

Feb. 20, 1934.

H. H. HAGLUND

1,947,984

TELEGRAPH REPEATING AND RECEIVING APPARATUS

Filed Aug. 24, 1932

3 Sheets-Sheet 1

FIG. 1

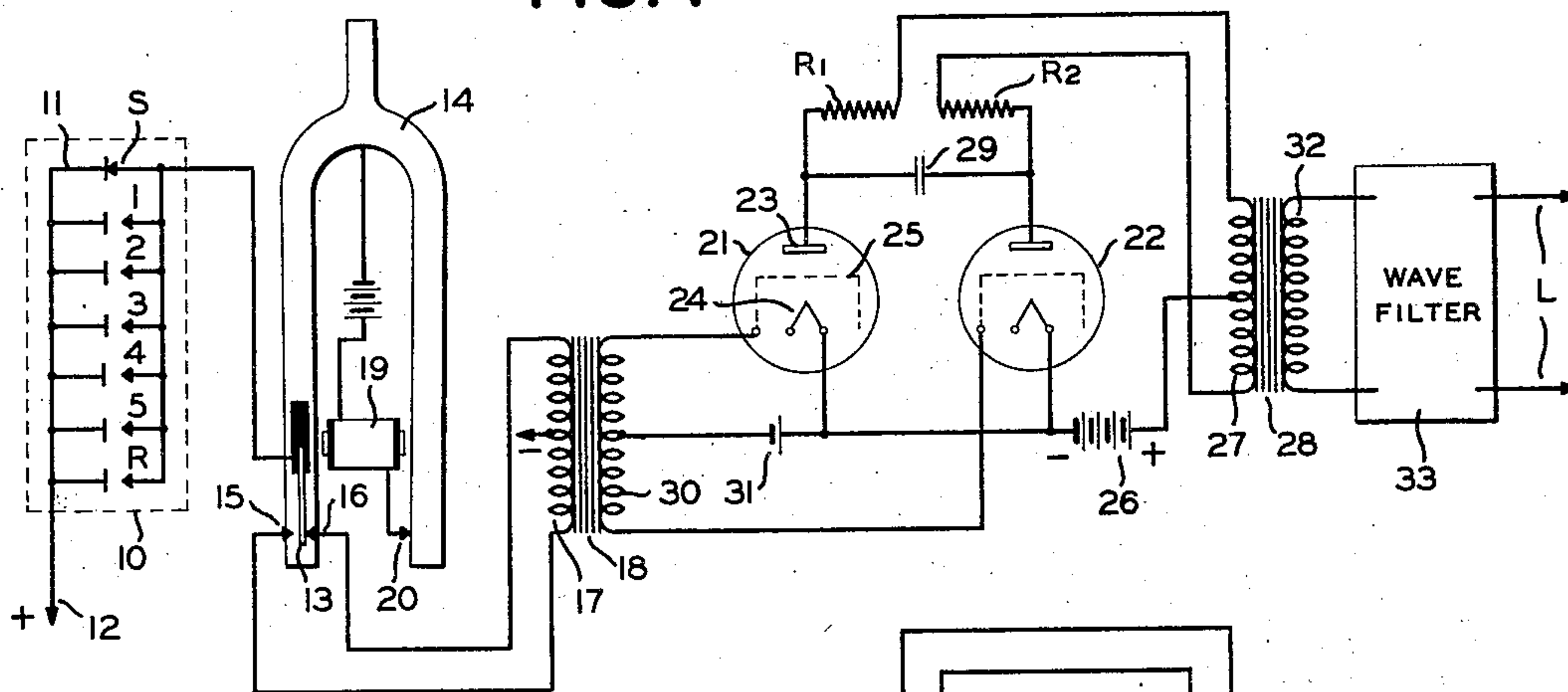


FIG. 2

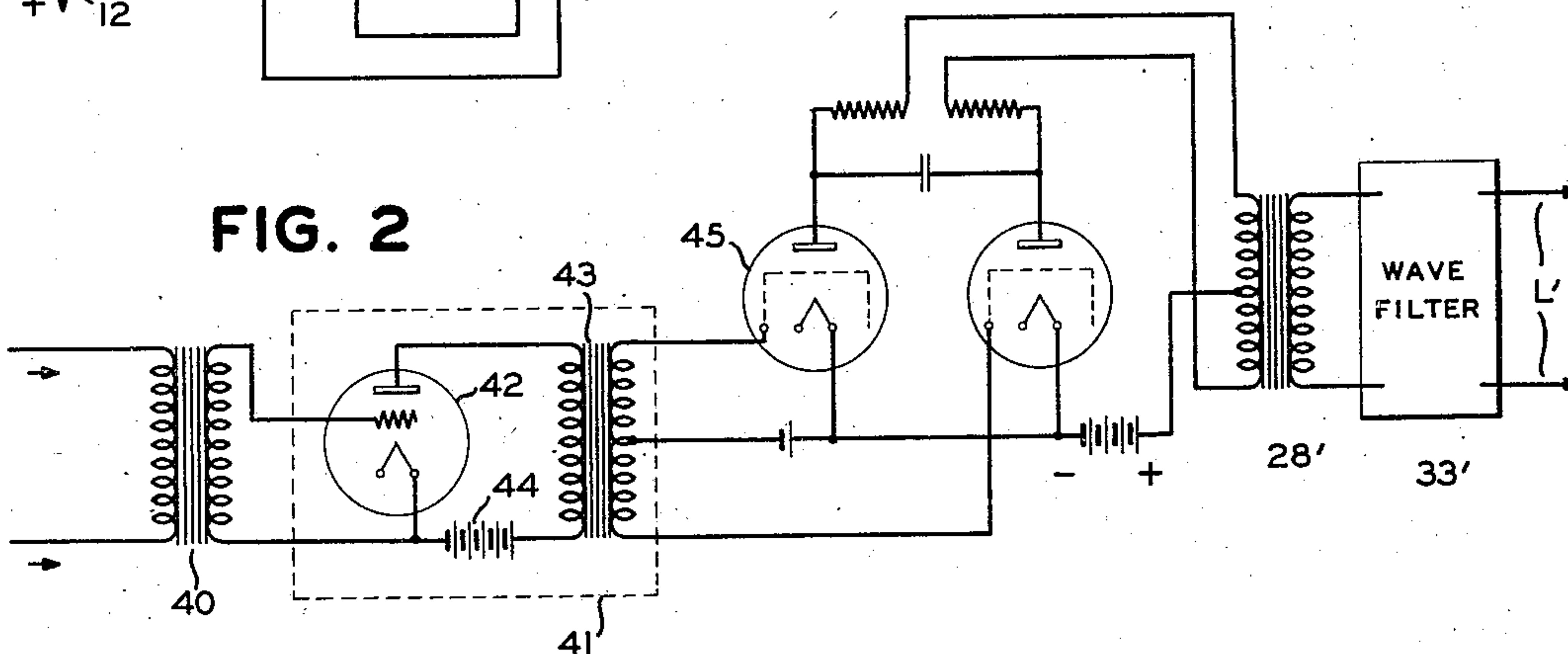
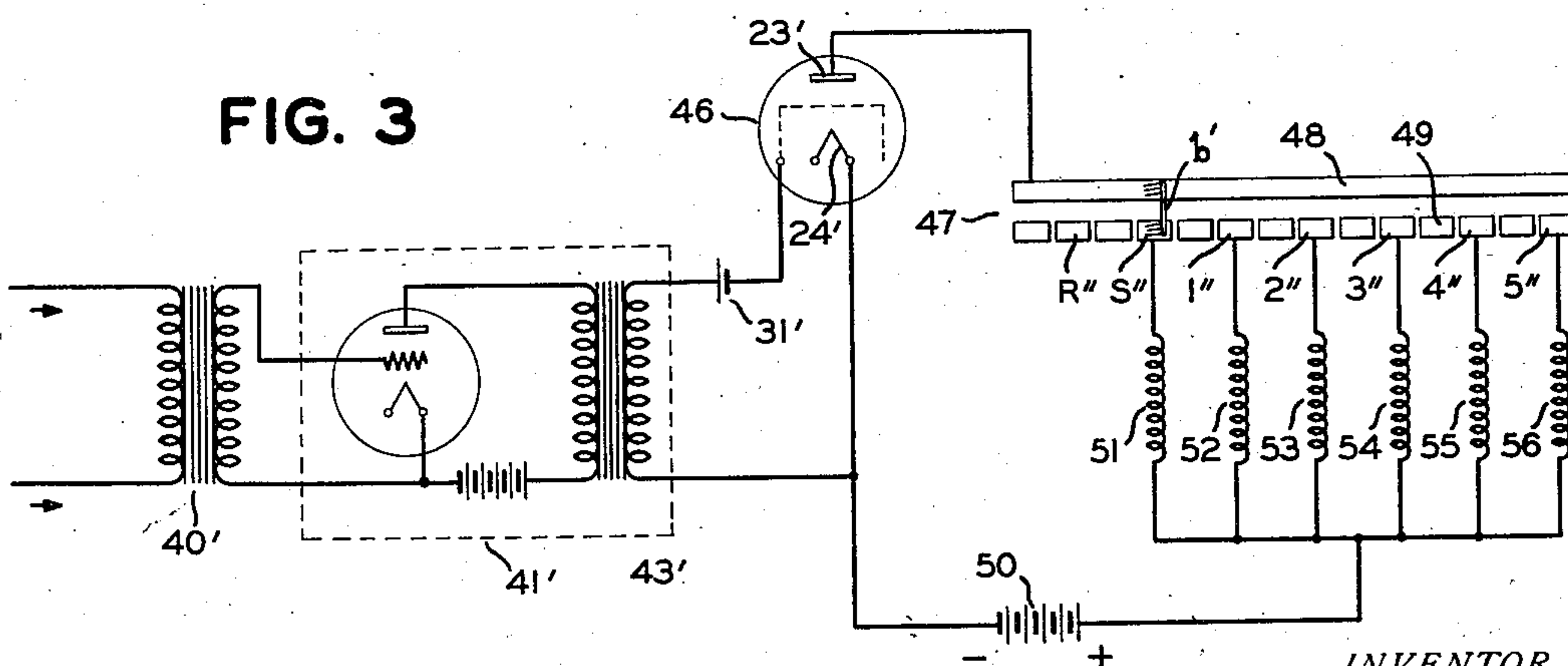


