement, to the extent that copper oxide rectifiers 37—W, 37—J, 37—R and 37—M have been connected in series with the ringers of the W, J, R and M sets, respectively, in such a manner that current will only flow through the desired ringer coils as determined by the setting of the ringing keys at the central office. This arrangement makes it unnecessary to bias the ringers as heretofore.

The circuit details and method of operation of these selective ringing sets, except as changed by the rectifiers, are well known and

described in the patent to Thompson et al. 644,647, patented March 6, 1900.

The invention will probably be best understood from a description of the operation of the circuit shown in the drawing and it will, therefore, be first assumed that the operator having control of the automatic or machine ringing cord circuit of Fig. 1 desires to ring the bell of the subscriber W on line L1 of Fig. 2. To accomplish this the operator will insert the plug 1 in the jack 2 of the subscriber's line and press the selective ringing key KW associated with the cord circuit.

Insertion of the plug 1 in the jack completes an obvious circuit for operating the sleeve relay 3 which in operating completes circuits for operating start relay 4 and relay 5 which can be traced from battery, contacts 19 and 6 of relay 3, winding of relay 4 and contacts 7 of cut-off relay 8 to ground, and from battery, contacts 9 of relay 3, contacts 10 of relay 8 and winding of relay 5 to ground.

When key KW is actuated an obvious circuit is closed for operating relay 11 which thereupon locks up to ground under control of relay 5 in the following circuit, battery, winding and contacts 12 of relay 11 and contacts 13 of relay 5 to ground. Relay 11 also completes, at its contacts 14, a circuit for operating relay 15 which can be traced from battery, winding of relay 15, contacts 14 and 12 of relay 11 and contacts 13 of relay 5 to ground.

Relay 15 in operating completes a circuit, at its left-hand contacts, for operating relay 16 which can be traced from battery, winding of relay 16, left-hand contacts of relay 15 and contacts 13 of relay 5 to ground.

The operation of relay 15 also completes a circuit to operate ringing relay 17 which can be traced from battery, right-hand contacts of relay 15, left-hand contacts of relay 5, left-hand contacts of relay 4, winding of relay 17 and right-hand normal contacts of tripping relay 18 to ground.

When relay 17 operates it connects the ringing leads 43 and 44 to the tip and ring of the cord and locks itself operated, at its contacts 21, under control of relay 3.

The operation of relay 16 completes a circuit for operating relay 8 which can be traced from battery, contacts 19 of relay 3, winding of relay 8, contacts 20 of relay 4 and contacts of relay 16 to ground. Relay 8 in operating locks up at its left-hand contacts to ground under control of the sleeve relay 3, by opening its contacts 7 it releases relay 4 and by opening its contacts 10 releases relay 5.

Relay 5 in releasing opens the holding path for relays 11, 15 and 16 which relays in turn release.

It will be noted that relays 8 and 17 are now held operated under control of sleeve relay 3.

When relay 8 operated it also closed its right-hand contacts 22 thereby connecting negative pulsating current, generated by superimposed alternating ringing current supplied by source 23 on the battery PB−, to the ring conductors of the cord and line in a circuit including the left-hand winding of tripping relay 18, contacts 22 of relay 8, contacts 24 of relay 25, contacts 26 of relay 27 and contacts 28 of relay 17 to the ring conductor of the cord and thence over the ring contacts of the plug 1 and jack 2 and ring conductor of the line L1 to the W station where it flows over conductor 29, through condenser 30, relay 31—W, left-hand winding of induction coil 32, over conductor 33 to the tip side of the line and thence to the cord circuit where it finds ground over contacts 34 of relay 17 and contacts 35 of relay 27. This current also flows through similar paths provided by the other three stations on the line.

Battery PB− is connected in the circuit with its negative pole toward the line and its positive pole toward the AC source 23 and consequently the positive halves of the alternating current waves will be increased and the negative half waves decreased thus supplying what is termed a negative pulsating current to the ring conductors of the line. This method of generating a so-called pulsating current for selective ringing purposes by superposing alternating current on a direct current source was described in patent 763,970 to T. C. Drake, dated July 5, 1904.

