

Jan. 9, 1940.

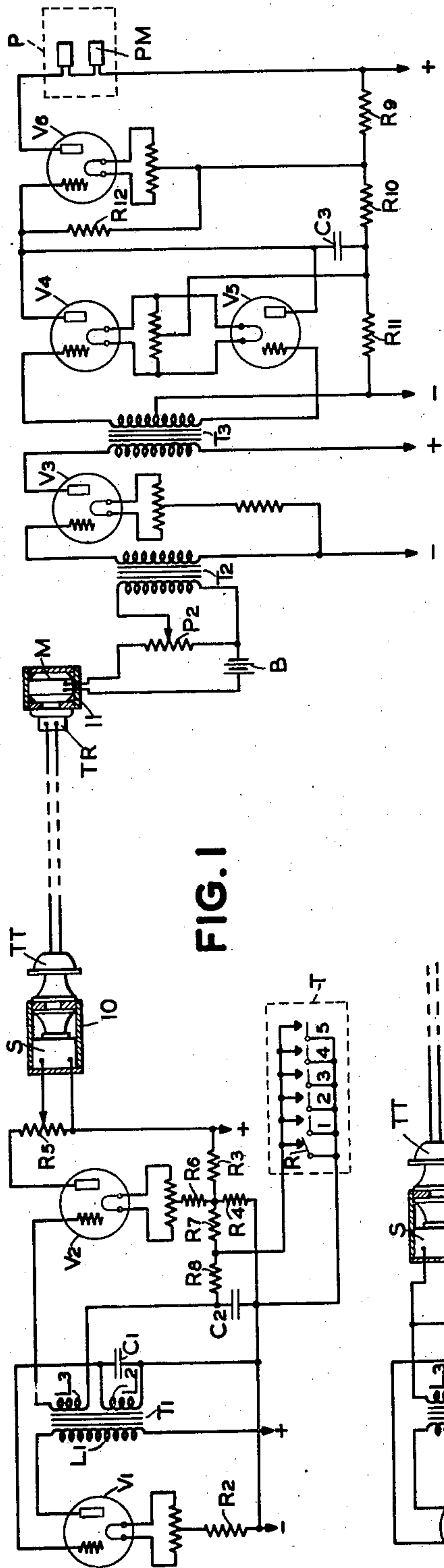
F. E. D'HUMY ET AL

TELEGRAPH SYSTEM

Filed April 23, 1935

3 Sheets-Sheet 1

2,186,895



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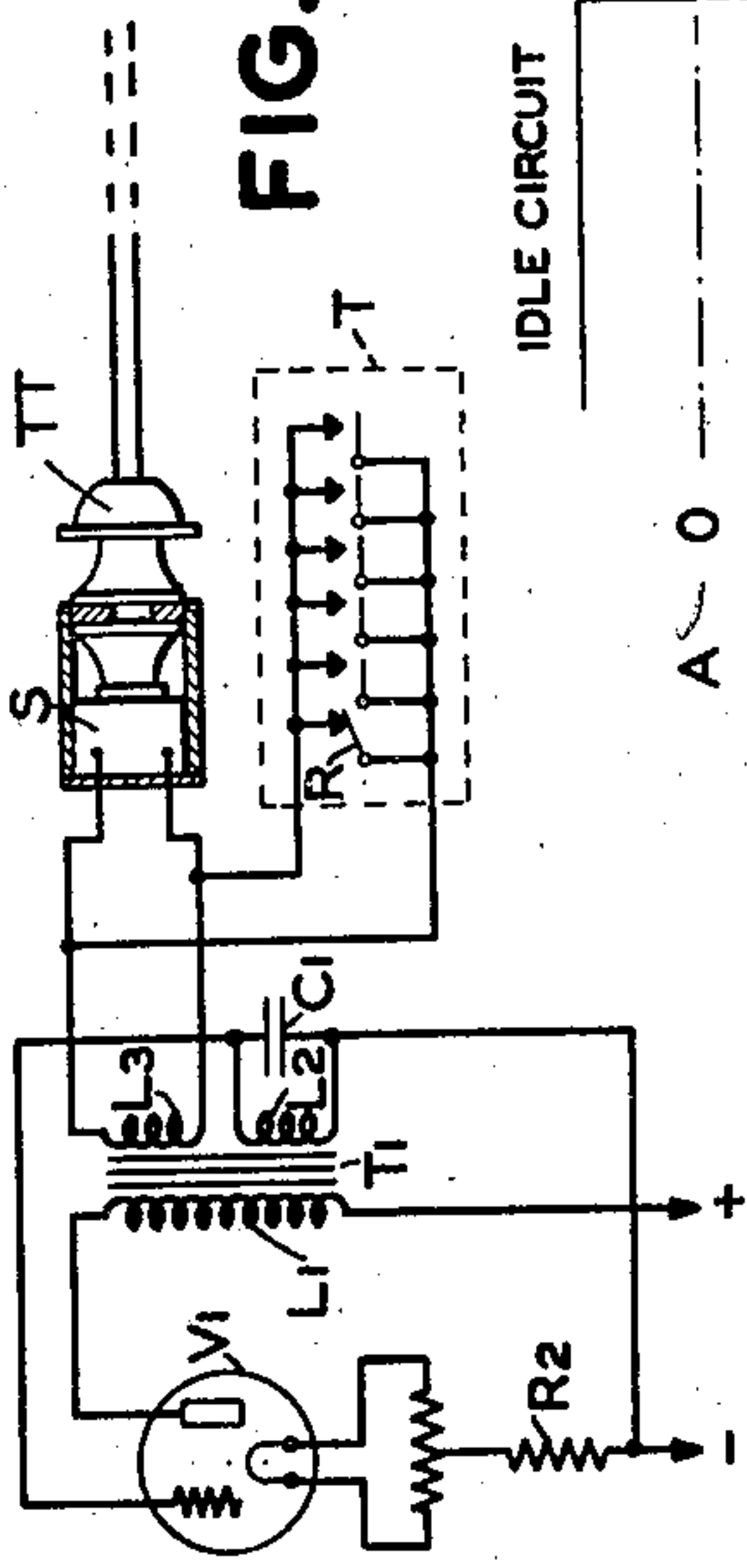


