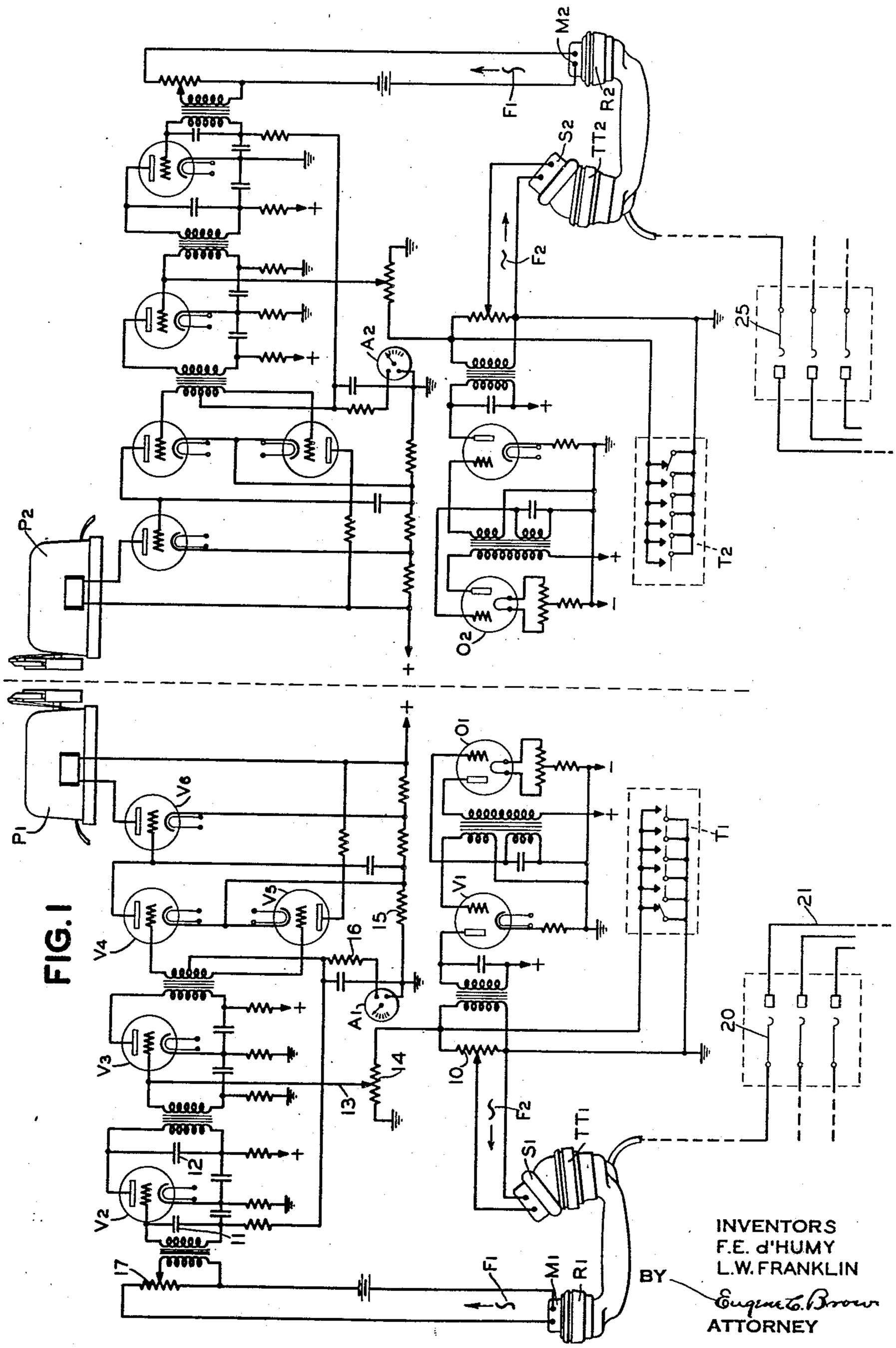
Jan. 9, 1940. F. E. D'HUMY ET AL 2,186,899