This so-called pulsating current is in fact alternating current with its neutral axis displaced from the center line of the wave by the amount of the battery voltage and causes relays 31—W, J, R and M to operate thereby connecting the ringers 36—W and R between the ring side of the line and ground and ringers 37—J and M between the tip side and ground.

Connected in series with each of the ringers is a uni-lateral current conducting device or rectifier 37—W, J, R or M preferably of the well-known copper oxide type, poled as indicated by the arrows and therefore negative pulsating current flowing in the ring conductor of the line can only flow through rectifier 37—W and ringer 36—W to ground. Due to the fact that rectifier 37—R is positively poled no current will flow through 36—R and cause it to respond. It will be noted that ringers 36—J and M which are connected to the tip side of the line are shunted at this time by the resistance of the tip side of the line.

As before mentioned, the present four-party selective ringing system employing pulsating or superimposed current is so arranged that, whenever ringing current is applied to the line, two of the ringers are directly connected between one side of the line and ground and two between the other side

and ground. Current, therefore, flows from the live side of the line to ground through both of the ringers connected thereto but due to proper poling only one ringer responds.

The system shown in Fig. 2 differs from the above described system by the inclusion of a properly poled rectifier in series with each ringer whereby current only flows through the ringing coils of the selected station.

When the called subscriber responds by lifting his receiver from the hook the impedance of the circuit is reduced and an increased current flow results thereby causing the tripping relay 18 to operate which removes the holding ground from relay 17 which thereupon releases and disconnects ringing leads 43 and 44 from the line.

In case the operator desires to ring the R subscriber she depresses the key KR which causes consecutive operation of relays 38, 25 and 15, 16 and 17, and 8. The operation of relay 25 opens, at its contacts 24, the negative ringing lead 44 previously described and closes, at its contacts 39, the positive ringing lead which can be traced from battery PB+, through interrupter I and the right-hand winding of tripping relay 18, contacts 39 of relay 25, contacts 26 of relay 27, ringing lead 44, and contacts 28 of relay 17 to the ring side of the cord and line which current will flow through rectifier 37—R and ringer 36—R of the R station to ground. No current will flow through ringer 36—W, connected to the same side of the line, due to the fact that rectifier 37—W is poled in an opposite direction to that of 37—R.

Similarly, operation of key KJ operates relays 40, 15 and 27, 16 and 17 and 18. Relay 27 reverses the ringing and ground leads (44 and 43) with respect to the contacts of ringing relay 17 thereby causing negative pulsating current to be connected to the tip of the cord and line, instead of the ring as in the case of key KW. Negative ringing current on the tip of the line will only find a path to ground through rectifier 37—J and therefore only ringer 37—J will respond.

Finally operation of key KM operates relays 14, 15, 25 and 27, 16 and 17, and 18. Relays 25 and 27, which in this instance are both operated, connect positive pulsating current to the tip of the cord over a path which includes the right-hand winding of relay 18, contacts 39 of relay 25, contacts 42 of relay 27, ringing lead 43, and contacts 34 of relay 17. Positive pulsating current on the tip of the line only finds a path to ground through rectifier 37—M thereby selectively operating ringer 37—M.

It will be obvious that, by the use of rectifiers 37 as shown in Fig. 2, the load on the source of ringing supply is considerably less than that required when two ringers are connected directly between each side of the line and ground upon the operation of relays 31, as in systems now in operation.

Fig. 3 is a modification of the circuit of Fig. 2 in which the alternating current relays 31 of Fig. 2 are eliminated and the ringers permanently connected between one or the other of the two sides of the line and ground in series with a rectifier similar to those shown in Fig. 2 and also a low voltage discharge tube of the general type described in the patent to Schroter 1,601,001. In this arrangement each rectifier and its associated discharge tube, which by itself has certain rectifying characteristics, are both poled in the same direction to give the desired selectivity.

By this arrangement all the ringers are normally open circuited as before and therefore do not interfere with the transmission of speech currents. However, due to the low voltage breakdown characteristics of the discharge tubes, negative pulsating current on the ring conductor of line L2, for example, breaks down the discharge gap of tube 45—W in a well-known manner and current therefore flows through the negatively poled rectifier 46—W and ringer 47—W to ground. Due to the fact that rectifier 46—R is oppositely poled no current flows through ringer 47—R.