FIG. 3



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FIG. 4

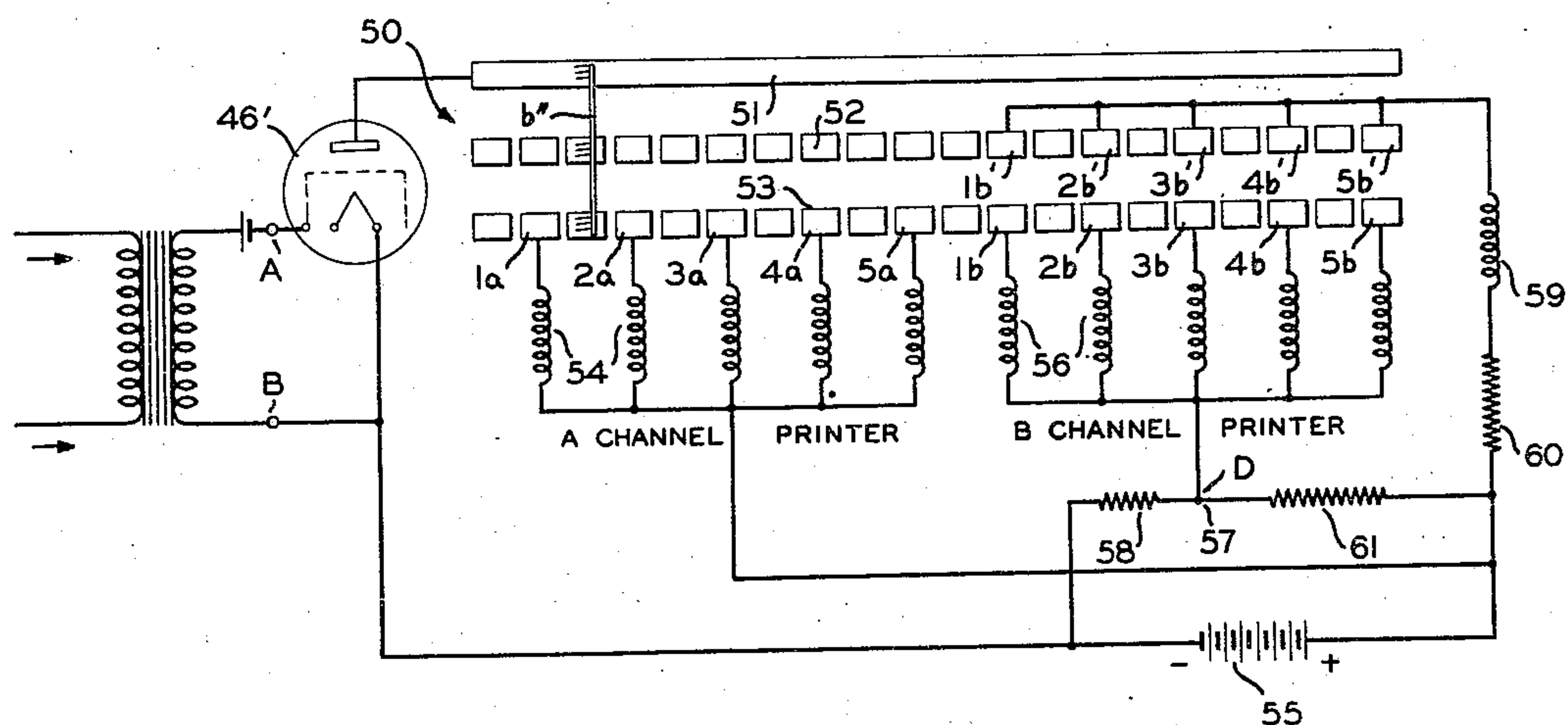
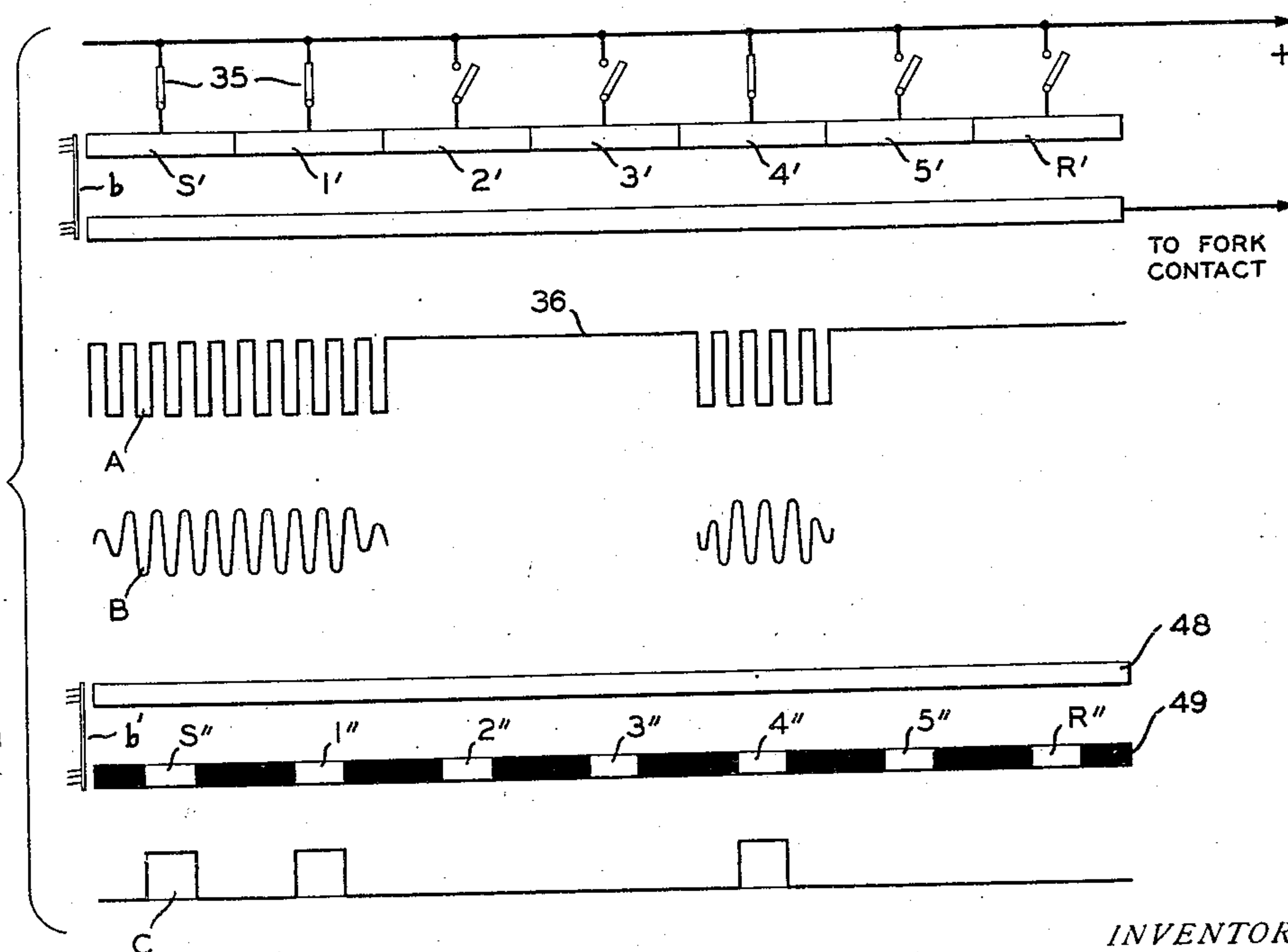