TELEGRAPH SYSTEM

Original Filed April 23, 1936 5 Sheets-Sheet 1

FIG. 1



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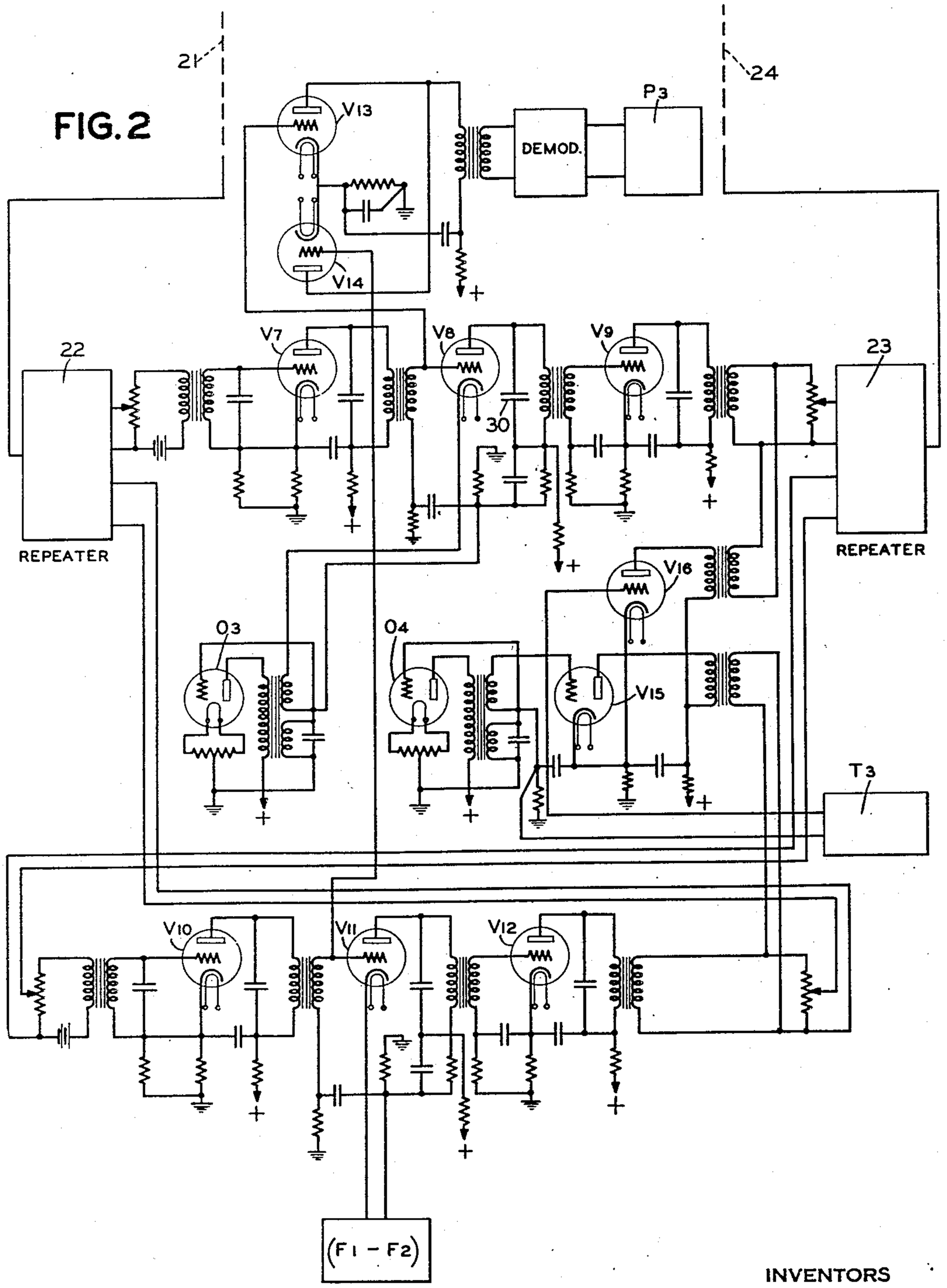
TELEGRAPH SYSTEM

Original Filed April 23, 1936 5 Sheets-Sheet 2

FIG. 2



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TELEGRAPH SYSTEM

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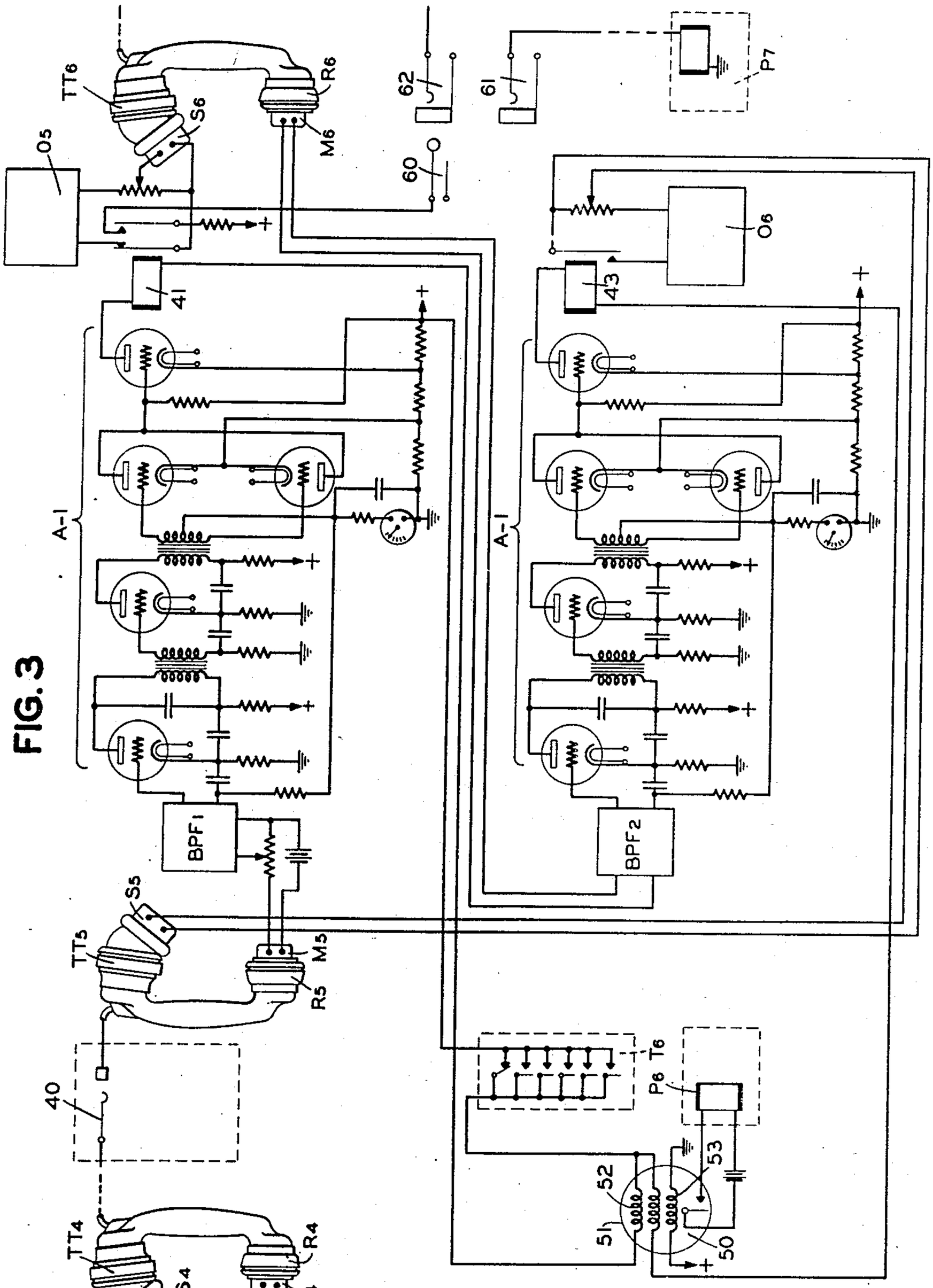
FIG. 3