Similarly negative pulsating current on the tip conductor only flows through ringer 47—J, positive current on the ring flows only through ringer 47—R and positive current on the tip only finds a path to ground through ringer 47—M.

Fig. 4 is also a modification of Fig. 2 in which the bridged alternating current relays 31 are eliminated from the subscriber's set and a direct current relay at each station 48—W, J, R and M, is connected between one or the other sides of the line and ground in series with a rectifier 49—W, J, R or M poled in the same direction as the rectifiers in Fig. 2, whereby only one relay will be energized, at a time, depending upon the side of the line to which it is connected and the direction of the current applied at the central office.

Operation of any one of the relays connects its associated ringer to the same side of the line to which the relay is connected, whereupon it responds in the usual manner. None of the other relays being operated the remaining three ringers remain disconnected from the line and therefore cannot operate.

Fig. 5 is a modification of Fig. 3 in that the discharge tubes 45 are omitted. In this arrangement ringers 51—W and 51—R are connected through rectifiers 50—W and 50—R, respectively, to the ring side of the line L—4 and ringers 51—J and 51—M are connected to the tip side of the line in series with rectifiers 50—J and 50—M, respectively. Rectifiers 50—W and 50—J are poled in one direction with respect to the line and rectifiers 50—R and 50—M are poled in the opposite

direction. Therefore, pulsating current applied to either side of the line will only find a path to ground through one of the ringers, depending upon the direction of the ringing current.

The arrangement of Fig. 5, while satisfactory from the standpoint of ringer selectivity, is not as satisfactory as the arrangements shown in the other figures for the reason that the direct current used for talking, which is connected across the line at the central office in a well-known manner, will find a leakage path through two of the rectifiers and their associated ringers. Such a leakage path, for example, may be traced from the positive terminal of the central office battery, over the tip side of the cord and line through the positively poled rectifier 50—M, ringer 51—M to ground, thence through ringer 51—W, negatively poled rectifiers 50—W to the ring side of the line and cord and to the negative side of the battery.

What is claimed is:

1. In a telephone system, a line, a plurality of signal responsive devices associated with said line and normally disconnected therefrom, means responsive to the application of signaling current to said line for connecting a plurality of said devices thereto and additional means for preventing the flow of signaling current through more than one of said devices.

2. A transmission line, means for applying thereto currents of different polarities and a plurality of normally open signaling circuits connected to said line, each of said signaling circuits comprising polarized signal means and rectifying means poled in a manner similar to said signaling means, and means responsive to certain currents transmitted over said line for closing said normally open signal circuits.

3. In a telephone system, the combination with a line conductor of means for transmitting either positive or negative intermittent current thereover, two earth branches for said conductor, each branch serially including a polarized ringer biased to respond to said positive and negative currents, means for normally maintaining said earth branches open and responsive to said intermittent current for closing said branches, and unilateral conducting devices also serially included in said earth branches in such a manner that current of either polarity applied to said line conductor will traverse only one of said earth branches.

4. In a telephone system, the combination with a telephone line conductor, of means for transmitting either positive or negative intermittent current thereover, two earth branches for said conductor each serially including a polarized ringer biased to respond to said positive and negative current respectively, and an electric current rectifier in each branch poled to pass current of the polarity to which the associated ringer is adapted to respond.

5. In a telephone system, a line, a plurality of signaling devices connected thereto and adapted to be selectively controlled, a source of intermittent current for operating said devices, means for connecting said current to said line in such a manner as to selectively operate a desired one of said signaling devices, and a unidirectional current device in circuit with each of said signaling devices poled in such a manner as to prevent said current from passing through more than one of said signaling devices at the same time.

6. In a telephone system, the combination with a line conductor of means for transmitting either positive or negative intermittent current thereover, four earth branches for said conductor, two of said branches each serially including a relay adapted to respond to direct current and an electric current rectifier, each rectifier oppositely poled with respect to the other, and the other two of said earth branches each serially including a polarized ringer biased to respond to said positive and negative current respectively, each of said ringer branches being normally open at contacts of one of said relays and adapted to be closed when the associated relay operates in response to application of ringing current to the line conductor.

In witness whereof, I hereunto subscribe my name this 1st day of May, 1929.

PHILANDER NORTON.