FIG. 5



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FIG. 6

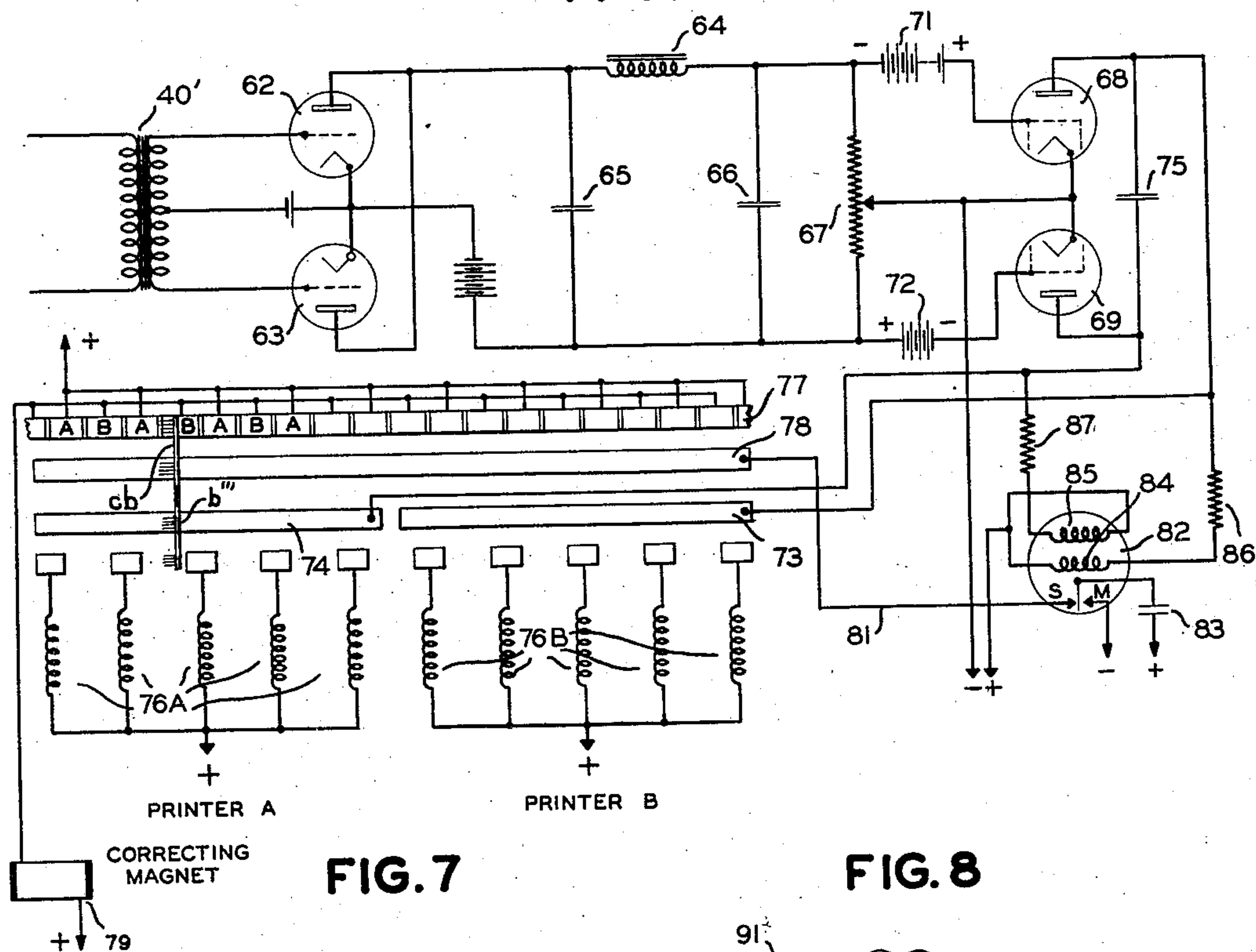


FIG. 7

FIG. 8

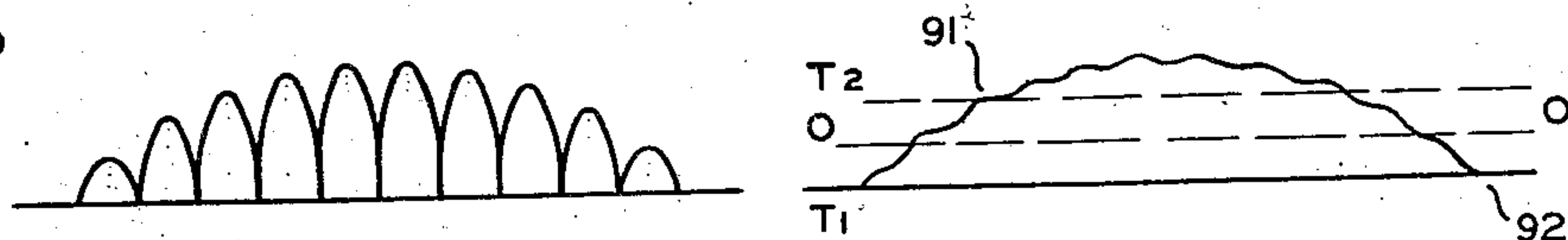
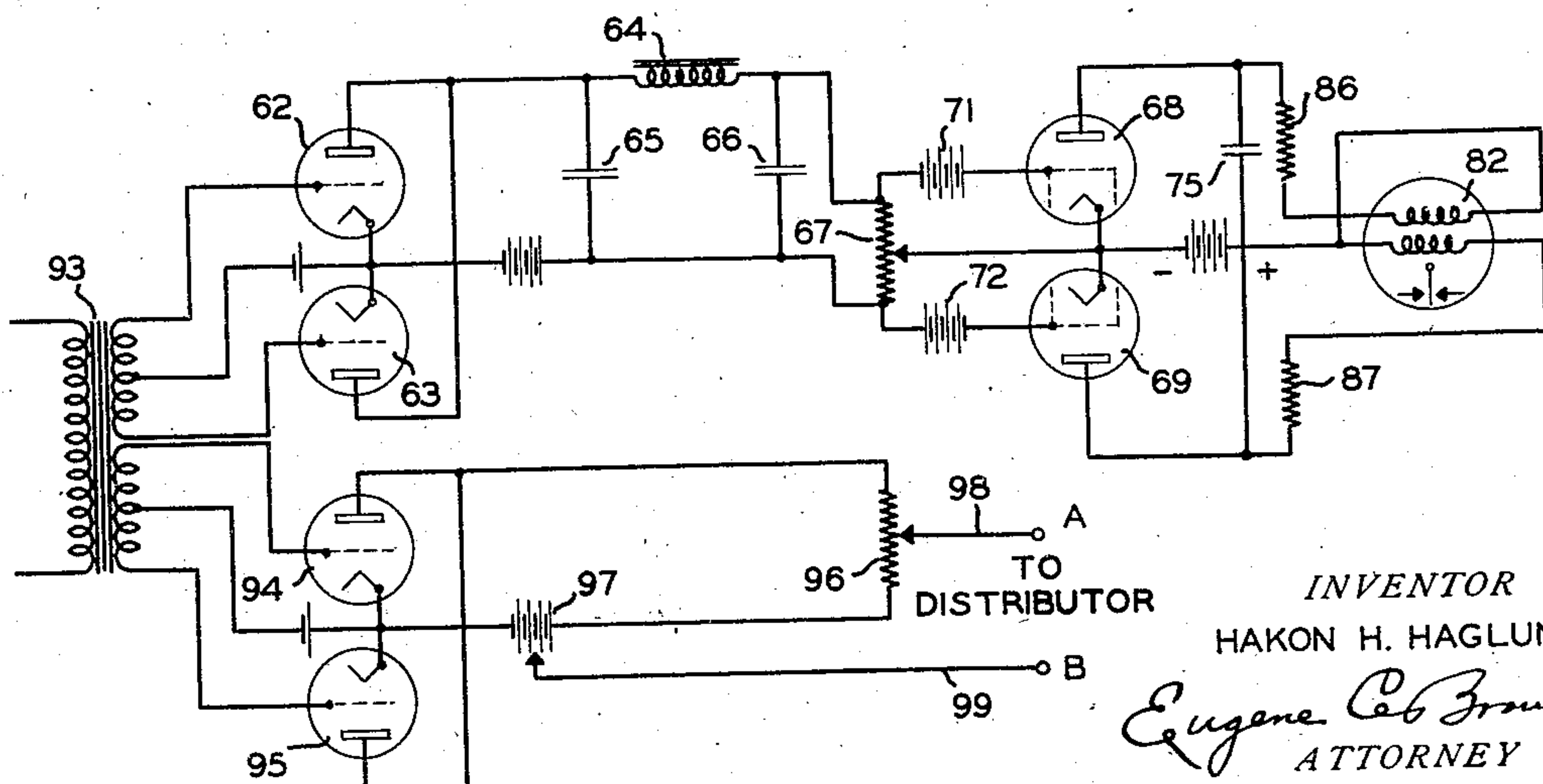


FIG. 9



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1,947,984

TELEGRAPH REPEATING AND RECEIVING APPARATUS

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New York, N. Y., a corporation of New York

Application August 24, 1932. Serial No. 630,273

16 Claims. (Cl. 178—51)

This invention relates to telegraph repeating and receiving apparatus and more particularly to a telegraph carrier current system in which code signals are transmitted in the form of groups or trains of current alternations of predetermined frequency. It is a continuation in part of my application Ser. No. 464,638, filed June 28, 1930, now Patent No. 1,882,817, granted Oct. 18, 1932.

The invention is applicable to land line transmission over a wide range of frequencies but is particularly suitable to relatively low frequency, high current systems such as are required in submarine cable systems.

For instance, in certain trans-Atlantic submarine cable telegraph lines, a number of relatively low speed long span cables extend between Newfoundland and Ireland and are connected at each end to other cable sections extending between Nova Scotia and Newfoundland and between England and Ireland respectively. The system is extended by land lines from the cable stations in Nova Scotia and England. The long cable sections now in use between Newfoundland and Ireland are of the unloaded type and transmission thereover is restricted to a dot frequency of from five to seven and a half cycles per second. In order to permit through transmission the signal speed on the short end sections is necessarily restricted to the operating speed of the longer unloaded sections. However, the end sections are capable of operation at frequencies up to one hundred cycles or more. Therefore, in order to reduce the number of short sections required and provide spare channels in case of failure of one of the short connecting sections, it has been proposed to provide a carrier channel in each direction over the short sections in addition to the regular duplex channels. The current required for carrier operation over the short cable sections is relatively high, however, of the magnitude of 0.5 amperes and is not readily obtained through the use of vacuum tube amplifiers.

Heretofore it has been the practice to apply the output of an alternator of the carrier frequency directly to the cable and to control the output thereof by controlling the field of the generator.