FIG. 2

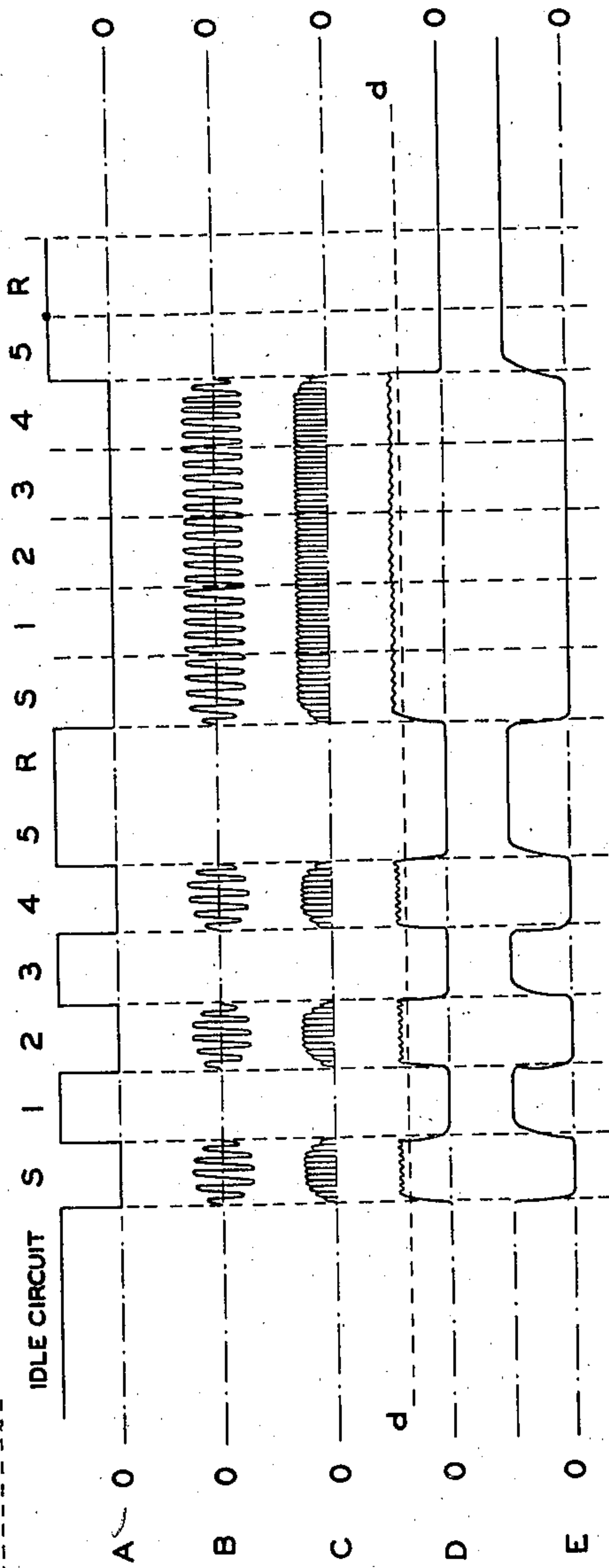


FIG. 3

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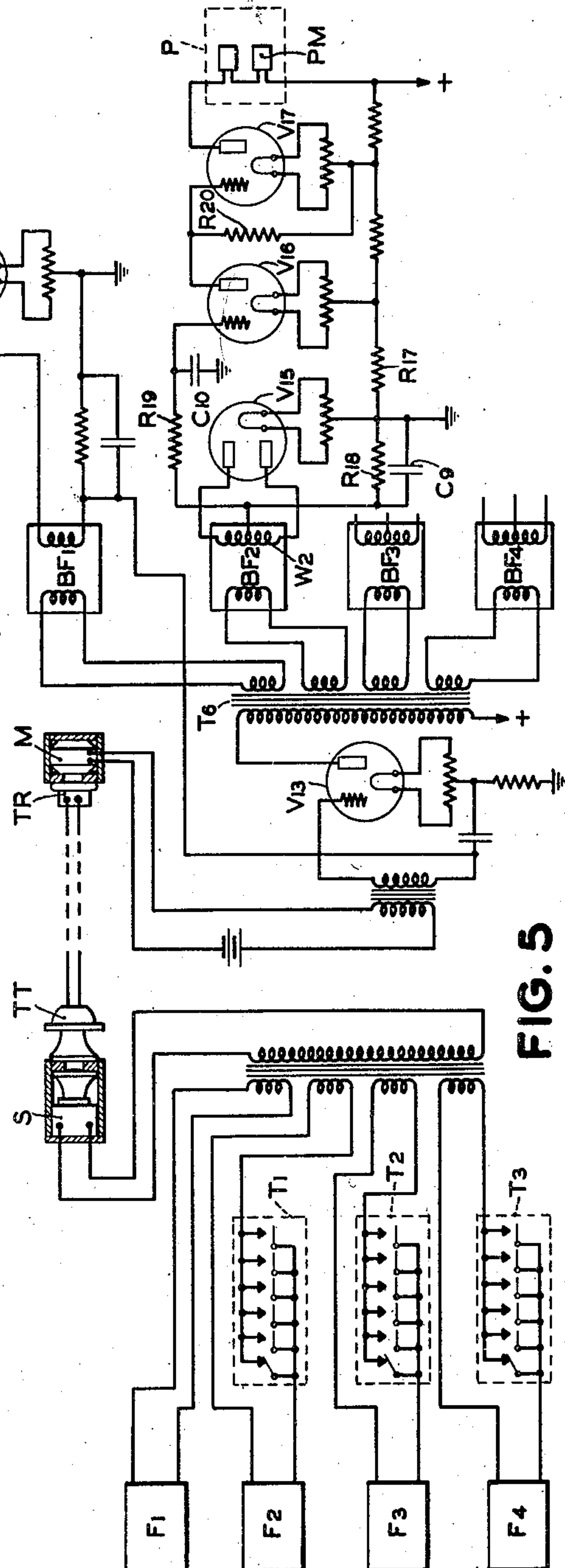
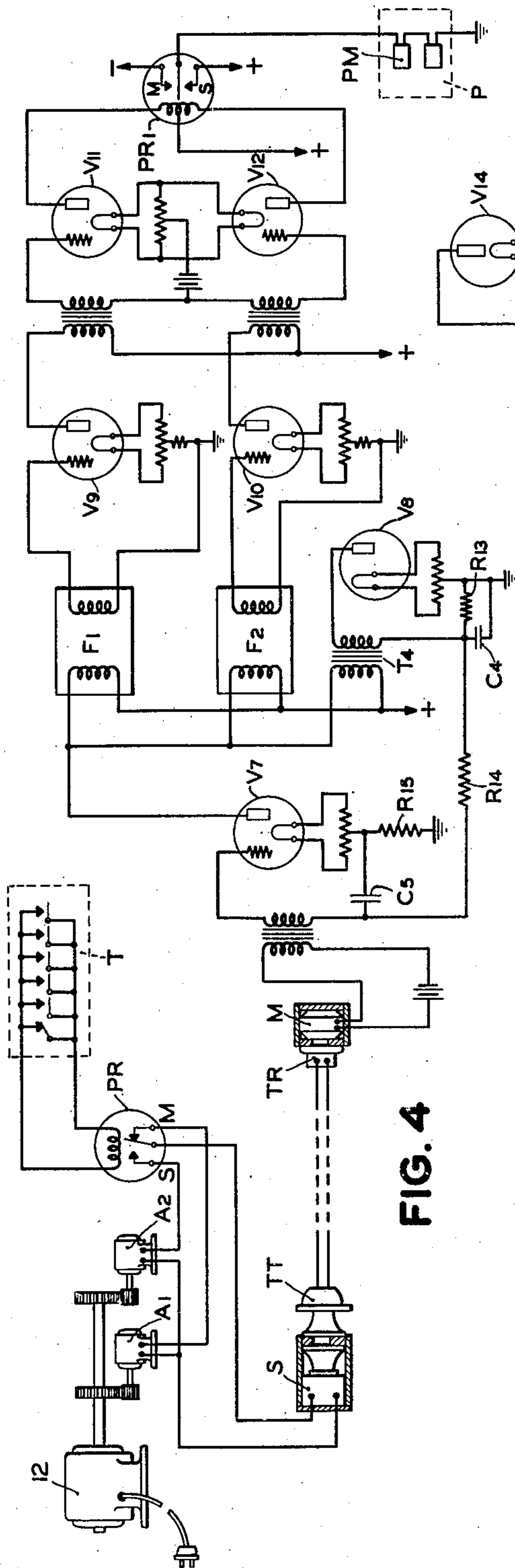
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3 Sheets-Sheet 2