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TELEGRAPH SYSTEM

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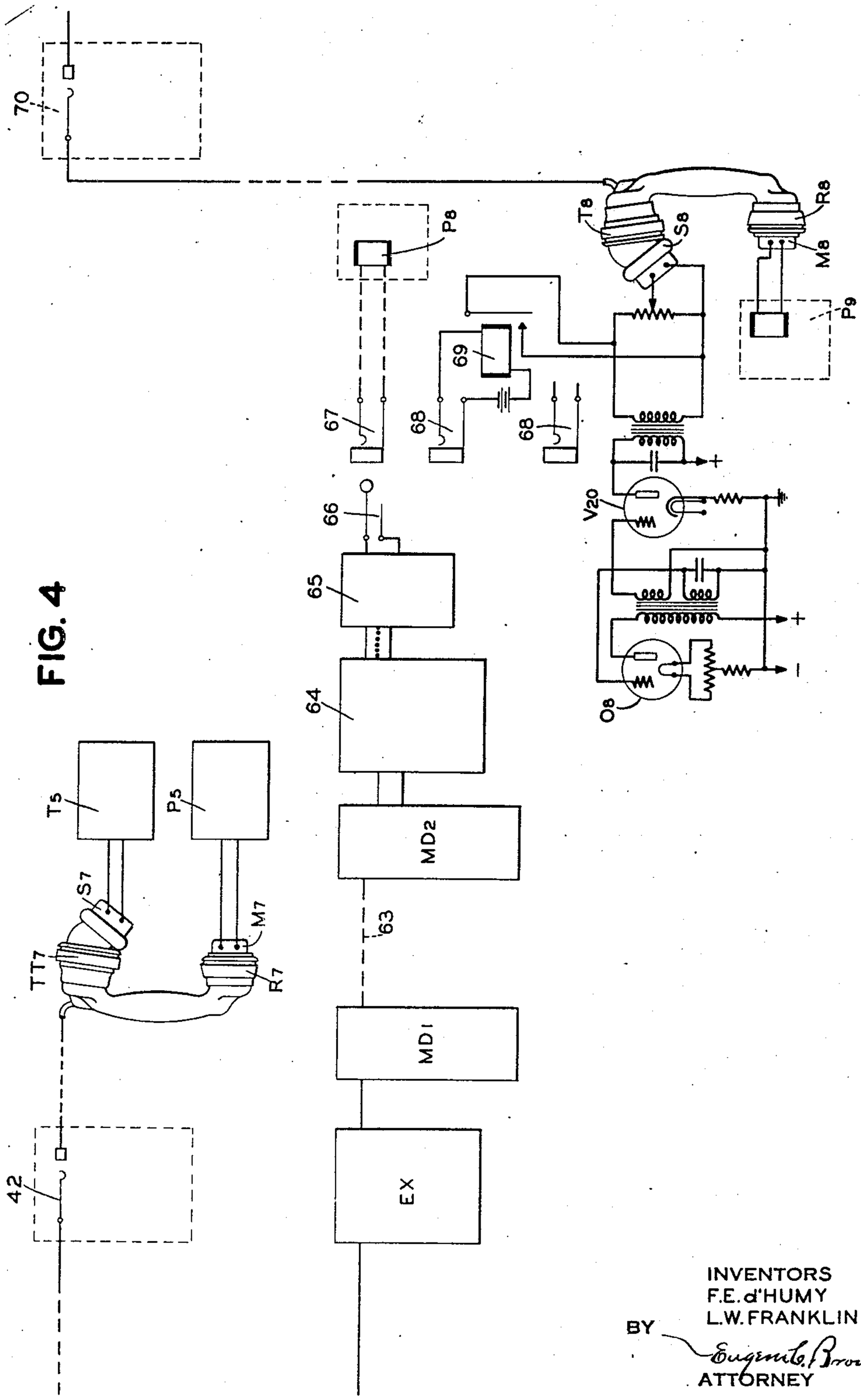
FIG. 4