One of the objects of the present invention is to provide a receiving means for a carrier current system in which the received signals will be completely regenerated so that the printing apparatus will receive a substantially perfect signal.

Another object is to provide a receiving apparatus for a carrier current multiplex system in which the groups of oscillations serve as marking signals for certain channel printers and as spacing signals for other channel printers.

A still further object is to provide a telegraph carrier current transmitting system which is simple and inexpensive.

Another object is to provide a correcting mechanism which will respond to said carrier current signals for maintaining correct phase relation of multiplex receiving apparatus.

Other objects and advantages of the invention will hereinafter appear.

In the form of transmitting apparatus shown in the parent application I employ a tuning fork oscillator having an output of small amplitude to control the discharge through gaseous conduction tubes of a type which are capable of passing a relatively large amount of current. The tube normally interposes a high resistance in the circuit in which it is connected but this resistance may be broken down by a relatively small current in the auxiliary or control circuit, the tube when its internal resistance is broken down being capable of passing a large amount of current.

A type of tube which I have found particularly satisfactory for this purpose is the so-called thyatron tube described in an article by Dr. Albert W. Hull, entitled "Hot cathode thyratrons" and published in the General Electric Review, vol. 32, No. 4, of April, 1929, at page 213. This type of tube is in effect an electrostatically controlled arc rectifier and briefly consists of a gas filled envelope containing an electron emitting cathode, a surrounding grid and an anode, the geometry of the tube, nature and pressure of the gas and electron emissivity of the cathode being such that with the proper positive potential applied to the anode, the grid will interpose a high starting resistance to the tube but if the grid has a certain critical potential applied thereto, as by a feeble current, the tube will break down and due to the arc discharge then occurring, will allow a large amount of current to flow from the anode to the cathode.

The tube is unlike the ordinary three electrode vacuum tube or audion in that as soon as the plate current starts, the grid has no further influence on the plate current and the discharge can only be stopped by removing or reducing the plate voltage.

This effect is attributed to the formation of a sheath of positive ions around the grid, usually only a fraction of a millimeter in thickness, which contains the entire voltage drop between the grid and the surrounding space. Varying the potential of the grid merely changes the thickness of this sheath without effecting the potential of the remaining space. The action of the grid may, therefore, be likened to a trigger since it is effective to initiate the discharge, but thereafter has no further influence on the discharge, the nature of the electrode being thus distinguished from the usual audion grid, which exerts a continuous influence on the discharge through the tube. A type of tube inherently capable of operation in this manner is also shown in re-issue patent to

Von Lieben and Reiss, No. 13,779, reissued July 21, 1914.

Two of such devices are employed, arranged to operate as an inverter having their input circuits coupled to the output circuit of the oscillator in such a manner that the gaseous conduction devices operate alternately during each cycle of the oscillator output. The output of the gaseous conduction devices, is applied to an output transformer, the secondary winding of which is connected to a line circuit through a filter which serves to shape the output wave.

A repeater may be employed at an intermediate station, the signals being applied directly or through a vacuum tube amplifier to the grid circuit of a second thyatron inverter, the output wave of which is again shaped by a suitable filter circuit.

In one modification of the invention, at the receiving station the signals are applied to the grid of a single thyatron tube having a rotary distributor connected in the output circuit whereby, as the distributor brush rotates in synchronism with the transmitted signals, the output circuit of the tube will be interrupted between each signal and the signal will be regenerated so that substantially perfect signals are supplied to the receiving printer.

In another embodiment a full wave rectifier is inserted in the receiver, preceding the thyatron detector, thereby enabling the relay tube to operate on the first received half cycle of either polarity and thus establishing a reference point for controlling the operation of a corrector mechanism for the multiplex equipment.

The system may be either start-stop or multiplex and in the latter case the printer circuit may be arranged so that the printers associated with each alternate channel will operate on the received oscillations as marking signals and those associated with the intermediate channels will operate on the received oscillations as spacing signals.

In order that the invention may be more fully understood reference will be had to the accompanying drawings in which:

Figure 1 is a circuit diagram showing the carrier current transmitting system embodying my invention;

Figure 2 is a circuit diagram of a repeating system embodying the invention;

Figure 3 is a circuit diagram illustrating a receiving system employing a start-stop printer;

Figure 4 shows diagrammatically a receiving system employing multiplex printers;

Figure 5 is a schematic view illustrating the form of the inverter output waves, the transmitted signals and the regenerated signals supplied to the printing mechanism;

Figure 6 is a circuit diagram of a modified form of receiver showing corrector mechanism;

Figures 7 and 8 show the form of a rectified and filtered oscillation group, respectively, produced in the circuit of Figure 6; and

Figure 9 shows a still further form of receiving circuit.

The transmitting apparatus shown in Figure 1 comprises a suitable keying device 10 which may be a manually controlled transmitter of the start-stop type, or a tape controlled transmitter such as is described in a copending application of S. W. Rothermel, Serial No. 390,726, filed September 6, 1929, now Patent No. 1,805,374, granted May 12, 1931, and entitled "Distributor-transmitter for simplex telegraph systems." This keying

device is diagrammatically illustrated as comprising a plurality of stationary contacts 11 connected to a common source of positive potential 12 and a group of movable contacts comprising a start contact S, code contacts 1 to 5, and a rest or stop contact R. The contacts S, 1 to 5, and R are connected to a contact arm 13 carried by one tine of a tuning fork 14 adapted to vibrate at a predetermined frequency. The arm 13 automatically engages contacts 15 and 16 which are connected respectively to the opposite ends of the primary winding 17 of a transformer 18, the midpoint of the winding 17 being connected to a source of negative potential. The fork is maintained in operation by a fork magnet 19 controlled through a fork contact 20 in the usual manner.

In transmitting a single character code combination, the transmitter contacts S, 1 to 5 and R are operated in succession, contacts 1 to 5 closing in different combinations in accordance with the usual arrangement of the Baudot code. Upon closing of one of the contacts, as the start contact S, current reversals occur in the winding 17 of a frequency equal to that of the fork 14. During the period of a spacing signal when none of the transmitter contacts are closed, the circuit to the primary winding 17 is open.

The current reversals produced in the windings of the transformer 18 may be of very low amplitude and therefore readily controlled at the transmitter and fork contacts. In order to increase the output of the oscillator, I employ an inverter comprising two gaseous conduction tubes 21 and 22 which may be of the "thyatron" type or having characteristics similar thereto, each tube having a positive electrode or anode 23, an electron emitting cathode 24, either of the directly or indirectly heated type, and a grid 25, enclosed within a gas filled envelope. The input and output circuit of the tubes 21 and 22 are arranged so that upon the application of a critical potential to the grid of one of the tubes, a discharge is initiated therethrough, which causes the discharge to cease in the other tube. Thus by alternately applying this starting charge to the grids of the two tubes, they may be caused to operate alternately. The cathodes 24 of the two tubes are connected together and to the negative terminal of a battery or other source of potential 26. The anodes 23 are connected through resistances R_1 and R_2 to the opposite terminals of the primary winding 27 of an output transformer 28 and are directly bridged by a condenser 29. The midpoint of the winding 27 is connected to the positive terminal of the battery 26. The grids 25 of the gaseous discharge tubes are connected to the opposite terminals of the secondary winding 30 of the transformer 18, the midpoint of which is joined through a stabilizing battery 31 to the cathodes of the tubes. The secondary winding 32 of the output transformer is connected to the outgoing line circuit L through a suitable wave shaping filter 33.