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TELEGRAPH SYSTEM

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3 Sheets-Sheet 3

FIG.6

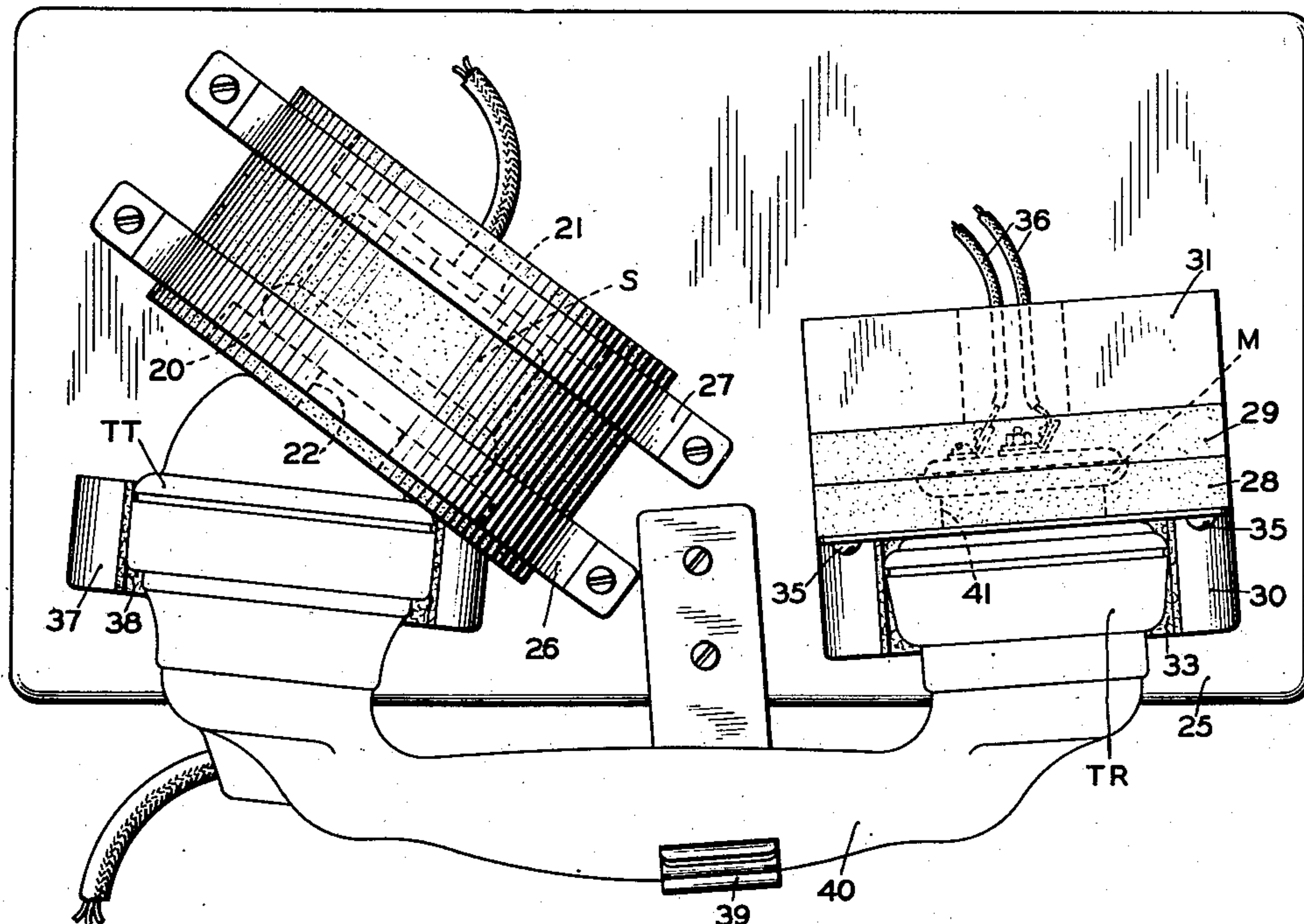
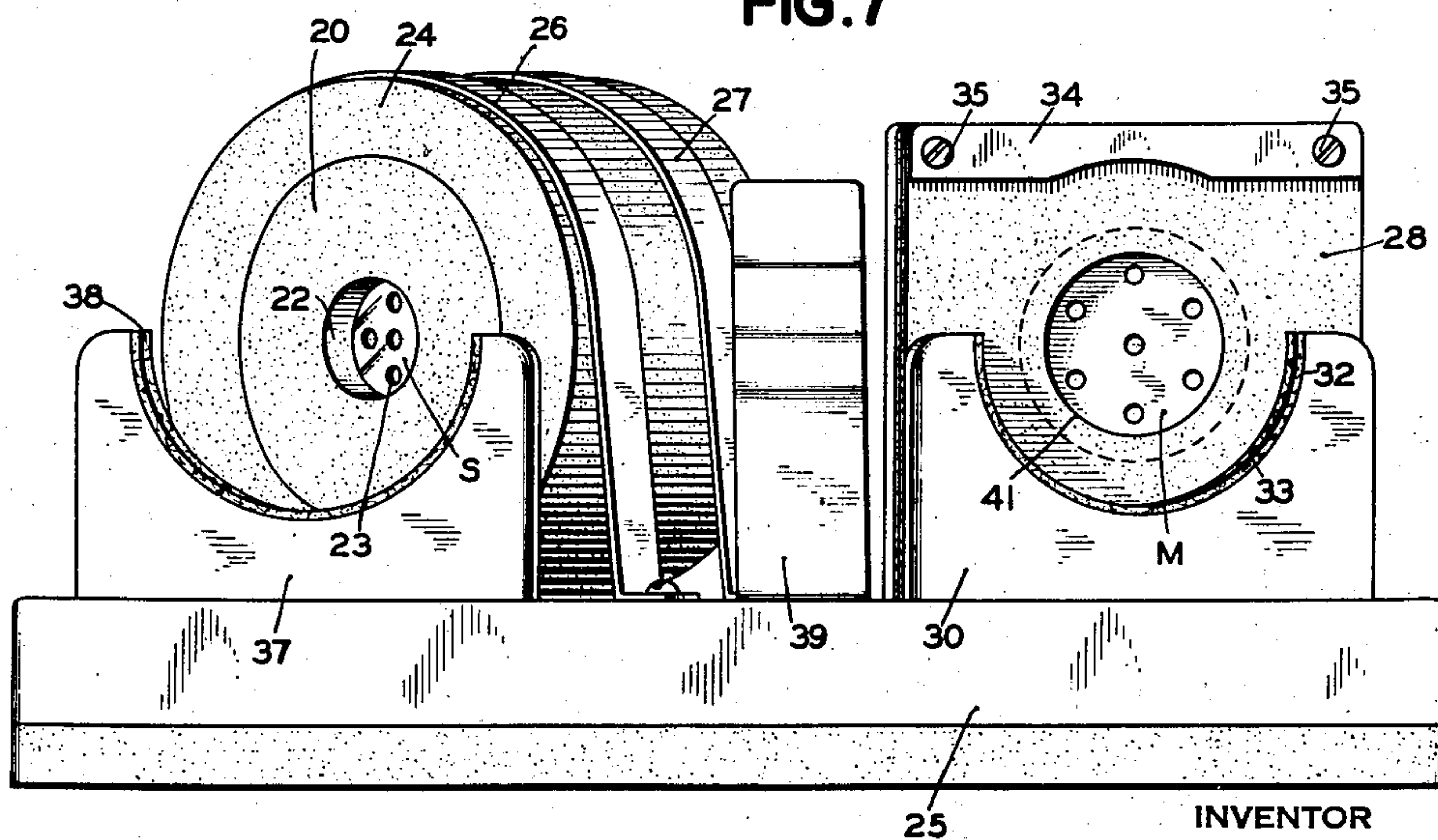


FIG.7



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TELEGRAPH SYSTEM

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Application April 23, 1935, Serial No. 17,342

31 Claims. (Cl. 173-4)

This invention relates to telegraph systems and more particularly to the transmission of telegraph signals over standard telephone circuits.

5 One of the objects of the invention is the provision of means for enabling telegraph communication to be carried on over a telephone system with standard telegraph equipment and without
10 any changes in the telephone circuit or equipment.

Another object is to provide means whereby telegraph communication may be carried on over telephone circuits of widely differing characteristics.