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TELEGRAPH SYSTEM

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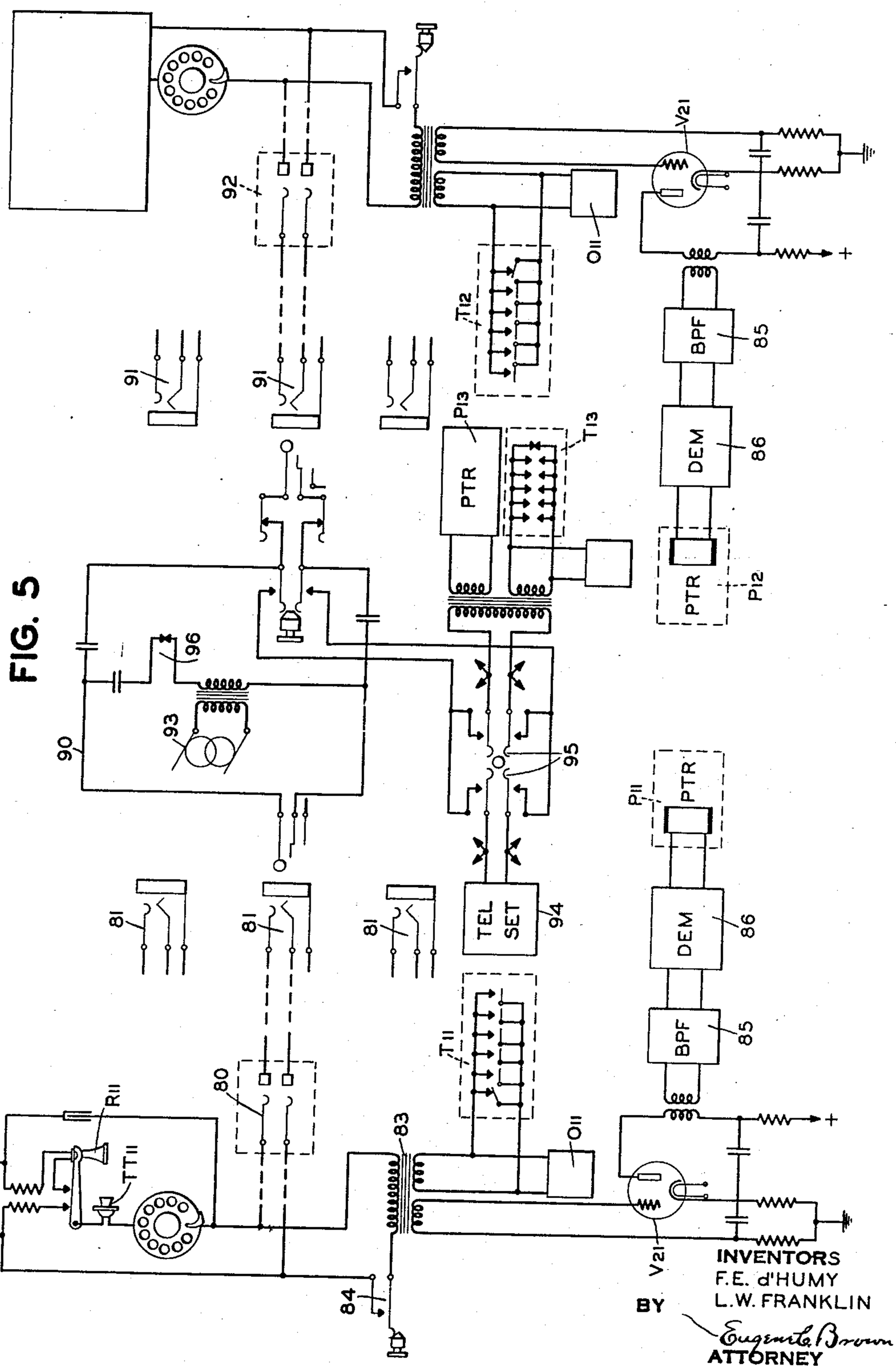
FIG. 5



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UNITED STATES PATENT OFFICE

2,186,899

TELEGRAPH SYSTEM

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Application April 23, 1936, Serial No. 76,064
Renewed September 26, 1939

20 Claims. (Cl. 179—4)

This invention relates to telegraph systems and more particularly to systems involving the transmission of telegraph signals over subscribers' lines terminating at a telephone exchange whereby the telephone plant may be utilized for telegraph communication; or involving transmission of telegraph signals partly over standard telephone circuits and partly over telegraph channels, such as intercity multiplex telegraph channels whereby long distance telegraph calls may be extended through such channels and completed through the local circuits of the telephone exchange.

In our prior application, Ser. No. 17,842 filed April 23, 1935, we have disclosed systems for controlling standard receiving telegraph apparatus or printers over telephone circuits by the utilization of audible tones or trains of audible frequency electrical oscillations which the telephone circuits are designed to transmit. Ordinarily the transmitting and receiving telegraph apparatus will be interconnected through the subscribers' telephones and the telephone switchboard or exchange. In the case of telegraph communication between two subscribers, however, it is often desirable to record and supervise the calls in order that charges may be made for the additional service or for other purposes. It is one of the objects of the present invention, therefore, to prevent telegraph communication between two subscribers except when the connecting circuit includes a special link circuit or a supervisory position or office for monitoring the calls although telephonic communication may be carried on in the usual manner through the direct connections provided at the telephone exchange.

In long distance calls between different cities, it is sometimes desirable to utilize intercity telegraph trunks or channels instead of telephone channels. Another object of the invention, therefore, is to provide a system of the character disclosed in our prior application in which the tone signals are converted into direct-current impulses and impressed upon a telegraph trunk circuit or channel.

A further object of the invention is to provide a system of this character in which direct-current impulses transmitted over a telegraph trunk circuit or channel are converted into tone signals for controlling a printer over a telephone circuit.

Other objects and advantages of the invention, including the provision of improved monitoring and supervisory apparatus, and regulating apparatus for maintaining the desired amplitude of the telegraph signals, will be apparent from the following description of the systems embodying the invention shown on the accompanying drawings. In the drawings:

Figs. 1 and 2 are circuit diagrams of a system embodying certain features of the invention;

Figs. 3 and 4 are similar diagrams of a modification including an intercity telegraph trunk or channel; and

Fig. 5 is a circuit diagram of a further modification of the invention.