The operation of the inverter is as follows:

With the contact S of the transmitter closed, to produce current reversals in the winding of the transformer 18, the grids of the tubes 21 and 22 are alternately rendered positive. Assuming that on the first half cycle the grid of tube 21 is made positive, the internal resistance of this tube will be decreased and a discharge initiated there-through, the current flowing from the positive terminal of the battery 26 through the upper half of the winding 27 of the output transformer and resistance R_1 to the anode of tube 21, and

thence from the cathode thereof back to the battery 26. A current is thus induced in the line circuit L, through the filter 33, in a definite direction. The tube 21 continues to operate as long as positive potential is applied to the anode thereof, independently of the grid 25 and until the beginning of the next current reversal through the transformer 18, at which time the positive charge is removed from the grid of tube 21 and a similar positive charge applied to the grid of tube 22. Tube 22 therefore starts to operate, permitting current to flow from the positive terminal of the battery 26 through the lower half of the winding 27 of the transformer 28 in the opposite direction. The condenser 29 which was previously charged from the tube 21, is now subject to a displacement current in the opposite direction and therefore discharges in such a direction as to momentarily reduce the voltage in the plate circuit of the tube 21 sufficiently to permit the tube to become deionized. The tube 22 continues to operate, inducing a current in the line circuit L in the reverse direction from that induced due to the operation of the tube 21. Alternations are thus sent over the line circuit L at the same frequency as that of the oscillating fork.

If the first intelligence signal, controlled through contact 1 of the transmitter, is of marking character, a second train of oscillations will be transmitted over the line circuit L, the number of reversals or cycles comprising the marking signal depending of course, upon the frequency and the length of time the contacts of the transmitter remain closed.

Assuming the second intelligence signal to be spacing, the transmitter contact 2 will remain open and the grids of both tubes 21 and 22 will remain negative under the influence of the stabilizing battery 31. The particular tube operating at the end of the preceding marking signal will continue to operate during the spacing period, but since the discharge is of a continuous nature, no current will be induced in the line circuit L. Therefore, each marking signal is transmitted over the line circuit as a train of oscillations and the spacing signals as no current intervals.

The oscillations at the terminals of the transformer 28 are of a regular form and may be readily shaped as desired and damped to reduce interference therefrom, by the wave filter 33.

Referring next to Figure 5 I have shown the transmitter diagrammatically as comprising a rotary distributor having a start segment S', five code segments, 1' to 5', and a rest segment R'. The brush b in passing over the segments, sets up different combinations of positive battery on the contact arm 13 of the fork, depending upon the position of the switch arms 35 which may represent the contacts of a tape transmitter such as that disclosed in patent to Benjamin, No. 1,298,440, granted March 25, 1919. The oscillations obtained at the terminals of the tubes 21 and 22 are substantially square topped as indicated at A, the spacing signals being represented by direct current portions 36. The crests of the waves will be rounded and the direct current portions 36 eliminated by the output transformer 28, and the waves may be further shaped and damped by the filter 33 so that the transmitted oscillations may appear in the form indicated at B.

If the transmission line is unduly long, one or more repeaters may be employed of the type

shown in Figure 2 and including a receiving transformer 40, having its secondary winding connected in the input circuit of a vacuum tube amplifier, indicated generally at 41, and comprising a three element vacuum tube 42 and a transformer 43. The grid and the cathode of the tube 42 are connected across the terminals of the secondary winding of the transformer 40, and the anode and cathode of the tube are connected across the primary winding of the transformer 43 through a suitable battery or other source of potential 44. The terminals of the secondary winding of the transformer 43 are connected to the grids of the two tubes of an inverter 45 of the same form as that employed in the transmitting apparatus. The output of the inverter is applied to the line L' through the output transformer 28' and wave filter 33'. Obviously, if the transmitted signals are not attenuated to too great an extent, the vacuum tube amplifier 41 may be omitted and the received signals employed directly through the transformer 40 to control the inverter 45. The inverter 45, transformer 28' and wave filter 33' may reform the waves and retransmit them in substantially their original shape.

One form of receiving apparatus is shown in Figure 3 and comprises the receiving transformer 40', a vacuum tube amplifier 41', a single gaseous conduction tube 46, and a rotary distributor 47 having a solid ring 48 and a segmented ring 49, the latter ring comprising a rest segment R'', a start segment S'', and five code segments, 1'' to 5'' each of these segments being separated by a dead segment. The grid and cathode of the tube 46 are connected across the terminals of the secondary winding of the transformer 43' through the usual stabilizing battery 31'. The anode 23' of the tube is joined to the solid ring 48 of the distributor, and the cathode 24' is connected through the battery 50 to one terminal of the winding 51 of the start magnet and windings 52 to 56 of the selecting magnets of the printing telegraph mechanism, the opposite terminals of these windings being connected to the contacts S'' and 1'' to 5'' respectively of the rotary distributor. The brush b' passes across the segments in substantial synchronism with the transmitted groups of oscillations.

With the brush b' resting on the start segment S'', upon the receipt of the first half cycle of the start signal train of oscillations, the tube 46 will start to operate, the circuit being completed from the anode 23' through the brush b', segment S'' and start magnet 51 to the battery 50. The brush b' is thus released so as to make one revolution across the face of the distributor. As the brush passes on to the dead segment following segment S'', the plate circuit of the tube 46 is interrupted and the discharge through the tube ceases. As the brush passes on to segment 1'', if a marking signal is being received, over the line circuit, the discharge again starts through the tube 46 to operate the selecting magnet 52. However, if a spacing signal or no current interval occurs at this time, tube 46 remains unoperated and the magnet 52 unenergized. The discharge through the tube 46 is caused to cease after each signal, and prior to the receipt of the succeeding signal train by interrupting the plate circuit through the intermediate dead segments of the distributor.

Referring again to Figure 5, the rings 48 and 49 of the receiving rotary distributor are

shown, the brush b' sweeping over the ring in synchronism with the received signals B. The live segments S'' , $1''$ to $5''$ and R'' are of such width as to correspond to the central portion only of each train of received oscillations, to insure the received signals being of sufficient strength to initiate the discharge through the tube 46 and produce perfect signals for the printer magnets, of the form shown at C.

In Figure 4 I have illustrated a modified receiving arrangement for two channel multiplex operation in which the received oscillations serve as marking signals for the first or A channel printer and as spacing signals for the second or B channel printer. The distributor 50 has a solid ring 51 and two segmented rings 52 and 53. The selecting magnets 54 of the A channel printer are connected to the segments 1_a , 2_a , 3_a , 4_a , and 5_a of the ring 53 and to the battery 55 so as to operate in response to the received oscillations in the same manner as described with reference to Figure 3. The selecting magnets 56 of the B channel printer are similarly connected to segments 1_b to 5_b of ring 53, the opposite terminals being connected to an intermediate point D of a potentiometer 57, such that the voltage drop through the portion 58 of the potentiometer is substantially equal to the voltage drop through the tube 46' when the tube is operating, whereby when a group of oscillations is received, during passage of the brush b'' across the B channel segments, the potential of the point D will be the same as that of the solid ring 51 and no current will flow therebetween through the printer magnets 56. The segments $1_b'$ to $5_b'$ of ring 52 are strapped together and connected to the positive terminal of the battery 55 through an inductance 59, which balances the inductance of one of the printer magnets and a resistance 60 substantially equal to the portion 61 of the potentiometer 57.