15 Another object is to provide a telegraph system employing audible telegraph signals and to operate receiving recorders thereby, over a standard telephone circuit.

20 Another object is to prevent objectionable interference in adjacent circuits by the signals set up in the telephone circuits.

Another object is to eliminate extraneous noises from the telephone circuit which might interfere with or reduce the efficiency of the audible telegraph signals being transmitted over the
25 circuit.

Another object is to provide such a system requiring in addition to standard telegraph transmitting and receiving equipment, auxiliary equipment of a relatively simple and inexpensive nature.
30

It has been proposed, heretofore, to carry on telegraph correspondence over a standard telephone circuit by tone or audible signals and
35 such a system is shown in a patent to John V. Foll, No. 1,321,146, granted September 1, 1931. There are a number of difficulties, however, in attempting to operate standard telegraph printers by tone signals received over such circuits
40 and such systems have not gone into commercial use.

Among the difficulties of such systems may be mentioned the extraneous noises picked up by the telephone transmitter and by the telegraph
45 receiving equipment which cause undesirable interference with the telegraph signals. In such systems, as heretofore proposed, due to the high percentage of loss, it is necessary to produce tones of considerable magnitude at the transmitter in
50 order to render the received signals of sufficient strength to actuate the receiving element. The noise produced by the transmitting buzzers or other tone producing devices is highly objectionable, particularly when used in offices of com-
55 mercial houses, banks, and similar places, and

when a number of such systems are employed as in telegraph offices, each system is subject to interference from adjacent transmitters.

The principal advantage of such systems is the flexibility thereof whereby any subscriber or office having a transmitting and receiving equip-
5 ment may communicate telegraphically with any other subscriber or office similarly equipped, over the regular telephone circuit established there-
10 between. The characteristics of telephone circuits vary, however, between wide limits, depending on a large number of variables, and the intensity of the received signals varies accordingly. While the ear is able to accommodate it-
15 self to a wide difference in the intensity of the received signals, this is not true of telegraph receiving equipment, such as standard printers and reperforators, which are designed for oper-
20 ation at predetermined current values.

A further object of the present invention is to
25 overcome these difficulties and to provide a system which operates in the absence of objectionable noise and which is applicable to any existing telephone circuit without manual adjustment for the characteristics of each particular
30 circuit or connection.

Another difficulty inherent in buzzer operated telephone-telegraph systems resides in the lack of uniformity of the keyed signals and the poor characteristic shape of the signalling currents
35 created thereby in the telephone circuit. The lack of uniformity of the signals renders it difficult to operate at the normal speeds for which modern telegraph equipment is designed, and the poor characteristic shape of the signals creates
40 interference in neighboring telephone circuits.

A further object of the invention is, therefore, to produce audible signals which are sharply defined and uniform at high operating speeds and which are particularly well adapted for trans-
45 mission over the usual telephone circuits.

Other objects and advantages of the invention will appear as the description proceeds.

In accordance with the present invention, the audible signals are not produced directly but a
45 series of oscillations are first produced, of definite frequency, sufficiently high so that they may be keyed at a relative high rate to produce trains of oscillations in accordance with a permutation
50 code. The frequency of the oscillations while within the audible range is such that there is an appreciable number of current reversals present in each unit signal of the permutation code. The signals are then shaped to facilitate their
55 transmission over the telephone circuit. and uti-

lized to operate a tone producing device. The tone signals are thus shaped or modulated and reproduce in the telephone circuit electrical variations or trains of oscillations properly shaped for efficient transmission. The sound producing device is acoustically coupled to the telephone transmitter in a manner to reduce to a minimum any sound loss, thereby enabling the sound signals impressed upon the transmitter to be regulated and controlled in volume with an assurance of uniformity and permitting a number of adjacent transmitters to be operated without interference from each other.

In start-stop telegraph systems the practice is to employ a normally closed line so that with the transmitting equipment idle, steady battery is applied to the line. However, in order to enable the telephone circuit to be employed readily for transmission in either direction, means is provided for inverting the signals so that in the rest or marking condition of the keying mechanism, that is when the keying circuit is closed, the oscillations are suppressed, and in the spacing or open condition of the keying mechanism, the oscillations are transmitted.

At the receiving end the received oscillations are converted into sound in the telephone receiver in the usual manner and serve to actuate a microphone acoustically coupled thereto, to again produce oscillations which are rectified, filtered and inverted, so as to enable a standard telegraph receiver to respond thereto. When no signals are being transmitted over the telephone circuit, that is when the telegraph transmitter is in its marking position, continuous current is locally supplied to the receiving recorder, and when tone signals are received, in the spacing condition of the telegraph transmitter, the received signals are utilized to interrupt or reduce to a negligible value the steady current supplied to the recorder. The selecting conditions applied to the recorder thus comprise substantially square topped impulses of the type for which the printer is designed for operation and a wide operating margin is obtained.

In order to permit the telegraph apparatus to be employed in connection with telephone circuits of widely differing characteristics, or with telephone switching connections which may be poor in some instances and better in others, means is provided for rendering the magnitude of the current supplied to the recorder substantially uniform under such varying circuit conditions. This may be effected by transmitting a continuous tone or alternating current of definite frequency and employing the same to control the level of the received signal tones or oscillations. The volume control signals may be entirely separate from the telegraph code signals or a number of code signal frequencies may be employed in such manner that one or another of such signals is always being transmitted over the telephone circuit, and utilized to control the magnitude of the code impulses applied to the receiving recorder.

The invention will be more fully understood by reference to the accompanying drawings in which:

Fig. 1 is a circuit diagram of a telegraphic-telephone transmitting and receiving system embodying certain features of the present invention;

Fig. 2 is a circuit diagram of a modified form of transmitter;

Fig. 3 is a diagram of the signals as they appear in various parts of the system;

Fig. 4 is a circuit diagram of a modified form of

the system employing polar or double current signals;

Fig. 5 is a circuit diagram of a further modification of the system employing a number of channels;

Fig. 6 is a plan view of an acoustic coupling between the telegraph and the telephone systems, and

Fig. 7 is an elevation view of the acoustic coupling shown in Fig. 6.

Referring first to Fig. 1, a vacuum tube V1 is shown having its output circuit connected to the primary winding L1 of a transformer T1 in such a manner that oscillations will be produced by the feeding back into the grid circuit through the secondary winding L2 of the transformer, of the energy from the plate circuit through winding L1. The frequency of oscillation is mainly controlled by the constants of the tuned circuit including the inductance L2 and the capacity C1, and is within the audio range of efficient telephone line transmission, which is approximately from 200 to 3000 cycles per second. A resistance R2 is shown in the filament return circuit of the vacuum tube V1 for the purpose of properly biasing the grid of the tube relative to the cathode, although other conventional methods of obtaining this bias, such as grid leak and condenser, battery bias, etc., may be used. A third winding L3 is shown as a part of the transformer T1 and is for the purpose of transferring a part of the energy or electrical oscillation created in the output circuit of tube V1, to the grid circuit of a keying vacuum tube V2. Other methods of coupling, such as resistance-condenser coupling, could be used, and are contemplated.

The positive terminal of a battery is connected through the resistances R3 and R4, to the negative terminal, and the output circuit of the tube V2 is connected across the resistance R3 so that the plate potential of the tube is equal to the potential drop across resistance R3, less, of course, the potential drop across resistance elements R5 and R6, the function of which will be referred to hereinafter. Resistance elements R7 and R8 are connected in series in the input circuit and a keying device, which is shown as a telegraph transmitter T is connected in shunt to the resistances R4 and R7. The transmitter T may be a standard start-stop transmitting distributor of the type shown in U. S. Patent to Rothermel No. 1,805,374 granted May 12, 1931. In transmitting distributors of this type the rest contact R is closed when the transmitter is idle, so as to apply steady marking battery to the line. The resistance of R4 is so chosen that with one of the contacts of the transmitting distributor closed the voltage drop across resistor R4 will apply a bias to the grid of the keying tube V2 sufficient to interrupt the plate current through the tube, even on the positive half cycles of the voltage applied to the grid from the oscillator tube V1. The resistance of R6 is of such value that with all of the contacts of the transmitting distributor T open, normal grid bias for amplifier operation is produced thereacross.