Referring to Figs. 1 and 2 of the drawings, in the system shown for the purpose of illustrating typical apparatus for utilizing the invention, two substations are provided with receiving apparatus such as printers P1, P2, one at each station adapted to respond to permutation code signals and transmitters T1, T2 for superimposing audible or tone signals on the transmission circuit, such as a telephone circuit, to control the printer at the remote station. In accordance with the present invention, the printers are arranged to respond to tone signals of a predetermined frequency F1 whereas the transmitters are adapted to send tone signals of a different frequency F2. At an intermediate point, for example at a supervisory position, the signals are converted from tone signals of frequency F2 to corresponding signals of the frequency (F1) adapted to operate the printer at the called station. In this manner direct communication between two stations independent of the intermediate supervisory office or position is prevented. On the other hand, each printer may be arranged to respond to the local transmitter at the same station, if desired, in order to make a record of each message transmitted. Obviously, the tone signals may be altered in various ways to convert them to a form adapted to operate a printer which would not be responsive to the original signals, as will be explained hereinafter with reference to the modified systems shown in Figs. 3, 4 and 5.

The contacts of transmitter T1 at one substation are shown arranged to key the output circuit of an amplifier tube V1 having its input circuit connected to the oscillator O1 to produce five-unit code signals consisting of spacing impulses of audible frequency oscillations, for example of a frequency of 750 cycles, and marking impulses during which no oscillations are impressed upon the circuit. The tone signals are applied to a telephone circuit through a loudspeaker or reproducer S1 and a telephone transmitter TT1 acoustically coupled to the reproducer,

a potentiometer 10 being provided in the circuit of the reproducer S1 to permit regulation of the amplitude of the signals applied to the transmission circuit.

The printer P1 is arranged to respond to the tone signals of frequency F1, for example 1250 cycles, received over the telephone circuit, reproduced by the telephone receiver R1 and the microphone M1, rectified and applied to the printer. The received impulses are amplified by the amplifier tubes V2 and V3, rectified by the tubes V4 and V5, and inverted by the inverter tube V6. The input and output circuits of the amplifier tubes V2 and/or V3 include resonant elements, such as coupling transformers and tuning condensers 11 and 12, whereby the amplifier is tuned to a frequency of 1250 cycles so that the amplifier is adapted to amplify tone signals of this frequency and sharply attenuate signals of other frequencies. The input circuit of amplifier tube V3 may be connected through conductor 13 and potentiometer 14 to the output circuit of the local transmitting amplifier V1 so that the printer P1 responds to the signals generated by the local transmitter T1 to make a record of outgoing messages.

The rectifier tubes V4 and V5 are connected to provide full-wave rectification and the control electrodes thereof are normally biased by the potential drop in resistor 15 so that no plate current traverses the tubes when no signalling impulses are received. The control electrodes are connected through a resistor 16 and milliammeter A1 to the negative terminal of resistor 15. The milliammeter A1 indicates the grid current of tubes V4 and V5 which depends upon the magnitude of the received signals and thus the meter reading facilitates the adjustment of the regulating potentiometer 17 to maintain the amplitude of the impulses applied to the printer magnet within the limits required for satisfactory operation.

The elements of the amplifier, rectifier and inverter circuits correspond generally to those shown and described in detail in our copending application referred to above and, except as above noted and as described in said application, correspond to the usual practice. The tone signals representing spacing signals of the code employed cause the control electrodes of the rectifier tubes V4 and V5 to become positive or less negative, whereupon the tubes become conducting. The anodes or plate electrodes of the tubes V4 and V5 are connected together and to the control electrode of the inverter tube V6. The control electrode of the latter is normally at such potential that the tube V6 is conductive and the printer magnet connected thereto is normally energized. Upon the occurrence of a spacing signal, the flow of current through the rectifier tubes V4 and V5 causes the control electrode of the tube V6 to become more negative and the current through the printer magnet is interrupted for the duration of the signal. When marking signals are received, the tube V6 becomes conductive and the printer magnet is energized so that the printer responds to the signals.

The circuit of the printer P2 is identical with that of printer P1, the associated amplifier being likewise tuned to the frequency F1 so that it is not adapted to respond to the signals from transmitter T1 until such signals are converted to the proper frequency. In the system shown, the subscriber at the first substation may be connected through a switch 20, which may be located at a telephone exchange, to a circuit 21 extending to supervisory position or office when telegraph communication is desired with another subscriber. It may be assumed that the first mentioned subscriber may be also connected directly at the telephone exchange to other subscribers for telephone communication but in that case, the printer at the called subscriber's station will not respond to the transmitter T1 as pointed out above.

The circuit 21 terminates in a two-way repeater 22, such as a telephone transmitter and receiver, a reproducer coupled to the transmitter and a microphone coupled to the receiver as in Fig. 1. The operator at the supervisory position extends the connection to the called subscriber's station through a two-way repeater 23, which may be similar to the repeater 22 and forms the other terminal of the link circuit individual to said repeater, the circuit 24 and switch 25 corresponding to the switch 20. When the connection is established to the called substation, the calling subscriber at the first station may control the printer P2 at the called substation by the transmitter T1, the tone signals of frequency F2 being converted to tone signals of frequency F1 at the supervisory position or office.

The frequency conversion of the tone signals may be accomplished in various ways, one of which is illustrated in Fig. 2. The incoming signals of frequency F2 are amplified by an amplifier tube V7 and impressed upon the input circuit of a modulator tube V8. A local oscillator O3 of a frequency of F1—F2 or 500 cycles is also coupled to the tube V8. The output circuit of the tube V8 is tuned to the frequency F1, as by means of a condenser 30, whereby signals of frequency F1 corresponding to the received signals of frequency F2 are impressed upon the amplifier V9, amplified and transmitted by the repeater 23 and circuit 24 to the called substation. It will be apparent to those skilled in the art that other frequency converter systems may be employed at the supervisory office instead of that shown without departing from the scope of the invention since such substitution would not affect the general operation of the system.