During the passage of the brush b'' over segments 1_a to 5_a , the tube 46' operates in response to each group of oscillations received through the transformer 40', the output circuit of the tube being completed directly through the ring 51 and segments 1_a to 5_a to the printer magnets 54 and thence to the positive terminal of the battery 55. During passage of the brush over segments 1_b to 5_b , if no oscillations are received, current flows from the positive terminal of the battery through the resistance 60 and inductance 59 across the segments of rings 52 and 53 and through the printer magnets 56 and resistance 58 to the negative terminal of the battery. If a group of oscillations are received during the passage of the brush over one of the B channel segments, as segment 2_b the tube 46' operates, producing a shunt path from the segment $2_b'$ and solid ring 51 to the negative terminal of the battery, thus reducing the current through the printer magnets to such an extent that the magnet does not respond. The received oscillations therefore serve as spacing signals for the B channel printer.

Inasmuch as the gaseous conduction tubes of the thyatron type of moderate size are capable of passing large currents, of several amperes, under the control of extremely feeble currents, the present system is particularly adaptable for carrier current telegraph systems requiring the transmission of signals of large amplitude.

It will be understood, that the transmitters shown in Figure 1 may be modified for multiplex transmission for operation with the receiver of

Figure 4 by substituting the usual multiplex transmitting face plate for the start-stop transmitter 10.

In Figure 6 another form of multiplex receiver is shown in which the oscillations received through the transformer 40' are rectified and amplified by the vacuum tubes 62 and 63, each oscillation group producing in the output circuit of the tubes a wave form of the nature shown in Figure 7, this wave being filtered through a network comprising the inductance 64 and condensers 65 and 66, thereby producing a wave form through the resistance 67 of the general shape shown in Figure 8. Two grid controlled arc discharge tubes 68 and 69 of the gaseous conduction type are arranged with their grids connected through biasing batteries 71 and 72, respectively, to the opposite terminals of the resistance 67 and their cathodes connected to the midpoint thereof. The battery 71 is poled to apply a positive bias or starting condition to the grid of tube 68 and the battery 72 is poled to apply a negative or blocking bias to the grid of tube 69. The anode of the tube 68 is joined to the solid segment 73 of the multiplex receiving ring and the anode of tube 69 is connected to the solid segment 74 thereof. A condenser 75 is placed across the anodes of the two tubes. The individual segments of the segmented ring of the receiving distributor are connected through the printer magnets 76A and 76B, of the A and B printers respectively, to positive battery, as shown. The distributor is also provided with a pair of correcting rings 77 and 78, the A-segments of ring 77 being strapped together and connected directly to positive battery and the B segments also being strapped together and being connected to positive battery through the winding of a correcting magnet 79. The solid correcting ring 78 is joined by conductor 81 to the spacing contact of a correcting relay 82, the marking contact of which has negative battery applied thereto and the tongue of which is connected through a condenser 83 to positive battery. The relay 82 has two opposed windings 84 and 85, the former being connected in series with the resistance 86, anode of the tube 68 and positive battery and the latter being connected in series with the anode of tube 69, resistance 87, and positive battery.

The operation of the system of Figure 6 is as follows: With no signal on the line (spacing condition for printer A and marking condition for printer B) and with the brush b''' passing over the segments of the A printer, the tube 69 will not operate since continuous negative or blocking bias is applied to its grid. The tube 68 will operate this time however since its grid is positively biased, the plate circuit being completed from negative battery through the tube, resistance 86 and winding 84 of relay 82 to positive battery. The tongue of relay 82 will therefore be held on its spacing contact. If now a group of oscillations are received over the line (marking condition for printer A) a drop of potential will occur across the resistance 67 reversing the charge on the grids of the tubes 68 and 69, making the former negative and the latter positive. A discharge now occurs through the tube 69 by way of resistance 87 and winding 85 to positive battery. The starting of a discharge through the tube 69 permits the condenser 75 to be discharged, thereby reducing the plate current of the tube 68 sufficiently to extinguish the discharge therein, in a manner well known. At the same time the tongue of relay 82 moves over to

its marking contact causing a charging of the condenser 83. With the tube 69 in operation, as brush *b'''* engages one of the segments of the A printer current is supplied to the corresponding operating magnet through the solid ring 74. If the succeeding line condition is a no current condition, the tube 68 will again go into operation extinguishing tube 69 and moving the tongue of the relay 82 into its spacing contact. If the multiplex distributor is in proper phase relation to the signals the correcting brush *cb* will be on the right end of the A segments at the time the relay moves against its spacing contact, causing the condenser 83 to discharge directly to positive battery. However if the brush has gained slightly it will rest on B segment at this time permitting the condenser 83 to discharge through the corrector magnet 79, thereby stepping the brush back into proper position. It will be understood that the multiplex distributor is designed to normally operate slightly faster than the transmitting distributor so as to always correct by a backward step.

If, as the brush *b'''* passes onto the segments of the B printer, oscillations are received over the line, tube 68 will be unoperated and no current will flow through the magnets of the B printer. However, if no oscillations are being received, the tube 68 will operate, completing a circuit to the magnets 76. It will be noted therefore that the A printer operates on oscillation groups, as marking signals and the B printer acts on oscillation groups, as spacing signals. This is in accordance with the usual practice of reversing the marking battery on adjacent multiplex channels.

It will also be noted that the operation of the relay 83 occurs in definite timed relation to each group of incoming signals and therefore produces a reference point from which the correcting mechanism may be accurately controlled. This will be understood more clearly by reference to Figure 8 in which the wave form shown is of the same shape and in the same phase position regardless of whether the first received oscillation is of a negative or positive character. The grids of both tubes 68 and 69 are biased so that each will be at the same potential as the cathode when the current is of a value represented by the ordinant O—O. Due to the push-pull relation of these tubes the tube 68 operates whenever the current falls to zero as represented by the ordinant T1 and the tube 69 will operate when the current rises to the ordinate T2. Consequently either the point 91 or 92 may be used as a reference point for the operation of the corrector. I have shown the correcting relay 82 so connected that the correcting mechanism operates at the point 92, that is, when the signals pass from a condition of oscillation to one of no oscillation.

It will be evident that the tube 68 operates for a longer period than the tube 69 but this is not detrimental to the operation of the corrector mechanism since the corrector operates only at the point of reversal from marking to spacing. A satisfactory operation of the printer is also obtained under these conditions since the printing magnets respond only to the midportion of each signal.