As a result of the above connections the code signals produced by the transmitting distributor T are inverted, no current flowing in the plate circuit of the tube V2 when the contacts are closed, that is, in response to marking conditions and plate current flowing in the plate circuit of tube V2, modulated by the frequency of oscillations of tube V1, when the contacts of the

transmitting distributor are open, or in their spacing positions.

Consequently during idle periods of the transmitting distributor there will be no tone signals over the telephone circuit and therefore the operator at the distant end of the system may send on the same circuit, without recourse to the use of different frequencies and the filters required for use therewith and without necessitating the use of manual send-receiving switches or other complications.

As is well understood in the art, the rest contact R of the transmitting distributor T opens on starting of the distributor to send a start signal of spacing character followed by the successive selective closing of the code contacts 1 to 5. The permutation code signals are set up on the code contacts by a perforated tape, keyboard or other device. A keyboard transmitter suitable for use in this system is shown in U. S. Patent to Morton; No. 1,884,807, granted October 25, 1932.

In order to shape the signals for efficient transmission over a telephone circuit, a condenser C2 is connected in shunt to the resistance R8, and condenser C2 and resistance R8 are chosen of such value as to allow the front of the signal train to be properly rounded without noticeably affecting the general envelope of the group of oscillations. Since the change in the potential of the grid of the tube V2 at the beginning of each train of oscillations is accompanied by a variation in the charge on the condenser C2, the growth of current at the commencement of each code impulse follows an exponential or logarithmic curve as well understood by those skilled in the art. By making resistance R7 of low resistance as compared to resistance R8, the discharging rate of condenser C2, though resistances R8 and R7 on opening of the distributor contacts, will not be materially greater than the charging rate thereof through resistance R8 only, upon closing of the transmitting distributor contacts. Consequently the rounding of the end of the signal train will be similar to that of the front thereof and the signals will be essentially unbiased.

The tone producing device S is connected across the resistance R5 so as to produce a tone of the frequency of the oscillations of the current in the output circuit of tube V2 and modulated in accordance with the values of the condenser C2 and resistors R7 and R8. The connection of the tone producer S to the resistance R5 is adjustable for the purpose of regulating the volume of the tone to be transmitted over the telephone circuit, to within a range which can properly be handled by existing telephone circuits.

The tone producer S is acoustically shielded and coupled to the transmitter TT of a telephone system terminating at a distant point in a telephone receiver TR, in turn acoustically coupled to a shielded microphone M. The acoustic shielding and coupling is shown diagrammatically in Fig. 1 by the casings 10 and 11, of sound insulating material enclosing the sound producer S, and the microphone M, respectively. By virtue of the acoustic shielding 10 all extraneous noises are precluded from affecting the diaphragm of the telephone transmitter and substantially all of the tone from the sound producer S is effective upon the diaphragm. Consequently the level of the tone may be relatively low while still having an appreciable and uniform effect on the diaphragm of the telephone

transmitter. Due to the low intensity of the sound and the acoustic shielding of the sound producer, none of the tone signals penetrate into the room and the operation of the transmitter is, therefore, as quiet as ordinary telegraph transmittive apparatus.

The acoustic shielding 11 also protects the microphone M from extraneous noises and directs the received tone signals most efficiently to the diaphragm of the microphone.

The telegraph receiving apparatus comprises in addition to the microphone M, a vacuum tube amplifier V3, a push pull rectifier embodying tubes V4 and V5 and a fourth vacuum tube V6 which serves to reinvert the signals so they will be suitable for operation of the recorder P.

If the microphone is of the carbon button type, a battery B or other source of microphone current is necessary. A potentiometer or manual gain control P2 is included in the microphone circuit to adjust the input to the first amplifier tube V3, through the microphone transformer T2, so that the different transmission constants of different telephone lines can be readily compensated for and brought to the same volume level at the grid of the amplifier tube V3. The signals which have been amplified by V3, are applied in push-pull to the grids of tubes V4 and V5 through a transformer T3, which has a center-tapped secondary. As stated, the function of tubes V4 and V5 is to rectify the signals full wave, amplify them, and, in combination with the output tube V6, to reinvert the signals so they will again be adaptable for the operation of a standard stop-start printer. These functions are performed in the following manner:

A bleeder circuit is provided from positive battery through resistances R9, R10 and R11, to ground return, or negative battery, as shown. Tubes V4 and V5 obtain their plate voltage from a point on this voltage divider or bleeder circuit through the coupling resistor R12. This point is the junction of R9 and R10 and is also the point of the filament return of the output tube V6. The rectifier tubes V4 and V5 have their filament return to the junction of resistors R10 and R11. The grid return from the center-tap of the secondary winding of transformer T3 is made to the negative end of the bleeder circuit. Therefore, the negative grid bias on tubes V4 and V5 is the voltage drop across the resistance R11; the plate voltage applied to tubes V4 and V5 is the voltage drop across the resistance R10, less the voltage drop across resistance R12 (if any). The grid bias on the output tube V6 is the voltage drop across resistance R12 (if any) and the plate voltage applied to tube V6 is the voltage drop across resistance R9, less the voltage drop in the printer magnets PM. The value of resistance R11 is of such value that the plate current, with no signal applied to the grids, is cut off, or nearly so, in tubes V4 and V5. With this plate current interrupted, or nearly so, there is little or no current flow through resistance R12, and therefore little or no negative bias on the output tube V6. Maximum plate current will flow through the printer magnets PM at this time, the value of the current being determined by an appropriate choice of the values of resistances R9, and R12 and of the characteristics of tube V6.

When a tone is received from the telephone line, indicating what is normally a spacing or no-current background signal, this tone is amplified in tube V3 and applied to the grids of tubes V4

and V5. On one half cycle the grid of tube V4 is either positive, or at least less negative, than before, therefore, plate currents will flow through this tube and through resistance R12. On alternate half cycles the grid of tube V5 becomes less negative, and also passes current through resistance R12. A small condenser C3 is connected between the paralleled plates of tubes V4 and V5 to the filament or other unipotential point. The value of this condenser is such that the charging of this condenser during the time that neither tube is passing current through resistance R12, and the discharging of the condenser during the time that either tube is passing current through resistance R12 will effect a filtering action which will hold the voltage on the grid of the output tube V6 at an essentially constant value during the period of any pulse, without seriously affecting the general shape of the printer signal.

A reference to Fig. 3 will show the action of this condenser more clearly. In Fig. 3, A represents the signals of a standard stop-start printer system of conventional design when operating on a make and break line as is commonly used; B shows the signals which will be sent to the telephone line by the telephone transmitter TT, each signal pulse comprising a train of substantially sinusoidal alternations corresponding to the oscillations produced by the vacuum tube oscillator V1. The beginning and end of each signal pulse is not abrupt but has been rounded to some extent by the keying system described above to reduce in magnitude any interference which might be transmitted to adjacent telephone circuits. B is also representative of the signals through the amplifier tube V3 as far as the grids of the rectifying tubes V4 and V5. Due to the full-wave rectifying action of tubes V4 and V5, the current through resistance R12, and also the relative voltage on the grid of tube V6 would appear as shown at C if the condenser C3 were not used. The effect of this condenser is to smooth out this voltage which is applied to the grid of tube V6, so that it will appear as shown in D. The dotted line *d-d* represents the negative bias above which the plate current of tube V6 is essentially cut off. Therefore, the signals which will operate the printer will be as shown in E, and will correspond to the signals which were sent from the transmitting keyboard T, as shown at A.