The system shown is arranged to provide two-way communication. The operation of the transmitter T2 at the second substation impresses permutation code signals of frequency F2 upon the telephone line, the circuit 24 and the repeater 23, said signals being amplified and converted to signals of frequency F1 by the tubes V10, V11 and V12 corresponding to the tubes V7, V8 and V9. The converted signals of the character required to operate the printer P1 are impressed thereon through the repeater 22, the circuit 21, the telephone line to the calling substation and the receiver R1 which is connected to the printer magnet through the microphone M1 and the associated amplifier and inverter system.

If desired, a monitor printer P3 and a monitor transmitter T3 may be provided at the supervisory position or office. The monitor printer as shown is arranged to respond to the transmitters T1 and T2 at both subscribers' stations. In order to effect this result two amplifier tubes V13 and V14 are provided having their input circuits connected to the control electrodes of the modulator tubes V8 and V11, respectively, whereby signals impressed upon either of the tubes V8 and V11 will also be impressed upon one or the other of the tubes V13 and V14. The output cir-

cuits of the tubes V13 and V14 are connected in parallel through a demodulator D to the monitor printer P3. The transmitter T3 is arranged to key a local oscillator O4 of frequency F1, the output circuit of the oscillator being connected in parallel to the amplifier tubes V15 and V16 associated with the outgoing circuits of the repeaters 22 and 23, respectively. The output circuits of the tubes V15 and V16 are bridged by the contacts of the transmitter T3 so that when the contacts are open, signalling impulses are transmitted simultaneously to the printers P1 and P2 at the subscribers' stations. In this manner the operator at the supervisory position may transmit to and receive from both of the subscribers' stations.

Any suitable tone frequencies may be employed in systems embodying the invention. Frequencies between 600 and 1600 cycles are preferred since the resonant characteristics of the telephone are such that this range of frequencies is transmitted with maximum efficiency. In accordance with a further feature of the invention, signalling currents approximating a frequency of 1000 cycles are avoided because this frequency is employed for ringing purposes on intercity carrier telephone channels. The amplitude of the ringing current furthermore is much greater than that of the voice currents transmitted over the same channel. The amplitude of the signalling currents in the telephone channels according to the present system is preferably maintained at or below the level of the voice currents and thus by reason of the difference in frequency and the difference in amplitude, there is no interference with the ringing apparatus of the telephone system where a connection includes a carrier channel.

In another embodiment of the invention, instead of changing the frequency of the tone signals by impressing the signals upon a frequency converter of the tube type, the signals may be impressed upon a relay adapted to control a current of different frequency or make and break a circuit containing a source of direct current. In this manner it is possible to utilize an intercity telegraph channel adapted to transmit direct-current impulses instead of a voice-current carrier channel. A system of this character in which a repeater relay converts the tone signals into both direct-current impulses and tone signals of a different frequency is shown in Figs. 3 and 4.

Referring to these figures of the drawings, the subscriber's substation comprises a transmitter T4 and printer P4, including tone generating and receiving apparatus similar to that shown in Fig. 1, connected through the telephone transmitter TT4 and receiver R4, the telephone circuit and a switch 40 at the telephone exchange to a repeater including a telephone receiver R5, microphone M5, reproducer S5 and telephone transmitter TT5 at a supervisory position or exchange. The received signals of a frequency of 750 cycles from the transmitter T4 are impressed through a band pass filter BPF1, adapted to pass 750 cycle current, and an amplifier and inverter system A1 similar to that provided at the subscriber's station, upon the winding of a relay 41. The relay 41 thus responds to the code signals sent by the transmitter T4, being normally energized and becoming deenergized upon the occurrence of the "start" and spacing signals. A 1250-cycle oscillator O5 is connected through the inner armature and back contact of relay 41 to a loud speaker or reproducer S6. When the called station is a local station, the connection is made from the telephone TT6–R6 through a switch 42 at the telephone exchange whereupon the transmitter TT6 is acoustically coupled to the reproducer S6 and the code signals from transmitter T4, converted to signals of a frequency of 1250 cycles, are impressed upon the printer P5 through the telephone circuit, the telephone receiver R7, the microphone M7 and a suitable signal amplifier and inverter such as that shown in Fig. 1. When the message is completed, the called subscriber may operate the printer P4 through a circuit including the reproducer S7, telephone transmitter TT7, switch 42, receiver R6, microphone M6, band pass filter BPF2, amplifier and inverter system A1 associated with relay 43, contacts of said relay arranged to key the oscillator O6 of a frequency for which the printer P4 is tuned, reproducer S5, telephone transmitter TT5, the telephone circuit including switch 40, the receiver R4 and the microphone M4 connected to the receiving printer.

A monitor printer P6 and a transmitter T6 may also be provided at the supervisory position in this system if desired. The printer P6 is connected to the contacts of a relay 50 having two operating windings 51 and 52, and a biasing winding 53. The operating windings 51 and 52 are connected in series with relays 41 and 43, respectively, and the relay is adjusted to operate when the current through either relay 41 or 43 is interrupted. Relay 50, therefore, responds to signals from either transmitter T4 or transmitter T5. The contacts of the transmitter T6 are connected in the common circuit of relays 41, 43 and 50, so that said relays are deenergized when the transmitter contacts open, printer P6 is operated and a 1250-cycle tone signal is impressed upon the circuits extending to both printers P4 and P5. In this manner, two-way communication is provided between both subscribers' stations and the supervisory position.

The relay 41 may also be arranged to convert the tone signals received over a circuit through the telephone exchange to direct-current signals. As shown, the outer armature and front contact of said relay controls the circuit between a battery and the tip contact of a plug 60 adapted to be inserted in jacks 61, 62 forming terminals of telegraph circuits. A printer P7 is connected to the jack 61 so that when the plug 60 is inserted in the jack 61, the printer will be operated in accordance with the tone signals converted by the relay 41 into direct-current signals.