However if greater margin is desired on the printer, the correcting circuits and operating circuits may be independent as shown in Fig. 9, and separately energized from the common transformer 93. The correcting circuit is of the same form shown in Fig. 6, in which the corresponding numerals indicate identical parts. The

operating circuit includes a full wave rectifier employing three-element vacuum tubes 94 and 95 having a common output circuit including a resistance 96 and battery 97. The conductors 98 and 99 lead to the input of a gaseous discharge tube controlling the application of signals to a multiplex distributor, as shown in Fig. 4. The points A and B of these conductors may be connected directly to the corresponding parts of Fig. 4. A filter circuit is not required for the operating tube 46' since this tube is started into operation by the first received impulse of whatever polarity and continues to operate independently of the remaining impulses of an oscillation group until its plate circuit is interrupted by the dead segments of the distributor, as described in connection with Fig. 4. It will therefore be noted that both marking and spacing signals, for operating printer magnets 54 and 56 are of equal duration.

It is obvious, of course, that the invention may be embodied in a variety of other forms without departing from the spirit or essential attributes thereof, and therefore I do not desire to be limited to the exact modifications shown and described but contemplate all obvious variations thereof.

I claim:

1. In a carrier current telegraph system, means for transmitting groups of oscillations, a receiving apparatus comprising a gaseous conduction tube, means responsive to a received group of oscillations for starting a discharge through said tube, means for interrupting said discharge prior to the receipt of the succeeding group of oscillations, an output circuit for said tube and a recording instrument in said output circuit.

2. In a carrier current telegraph system, means for transmitting groups of oscillations, a receiving apparatus comprising a gaseous conduction tube, means responsive to a received group of oscillations for starting a discharge through said tube, an output circuit for said tube, a rotary distributor in said output circuit, means including segments of said distributor for interrupting said discharge prior to the receipt of the succeeding group of oscillations, and a recording instrument in said output circuit.

3. In a multiplex carrier current telegraph system, means for transmitting groups of oscillations, a receiving apparatus comprising a plurality of receiving instruments, and means for causing certain of said instruments to respond to certain groups of oscillations as marking signals, and other of said instruments to respond to other groups of oscillations as spacing signals.

4. In a multiplex carrier current telegraph system, means for transmitting groups of oscillations, a receiving apparatus comprising a plurality of receiving instruments, a gaseous conduction tube, means for initiating a discharge through said tube in response to each group of oscillations, means for interrupting said discharge prior to the receipt of the succeeding group of oscillations, means for applying the output current of said tube, in response to certain groups of oscillations, to one of said instruments as marking signals and means for applying the output current of said tube, in response to other groups of oscillations, to another of said instruments, as spacing signals.

5. In a multiplex telegraph system, means for transmitting code combinations of current and no current conditions, a receiving apparatus comprising a distributor, a plurality of recording instruments associated with said distributor, select-

- ing magnets for said instruments, a gaseous discharge tube operating in response to each received current condition, an output circuit for said tube, means including contacts of said distributor for completing said output circuit in series with the selecting magnets of one recording instrument and including other contacts of said distributor for completing said circuit in shunt to the selecting magnets of another of said recording instruments, and means, also including the contacts of said distributor for completing a circuit through said latter selecting magnets in response to received no current conditions.
6. In a carrier current system, a source of carrier current telegraph signals, a receiving apparatus for said signals, comprising a full wave rectifier, a multiplex receiving distributor and a correcting mechanism for said multiplex receiver controlled by said rectifying signals.
7. In a telegraph system, a source of carrier current telegraph signals, a receiving apparatus for said signals, comprising a full wave rectifier, a multiplex receiving distributor, a correcting mechanism for said distributor, a gaseous conduction tube in the output circuit of said rectifier, means for starting and stopping a discharge in said tube in definite timed relation to each oscillation group, and a correcting mechanism for said distributor controlled by the starting or stopping of said discharge.
8. In a carrier current telegraph system, a source of signals comprising groups of current oscillations, a receiving apparatus comprising a gaseous conduction tube, a multiplex distributor on which said signals are received, means for starting and stopping a discharge through said tube in definite timed relation to each received oscillation group, and a correcting mechanism for said distributor controlled by the starting or stopping of said discharge.
9. In a telegraph system, a source of carrier telegraph signals, a receiving apparatus for said signals comprising a full wave rectifier, a multiplex receiving distributor, a pair of gaseous conduction paths disposed in push-pull relation in the output circuit of said rectifier whereby discharges are created in said paths alternately and in definite timed relation to said received oscillation groups and a correcting mechanism for said distributor controlled by the alternation of the discharge from one path to the other.
10. In a telegraph system, a source of carrier telegraph signals, a receiving apparatus for said signals comprising a full wave rectifier, a multiplex receiving distributor, a pair of gaseous conduction paths disposed in push-pull relation in the output circuit of said rectifier whereby discharges are created in said paths alternately and in definite timed relation to said received oscillation groups, a correcting mechanism for said distributor controlled by the alternation of the discharge from one path to the other, a plurality of receiving instruments and means including said distributor for causing certain of said oscillations to operate one receiving instrument in a marking direction and for causing other oscillations to operate another receiving instrument in a spacing direction.
11. In a carrier current system, a source of telegraph signals comprising groups of current oscillations, a pair of gaseous conduction tubes disposed in push-pull relation, whereby a discharge is produced in one of said tubes when said oscillations are received and a discharge is produced in the other tube when said oscillations cease, means for interrupting the discharge in one tube upon the starting of that in the other and a multiplex correcting mechanism controlled by reversal of the discharges in said tubes.
12. In a carrier current system, a source of telegraph signals comprising groups of current oscillations, a receiving distributor for said signals, a pair of electric discharge tubes, one of said tubes being responsive to current oscillations to produce a discharge therethrough and the other being responsive to cessation of oscillations to produce a discharge therethrough, whereby said tubes operate alternately, and means controlled by the reversal of operation of said tubes for maintaining said distributor in synchronism with the received signals.
13. In a carrier current system, a source of telegraph signals comprising groups of current oscillations, a receiving distributor for said signals, a pair of electric discharge tubes, one of said tubes being responsive to current oscillations to produce a discharge therethrough and the other being responsive to cessation of oscillations to produce a discharge therethrough, whereby said tubes operate alternately, means controlled by the reversal of operation in said tubes for maintaining said distributor in synchronism with the received signals, a receiving instrument, and means including other tubes for applying a steady current condition to said receiving instrument in response to received oscillations.
14. In a carrier current system, a source of telegraph signals comprising groups of current oscillations, a receiving distributor for said signals, a pair of electric discharge tubes, one of said tubes being responsive to current oscillations to produce a discharge therethrough and the other being responsive to cessation of oscillations to produce a discharge therethrough, whereby said tubes operate alternately, means controlled by the reversal of operation of said tubes for maintaining said distributor in synchronism with the received signals, a receiving instrument, and means including said distributor for applying steady current conditions to said receiving instrument in response to received oscillations.
15. In a carrier current system, a source of telegraph signals, comprising groups of current oscillations, a receiving apparatus comprising a gaseous conduction tube, a receiving instrument and means including said tube for applying steady current conditions to said receiving instrument in response to received groups of oscillations.
16. In a carrier current telegraph system, a source of telegraph signals comprising permutation groups of two-line conditions, one of which consists of current oscillations, a receiving apparatus comprising a plurality of gaseous conducting tubes, a plurality of receiving instruments and means including one of said tubes for applying operating current to one of said receiving instruments in response to certain permutation groups of signals, and means including another tube for applying operating currents to another instrument in response to other permutation groups of signals.

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