In Fig. 2 a somewhat simplified sound keying arrangement is shown in which the transmitting distributor T is connected directly across the terminals of the sound producer S which in turn is connected directly to the terminals of secondary winding L3 of the transformer T1. The contacts of the transmitter T serve to shunt the tone producer S and therefore to prevent transmission of tone signals to the telephone system in response to marking signals. The envelope of the signals produced by this embodiment are substantially square topped and hence less suitable for transmission over the telephone circuit than the shaped signals produced by the modification shown in Fig. 1. However, they are suitable where interference with neighboring circuits is not an important factor.

Fig. 4 shows another method of transmitting signals over a telephone circuit, in which certain desirable features of ordinary "polar" operation are obtained. In addition, in this embodiment of the invention is incorporated a means for compensating for the variation in transmission efficiency of different telephone cir-

cuits which will be experienced in the practical operation of the system.

In the transmitting part of the system of this "polar" method, instead of using a vacuum tube oscillator for the generation of the tone or tones to be transmitted over the telephone line, a small alternator of the Alexanderson or other well-known type may be used, and is shown. One motor 12 may be used to rotate the armatures of two alternators A1 and A2. These two armatures are not similar, but have different numbers of poles, so that when the motor is rotating at the proper speed, as determined by a centrifugal governor, power line synchronism, or other means, two separate and distinct frequencies will be generated by the two alternators. These two frequencies are each within the audible range above referred to and sufficiently separated so that the two filters used in the receiving mechanism, to be described, can differentiate between them.

A relay PR which is controlled from the key board or other transmitting means T is used to connect the output of one or the other of these sources of tone frequency to the sound producer S which will transmit the signals to the transmitter TT of the telephone set.

At the receiving end of the telephone system the signals are again picked up from the telephone receiver TR by the microphone M and amplified by a conventional amplifier tube V7. A portion of the amplified signals from tube V7 is applied through an aperiodic transformer T4 to a diode rectifier tube V8. The signals are also applied through two filters F1 and F2, of the band-pass type, to each of two amplifier tubes V9 and V10. The filter F1 is tuned to only pass the signals from the alternator A1, while the filter F2 is tuned to only pass the signals from the alternator A2. Thus, each of the amplifier tubes V9 and V10 will only have signals applied to their grids when the tongue of the transmitting relay PR closes the circuit to the sound producer S from alternator A1 or A2, respectively. Each of the rectifier tubes V11 and V12, associated with tubes V9 and V10 respectively, will then respond and pass current through its plate circuit only when the relay PR has completed the circuit to the corresponding alternator. A polar receiving relay PR1 is shown connected in a differential manner in the combined circuit from positive battery to the plates of the two rectifier tubes V11 and V12 in such a manner that when the tongue of the transmitting relay is on the marking contact M, the plate current through the rectifier tube V11 will hold the tongue of the receiving relay PR1 on its corresponding marking contact. Conversely, when the tongue of the transmitting relay PR is on its spacing contact S, the plate current through tube V12 will hold the tongue of the receiving relay PR1 on its corresponding spacing contact S. Thus, whatever signals are sent to the telephone line from the transmitting keyboard T, controlling the transmitting relay PR, are reproduced by the receiving relay PR1 and may be applied to the printing mechanism P in conventional manner.

The portion of the signal energy which was applied to the rectifier tube V8 through the aperiodic transformer T4 is rectified and produces a pulsating direct current voltage across the resistance R13. This voltage is smoothed or filtered by the combined action of resistance R13, condenser C4 and resistance R14 and condenser C5 and produces an added negative volt-

age, in addition to that produced by the plate current drop through resistance R15. This added negative voltage is applied to the grid of tube V7, and thus acts to reduce the amplification of the amplifier tube V7. This added voltage is proportional, or nearly so, to the received signal, so that the action of the combination just described is to level out the amplitude of the signals as applied through the filters to tubes V9 and V10.

Fig. 5 illustrates a different method of compensating for variations in transmission constants between different telephone circuits. In this arrangement, a plurality of sources of current F1, F2, F3, F4, etc., each of a different frequency, are shown, each of which is coupled to the sound producer S, or other audible tone-producing means. Each of these sources of frequency might be a tuning fork and microphone oscillator of well known type, a microphone-receiver "howler", or either of the types shown in Fig. 1 or Fig. 4. The source of frequency marked F1 does not require a keying means, as it is to be left operating continuously.

A keyboard or other permutation code transmitting means T1, T2, T3, etc., is connected to each of the frequency sources so that the current transmitted to the line by the sound producer S is broken up by the permutations of the code of the transmitting means associated with its particular source of frequency. In this variation the signals are not inverted, and a receiving means is shown accordingly. If desired, however, the signals may be inverted as in Figs. 1 and 2.

In the receiving means for operating in connection with the transmitting means just described the tones are picked up by the microphone M and amplified through one or more stages of amplification. A single amplifier tube V13 is shown by way of example. The output of the amplifier tube V13 is connected through a transformer T6 and separate band-pass filters BF1 to BF4 to a separate demodulator system and relay tube for each tone frequency used, with the exception of the pilot channel associated with the band pass filter BF1. The corresponding frequency source F1, as has been stated before, is left running continuously. The filter BF1 passes only the frequency of source F1 and this current is rectified by a two element tube V14, and is used as a control voltage on the amplifier tube V13, as an additional bias for gain control, similar in action to that shown in Fig. 4. The outputs from the filters of other than the control or pilot channel, are applied to separate demodulators and relay tubes for each channel. The demodulator shown in Fig. 5 is different from that shown in either Fig. 1 or Fig. 4, although either of those could be readily adapted to this arrangement.

The operation of the demodulator of Fig. 5 is as follows: When a signal is received through the filter BF2 it is applied by means of a center-tapped winding W2 to a double anode rectifier V15. The rectification which takes place in this rectifier is full wave, and the voltage appears as a voltage across the resistance R18. By means of the filtering action of condenser C9, resistance R19, and condenser C10, the voltage which is applied to the grid of the amplifier tube V16 is essentially similar to the envelope of the rectified current from the tube V15, and is also essentially similar to the signals transmitted from the

keyboard T1 associated with the frequency source F2.

The action of the direct current amplifier shown is somewhat similar to that shown in Fig. 1. When a signal is received, the voltage across resistance R18 is applied as a negative voltage to the grid of tube V16. The no-signal voltage on the grid of this tube is set by the voltage drop across resistance R17 so that an appreciable plate current is drawn by the tube V16 through resistance R20, sufficient or nearly so, to completely cut off the plate current through the relay tube V17. When a signal is applied to, and rectified by tube V15, the added negative voltage on the grid of tube V16 greatly reduces, or completely cuts off the plate current which flows through resistance R20, and reduces the negative bias on tube V17 to a point where sufficient plate current flows through the magnets PM of a receiving recorder P to properly operate the same.

The recorder P shown in Figs. 1, 4 and 5 may be a standard start-stop printer such as that shown in patent to Morton et al. No. 1,745,633 granted Feb. 4, 1930, or it may be a receiving perforator such as shown in patent to Kleinschmidt No. 1,884,743 granted Oct. 25, 1932 or a repeater such as shown in patent to Kleinschmidt No. 1,884,744 granted Oct. 25, 1932, or in fact any other form of receiver adapted for use in connection with the particular transmitter employed.

It is obvious that many variations and combinations other than the particular ones shown could be made without departing from the spirit and intent of the invention. The system has been shown with particular reference to the start-stop telegraph system in general use today, but any of the adaptations may be used without changes with the present multiplex system, and such use is contemplated. It may also be used in the transmission of ticker signals, quotation board signals, facsimile, and in fact any means of communication where a telegraph code of any type is used. Any of the tone generating means and any of the demodulation means shown may be adapted to operate with other combinations than those with which they are shown.