The jack 62 forms the terminal of a multiplex channel of the intercity trunk circuit 63 terminating at opposite ends in the multiplex distributors MD1 and MD2. In order to transmit the start-stop signals over the multiplex channel, an extended channel system EX which may be similar to that disclosed in Franklin Patent No. 1,881,453 dated October 11, 1932, is provided in connection with the distributor MD1. In accordance with the disclosure of said patent, the multiplex channel may be arranged to provide two-way communication if desired. A tape transmitter 65 associated with the reperforator 64 is operative to repeat the stored signals after connection has been made to the called station. The terminals of the tape transmitter may be connected to a plug 66 adapted to be inserted in a jack 67 forming the terminal of the line leading to a printer P8. Thus the printer P8 is operated in accordance with the signals transmitted over the telegraph

channel 63 and stored in the tape in the reperforator 64.

Other jacks 68 are provided for extending calls to stations provided with printers responsive to audible tone signals and accessible through the telephone exchange. A relay 69 is connected to each jack 68 for the purpose of converting the direct-current signals from the tape transmitter 65 into corresponding tone signals. An oscillator O8 and associated amplifier V20 produce audible tone signals of suitable frequency, for example 1250 cycles which are keyed by the contacts of relay 69 and applied to the receiving printer through the reproducer S8, the telephone transmitter TT8 and the selective switching apparatus 70 of the telephone exchange. Transmission from the called station to the printer P9 may be effected in the usual manner through the telephone circuit, the receiver R8 and microphone M8.

It will be apparent that the invention is not limited to systems wherein the code signals from the calling station are converted into signals of a different frequency or direct-current signals at the intermediate supervisory position or office as the operation of the transmitter or receiver may be controlled in many different ways to effect the same result, i. e., to require the connection between the sending keyboard and the printer to include the intermediate position or special link circuit before the printer will respond to the keyboard. For example, in the embodiment of the invention shown in Fig. 5, a source of alternating current is connected to the transmission circuit at the supervisory position thereby modulating the signals produced at the sending station to generate signals of a character adapted to control the receiving printer.

In the system shown in Fig. 5, the calling subscriber's station includes the usual telephone receiver R11 and telephone transmitter TT11 which may be connected through the selective switching apparatus 80 at the telephone exchange either to other subscribers' lines or to an idle one of a plurality of jacks 81 at the supervisory position or office. A telegraph transmitter T11 and a printer P11 are also provided at the calling station, said transmitter and printer being connected to separate secondary windings of a transformer 83. The primary winding of transformer 83 may be bridged across the line circuit by closing a key 84 when the subscriber is desirous of sending or receiving telegraph signals or the transmitter T11 and printer P11 may be operatively connected to the circuit in any other suitable manner, as for example that shown in Figs. 1–4.

The transmitter T11 is shown as arranged to key the output of an oscillator O11 of frequency F2, for example of 750 cycles. A mixer tube V21, having its input circuit connected to the receiving secondary winding of transformer 83, is interposed between the transmission circuit and the printer P11. The output circuit of the tube V21 is connected through the band pass filter 85, adapted to pass signals of frequency F1, to the demodulator 86 arranged to rectify the signals. The tube V21 is operated as a non-linear amplifier, as by biasing the grid to cut-off, and thus when a current of frequency F1—F2 is applied to the telegraph circuit, for example at the supervisory position, and signals of frequency F2 are impressed on the circuit by the remote transmitter T12, the tube produces beat-note signals of frequency F1 for operating the printer P11. In a similar manner, the transmitter T11 is adapted to control the remote printer P12 if the source of alternating current of frequency F1—F2 at the supervisory position is connected to the circuit. Each printer is also adapted to respond to the local transmitter, because of the mutual inductance between the windings of the transformer corresponding to the transformer 83 at each station provided the connection has been extended to the supervisory position.

The operator at the supervisory position extends the call to the called station through the link or cord circuit 90 and an idle jack 91 providing access to the selective switching apparatus 92 at the telephone exchange. As soon as the operator plugs into the jack 81, a source of current 93 of frequency F1—F2, say 500 cycles, is bridged across the line circuit. The source 93 is preferably common to all of the link circuits and is connected to each line continuously during printer operation. A telephone set 94 may be connected to any link circuit by actuating a listening key 95, of which there is one for each link circuit. While the operator is conversing with a subscriber, a switch 96 is actuated to open the circuit of the 500-cycle generator 93. The operator may also be provided with a printer P13 and transmitter T13 connected to contacts of the listening key 95 to permit telegraph correspondence with either of the subscribers connected to any link circuit 90. The transmitters T11, T12 and T13 are adapted to transmit signal pulses of a frequency F2 whereas the printers P11, P12 and P13 are adapted to respond to currents of a frequency F1. When one of the printers is connected to one of the transmitters and the source 93 of frequency F1—F2 is connected to the circuit, the signals applied to the printer are converted or modified by the associated mixer tube so that the printer responds to the signals sent by the transmitter.

Many other modifications of the systems shown and described for the purpose of explaining the invention will occur to those skilled in the art and are within the scope of the invention if covered by the appended claims.

What we claim is:

1. The method of telegraph communication between telephone subscribers which comprises producing electrical oscillations of a predetermined audible frequency, keying said oscillations at one subscriber's station to produce permutation code signals formed of successive trains of oscillations, transmitting said signals over a channel adapted to transmit voice frequency currents, converting said signals into trains of oscillations of a different frequency and selectively operating a telegraph receiver at a second subscriber's station in accordance therewith.

2. The method of telegraph communication which comprises applying audible tone permutation code signals to a telephone channel, converting said signals into corresponding signals consisting of trains of oscillations of a frequency differing from that of the first mentioned tone signals but also within the audio frequency band and selectively operating a telegraph receiver in accordance therewith.