"Polar" operation, as shown in Fig. 4 could be used on a multiple channel system as depicted in Fig. 5. In this case two frequency channels would be used for each signal channel, one for "marking" signals, and one for "spacing" signals. The pilot or control channel would not then be necessary, since one band filter, which would pass both the "marking" and "spacing" frequencies of any one printer channel could be used to operate the gain control feature. It is equally obvious that instead of all channels of the system of Fig. 5 operating in only one direction, certain of the frequencies could be used in one direction while others were being used in the opposite direction. Also any or all channels could be switched from operation in one direction to operation in the opposite direction.

In Figs. 6 and 7 there is shown one form of acoustic coupling and shielding for the sound producer S, receiving microphone M and the telephone set. The sound producer S is shown as the unit of an ordinary telephone head set. It is retained between two discs 20 and 21 of sound absorbing material. The front disc 20 is of material which is also resilient, as for instance sponge rubber. The rear disc may be of the same material if desired. The conductors of the unit S extend through the rear disc 21. 75

The front disc 20 has a central aperture 22 registering generally with the opening 13 in the sound producer. The unit is enclosed in a cylinder 24 of sound deadening material which may be a sheet of sponge rubber or other suitable material wrapped therearound, with the discs 20 and 21 forming enclosures therefor. The shielded unit is secured to a suitable base 25 by straps 26 and 27.

The microphone M is shown as the single button type and is secured between two sheets 28 and 29 of resilient sound absorbing material, which again may be sponge rubber. The enclosing sheets of rubber are secured between two upright blocks 30 and 31, the forward block 30 having an arcuate upper contour 32 the surface of which is preferably covered with a soft resilient material 33, such as felt. The upper end of the sheets 28 and 29 are secured to the rear block 31 by a strip 34 of rigid material, fastened by screws 35. The conductors 36 extend through the rear sheet 29 and through an aperture in the rear block 31.

An upright block 37 also having an arcuate upper contour covered with a soft resilient material 38 is mounted adjacent the front face of the shielded unit S and a resilient bracket 39 extends upwardly between the blocks 30 and 37, these parts being so positioned as to retain a telephone set 40 with the transmitter TT resting in the block 37 and having its apertured end pressed against the front disc 20 substantially in alignment with the aperture 22; and with the receiver TR resting in the block 30 with its apertured end pressed against the face of the resilient sheet 28, in alignment with the aperture 41 therein.

In the use of the system a call between telephone subscribers is made in the usual manner, after which each subscriber sets his hand set into the blocks 30 and 37 of the acoustic coupling device, whereupon telegraph communication can proceed, either in one or both directions, depending upon the particular arrangement of the telegraph apparatus.

It will be noted that there have been no changes in the telephone circuit or any additions thereto. The telephone may, therefore, be used for either telephone conversation or telegraph communication. The telegraph apparatus required in addition to the standard transmitting distributor and printer is relatively simple in nature and may be constructed so as to be readily portable and therefore usable interchangeably on any telephone circuit.

The invention, of course, is not limited to the particular forms and details disclosed herein, but numerous other modifications and variations thereof will be apparent to those skilled in the art.

What is claimed is:

1. The method of telegraph communication which comprises producing electrical oscillations of a predetermined frequency, keying said oscillations to produce groups of oscillations in accordance with the telegraph code, shaping said groups of oscillations to decrease the amplitude of the end portions thereof relative to the mid-portion thereof, utilizing said keyed and shaped oscillations to produce audible tone signals and impressing said tone signals on the transmitter of a telephone system.

2. The method of telegraph communication which comprises producing electrical oscillations of a predetermined frequency, keying said oscil-

lations to produce groups of oscillations in accordance with a telegraph code, shaping said groups of oscillations to decrease the amplitude of the end portions thereof relative to the mid-portion thereof, regulating the amplitude thereof, utilizing said keyed and shaped oscillations to produce an audible tone and impressing said tone on the transmitter of a telephone system.

3. The method of telegraph communication which comprises producing electrical oscillations, interrupting said oscillations in accordance with marking conditions of a telegraph code, utilizing said oscillations to produce audible tone signals and impressing said signals on the transmitter of a telephone system.

4. The method of telegraph communication which comprises producing electrical oscillations, keying said oscillations to produce groups of oscillations in accordance with a telegraph code, decreasing exponentially the amplitude of the end portions of each of said groups of oscillations relative to the mid portion thereof, utilizing said oscillations to produce an audible tone and impressing said tone on the transmitter of a telephone system.

5. The method of telegraph communication which comprises producing sinusoidal electrical oscillations of a predetermined frequency, keying said oscillations to produce groups of oscillations in accordance with a telegraph code, utilizing said keyed oscillations to produce an audible tone, transmitting said tone over a telephone system, converting the received tone signals into groups of electrical oscillations, producing a direct current impulse corresponding to each group of oscillations and controlling the operation of a telegraph receiver in accordance with said impulses.

6. The method of telegraph communication which comprises producing electrical oscillations, interrupting said oscillations in accordance with marking conditions of a standard telegraph code to produce groups of oscillations inverted in relation to said telegraph code, utilizing said groups of oscillations to produce tone signals, transmitting said tone signals over a telephone circuit, translating the received tone signals into groups of electrical oscillations, producing a direct current impulse corresponding to each group of oscillations, reinverting said impulses and controlling the operation of a telegraph receiver in accordance with said reinverted impulses.

7. The method of telegraph communication which comprises producing electrical oscillations, interrupting said oscillations in accordance with marking conditions of a standard telegraph code to produce groups of oscillations inverted in relation to said telegraph code, utilizing said oscillations to produce interrupted audible tone signals, transmitting said tone signals over a telephone system, translating the received signals into groups of electrical oscillations and controlling the operation of a telegraph receiver in accordance with said oscillations.

8. The method of telegraph communication which comprises producing a plurality of electrical oscillations of predetermined different frequencies, keying said oscillations to produce groups of oscillations of one frequency or another in accordance with a telegraph code, utilizing said oscillations to produce tone signals, transmitting said tone signals over a telephone system, converting the received tone signals into groups of electrical oscillations, utilizing one or the other of said oscillations to continuously regulate the

amplitude of said received oscillations, in accordance with a characteristic of the telephone circuit and controlling the operation of a telegraph receiver in accordance with said oscillations.

9. The method of telegraph communication which comprises producing electrical oscillations, suppressing said oscillations in accordance with one condition of a standard telegraph code to produce groups of oscillations inverted in relation to said telegraph code, shaping said groups of oscillations, utilizing said oscillations to produce tone signals, acoustically shielding said tone signals and transmitting the same over a telephone system, converting the received tone signals into groups of electrical oscillations, regulating the amplitude of said oscillations in accordance with the characteristics of the telephone circuit, producing a direct current impulse corresponding to each group of oscillations, inverting said impulses and controlling the operation of a telegraph receiver in accordance with said inverted impulses.

10. A system of telegraph communication which comprises means for producing tone signals of a low amplitude corresponding to a telegraph code, means for acoustically shielding said tone signals against external sounds and transmitting the same over a telephone system, and means for converting the received tone signals into electrical signals and controlling the operation of a telegraph receiver in accordance therewith.

11. The method of telegraph communication which comprises producing a plurality of separate oscillating currents of different frequencies, modulating said currents in accordance with a telegraph code, transmitting at least one of said oscillating currents over a telephone system at every instant, amplifying the received signals, utilizing the received signals to regulate the amplification thereof and controlling the operation of a telegraph receiver in accordance with the amplified signals.