3. The method of telegraph communication over two serial communication channels which comprises transmitting audible tone permutation code signals over the first of said two channels and repeating the signals at a different tone frequency over the other channel.

4. The method of preventing telegraph communication between two substations in a com-

bined telephone-telegraph system comprising substations each provided with telephone sets and telegraph transmitting and receiving apparatus, a supervisory position for telegraph communication between said substations and means for interconnecting said substations for telephonic and telegraph communication, except when interconnected through said supervisory position which comprises modifying at said position the signals sent by the transmitting apparatus at one substation to convert them to a form adapted to operate the receiving apparatus at the other substation.

5. The method of preventing telegraph communication between two substations in a combined telephone-telegraph system comprising substations each provided with telephone sets and telegraph transmitting and receiving apparatus, a supervisory position for telegraph communication between said substations and means for interconnecting said substations for telephonic and telegraph communication, except when interconnected through said supervisory position which comprises modifying the character of the telegraph signals transmitted by the calling substation as long as said substation is connected to the supervisory position.

6. The method of preventing telegraph communication between two substations in a combined telephone-telegraph system comprising substations each provided with telephone sets and telegraph transmitting and receiving apparatus, a supervisory position for telegraph communication between said substations and means for interconnecting said substations for telephonic and telegraph communication, except when interconnected through said supervisory position which comprises modulating the signals received at the supervisory position and repeating the modulated signals over the circuit to the called substation.

7. A telegraph system comprising a communication channel, means for generating electrical oscillations of audible frequency, means for keying said oscillations to produce audible-tone permutation code signals and for impressing said signals upon said channel, a second channel, receiving apparatus arranged not to respond to said signals connected to said second channel and means for converting said signals to a form adapted to operate said receiving apparatus.

8. A telegraph system comprising a communication channel, means for generating electrical oscillations of audible frequency, means for keying said oscillations to produce audible-tone permutation code signals and for impressing said signals upon said channel, a second channel, receiving apparatus arranged not to respond to said signals connected to said second channel and means for converting said signals to a form adapted to operate said receiving apparatus, and for impressing the same on said second channel.

9. A telegraph system comprising a communication channel, means for generating electrical oscillations of audible frequency, means for keying said oscillations to produce audible-tone permutation code signals and for impressing said signals upon said channel, a second channel and means for converting the signals to corresponding signals of a different component frequency and for impressing the converted signals upon said second channel.

10. A telegraph system comprising a plurality of subscribers' stations each provided with telegraph transmitting and receiving apparatus, a supervisory position, means for interconnecting said stations either through said position or independently thereof as desired and means dependent upon the inclusion of the supervisory position in the connecting circuit for rendering the receiving apparatus at one station responsive to the transmitting apparatus at the other station.

11. A combined telephone-telegraph system comprising a plurality of subscribers' stations each provided with a telephone set and telegraph transmitting and receiving apparatus, telephone lines extending to said stations, said telegraph transmitting apparatus including means for impressing tone signals on said lines to operate the receiving apparatus at another station, means including said telephone lines for interconnecting said stations for telephone communication only and other means including said telephone lines for interconecting said stations for telegraph communication.

12. A combined telephone-telegraph system comprising a subscriber's station provided with a telephone set and audible-tone telegraph transmitting apparatus, a telephone line extending to said station, said transmitting apparatus including means for impressing tone signals on said line, a telegraph channel and means for repeating the tone signals transmitted over said line as direct-current impulses in said telegraph channel.

13. A combined telephone-telegraph system comprising a subscriber's station provided with a telephone set and audible-tone telegraph receiving apparatus, a telephone line extending to said station, a telegraph channel, means for impressing direct-current telegraph signals on said channel and means for repeating the signals transmitted over said channel as tone signals in said telephone line to operate said telegraph receiving apparatus.

14. A combined telephone-telegraph system comprising a subscriber's station provided with telegraph receiving apparatus, a telephone line extending to said station, means for impressing tone signals on said line to operate the telegraph receiving apparatus and means for indicating the amplitude of the signals received over said line.

15. In a combined telephone-telegraph system comprising subscribers' stations each provided with telephone and telegraph equipment and means for interconnecting the same for telephone and telegraph communication, an intermediate supervisory position provided with monitoring equipment responsive to telegraph communication between two connecting stations.

16. A telegraph system comprising a communication channel, means for generating electrical oscillations of audible frequency, said oscillations not including a 1000-cycle component of substantial amplitude, means for keying said oscillations to produce permutation code signals and for impressing the same upon said channel and telegraph receiving apparatus responsive to said signals connected to said channel.

17. A telegraph system comprising means for generating electrical oscillations of audible frequency, means for keying said oscillations to produce permutation code signals, a channel for transmitting said signals, means for impressing a constant frequency current upon said channel at a point remote from said keying means, receiving apparatus connected to said channel and means whereby said apparatus is jointly responsive to said signals and said current.

18. A telegraph system comprising means for generating electrical oscillations of audible frequency, means for keying said oscillations to produce permutation code signals, a channel for transmitting said signals, means for impressing a constant frequency current upon said channel, and receiving apparatus connected to said channel and rendered operative by said current.

19. A telegraph system comprising subscribers' stations, a telegraph transmitter at one of said stations, a printer at another of said stations, a link circuit and switching apparatus associated therewith for interconnecting said two stations, a source of current connected to said link circuit and means including said source of current for rendering said printer responsive to said transmitter when the same are interconnected through said link circuit.

20. A telegraph system comprising subscribers' stations each provided with telegraph transmitting and receiving apparatus, a supervisory position, means at said position for interconnecting any two of said stations and impressing a pulsating current upon the connecting circuit, and means including a non-linear amplifier preceding the telegraph receiving apparatus at each subscriber's station whereby the signals impressed upon the receiving apparatus are altered by said pulsating current.

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