12. The method of telegraph communication which comprises producing a plurality of tone signals of different frequencies, transmitting current continuously over a telephone circuit consisting of first one and then another of said tone signals, converting said received tone signals into electrical signals and utilizing the uninterrupted current transmitted over said telephone circuit to modify continuously the amplitude of said electrical signals in accordance with the characteristics of the telephone circuit.

13. The method of telegraph communication which comprises producing a plurality of tones of different frequencies, transmitting one of said tones continuously over a telephone circuit, keying another one of said tones in accordance with a telegraph code and transmitting the keyed tone signals over said telephone circuit concurrently with said continuous tone, converting said latter received tone signals into electrical signals and utilizing said continuous tone to modify the amplitude of said electrical signals in accordance with the characteristics of the telephone circuit.

14. The method of telegraph communication which comprises producing two tone signals of different frequencies, transmitting said tones alternately over a telephone circuit in accordance with a telegraph code, converting said received tone signals into electrical signals of two different frequencies and utilizing signals of each frequency to modify the amplitude of said signals

in accordance with the characteristics of the telephone circuit.

15. In a telegraph system, a source of substantially sinusoidal oscillations, a sound producing device responsive to said oscillations to produce a tone of low level, means for applying said oscillations to said sound producing device intermittently in accordance with a telegraph code, and means for physically connecting and acoustically coupling said sound producing device to a standard telephone transmitter, said last named means being also arranged to shield said transmitter against extraneous noises.

16. In combination with a telephone system, a source of substantially sinusoidal oscillations, a telegraph transmitter for interrupting said oscillations to produce trains of oscillations in accordance with a telegraph code, means for shaping said trains of oscillations, means responsive to said trains of oscillations for producing tone signals, means for physically connecting and acoustically coupling said last means to the transmitter of said telephone system, a sound responsive device acoustically coupled to the receiver of said telephone system for producing oscillations in accordance with received tone signals and means for converting said latter oscillations into direct current code signals.

17. In combination with a telephone system, a source of substantially sinusoidal oscillations, a telegraph transmitter for suppressing said oscillations in accordance with marking conditions of a standard telegraph code, to produce trains of oscillations inverted with relation to said telegraph code, means responsive to said trains of oscillations for producing tone signals for transmission over said telephone system, a sound responsive device acoustically coupled to the receiver of said telephone system for producing oscillations in accordance with received tone signals, means for converting said latter oscillations into direct current telegraph signals, a telegraph receiver and means for inverting said direct current signals and applying them to said telegraph receiver.

18. In combination with a telephone system, a source of substantially sinusoidal oscillations, a telegraph transmitter for suppressing said oscillations in accordance with marking conditions of a standard telegraph code, to produce groups of oscillations inverted with relation to said telegraph code, means responsive to said trains of oscillations for producing tone signals for transmission over said telephone system, a sound responsive device associated with the receiver of said telephone system for producing oscillations in accordance with received tone signals, means for converting said latter oscillations into direct current telegraph signals, a telegraph receiver and means for inverting said direct current signals and applying them to said receiver.

19. In combination with a telephone system, a plurality of sources of electrical oscillations, a telegraph transmitter for keying said oscillations to produce trains of oscillations in accordance with a code, at least one of said oscillations being transmitted at all times during operation of the system, means responsive to said trains of oscillations for producing tone signals for transmission over said telephone system, a sound responsive device associated with the receiver of said telephone system for producing oscillations in accordance with received tone signals, means responsive to said oscillations for modifying the amplitude of said oscillations in accordance with

the characteristics of the telephone system, a telegraph receiver and means for controlling the operation of said receiver in accordance with said oscillations.

20. In combination, a telephone instrument, including a transmitting and a receiving element, a sound producing device, a sound responsive device, acoustic shielding means for said sound producing device and said sound responsive device, means for supporting said transmitting and receiving elements in contact with said sound producing device and said sound responsive device respectively, a telegraph transmitter associated with said sound producing device and a telegraph receiver associated with said sound responsive device.

21. In combination, a telephone instrument, including a transmitting element, a sound producing device, means for supporting said transmitting element adjacent said sound producing device, acoustic shielding and coupling means intermediate said sound producing device and said transmitting element, said shielding means including a sound-absorbing pad surrounding said sound producing device and adapted to engage said telephone transmitting element, and a telegraph transmitter associated with said sound producing device.

22. In combination with a standard telephone system, a source of sinusoidal oscillations, a telegraph transmitter for keying said oscillations to produce groups of oscillations in accordance with a telegraph code and means entirely external to and independent of physical or electrical changes in said telephone system for impressing said oscillations on the telephone circuit and for shielding the telephone system against extraneous noises at the substation while signals are being impressed thereon from said telegraph transmitter.

23. In combination with a standard telephone system, a source of sinusoidal oscillations, a telegraph transmitter for keying said oscillations to produce groups of oscillations in accordance with a telegraph code, means entirely external to and independent of physical or electrical changes in said telephone system for impressing said oscillations on the telephone system, a telegraph receiver, means entirely external to and independent of physical or electrical changes in said telephone system for applying oscillations transmitted over said telephone system to said telegraph receiver and means for shielding the telephone transmitter at the sending station against extraneous noises while the telegraph signals are being transmitted over the telephone system.

24. A system of telegraph communication over a telephone system provided with a telephone transmitter comprising means for producing substantially sinusoidal oscillations of a predetermined frequency, means for keying said oscillations in accordance with a telegraph code and means for producing audible tone signals corresponding to said keyed oscillations and impressing the same upon said telephone transmitter.

25. A system of telegraph communication over a telephone system provided with a telephone transmitter comprising means for producing substantially sinusoidal oscillations of a predetermined frequency, means for keying said oscillations in accordance with a telegraph code to form

signalling impulses, means for exponentially shaping the initial portions of said impulses and means for converting said impulses into audible tone signals and impressing the same upon said telephone transmitter.

26. A system of telegraph communication over a telephone system provided with a telephone transmitter comprising means for producing substantially sinusoidal oscillations of a predetermined frequency, means for keying said oscillations in accordance with a telegraph code, means for converting said keyed oscillations into audible tone signals and impressing the same upon said telephone transmitter, means at a remote point of said telephone system for amplifying the signals to an extent depending upon the attenuation of the telephone circuit and a telegraph receiver responsive to the received signals.

27. A system of telegraph communication over a telephone system having a plurality of telephone substations comprising a telegraph code transmitter at a sending substation, means including said transmitter for impressing code signals consisting of trains of audible frequency oscillations upon the telephone system, means at a receiving substation for responding to said signals and means for acoustically shielding the telephone transmitter at said sending substation against extraneous noises during the transmission of said signals.

28. A system of communication comprising a plurality of telephone substations, means for interconnecting any two of said substations, means at one substation for generating tone signals of a definite frequency modulated in accordance with a telegraph code, means at another substation for amplifying said signals, said amplifying means automatically compensating for variable attenuation of the connecting circuit, and receiving means connected to said amplifying means.

29. A system of communication comprising a plurality of telephone substations, means for interconnecting any two of said substations, means at one substation for generating tone signals of a definite frequency modulated in accordance with a telegraph code, means at said one substation for acoustically shielding the telephone transmitter thereat against extraneous noises during code transmission and receiving means at another substation responsive to said signals.

30. The method of telegraph communication over a voice frequency channel which comprises concurrently impressing upon said channel continuous oscillations of one frequency in the audible range and keyed oscillations of another frequency forming telegraph signals, and controlling a telegraph receiver in accordance with the oscillations of both of said frequencies.

31. The method of telegraph communication over a voice frequency channel which comprises concurrently impressing upon said channel continuous oscillations of one frequency and keyed oscillations of another frequency forming telegraph signals, amplifying the received signals and controlling the amplification in accordance with the character of the received oscillations of said one frequency.

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