

Oct. 17, 1939.

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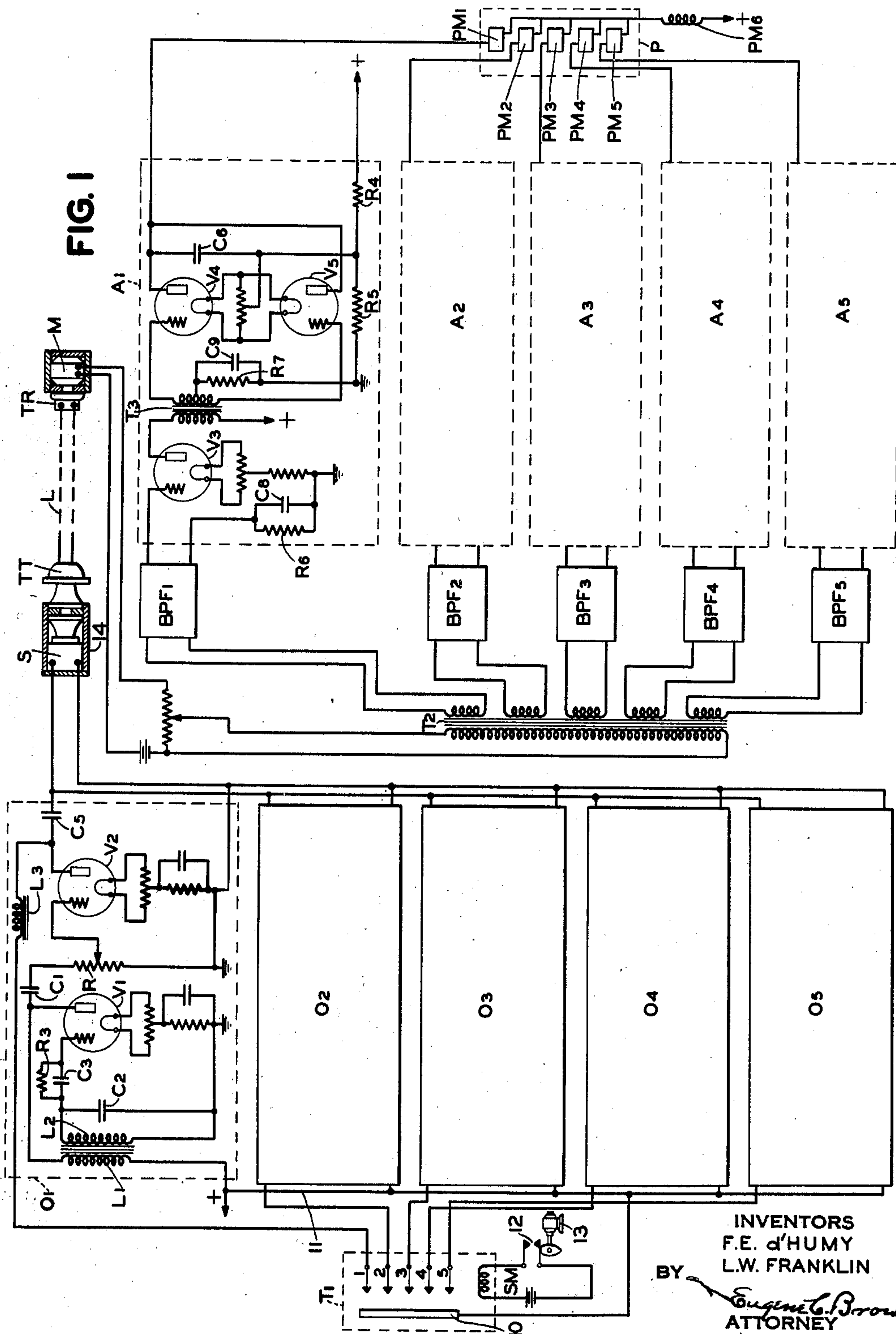
2,176,065

TELEGRAPH SYSTEM

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3 Sheets-Sheet 1

FIG. 1



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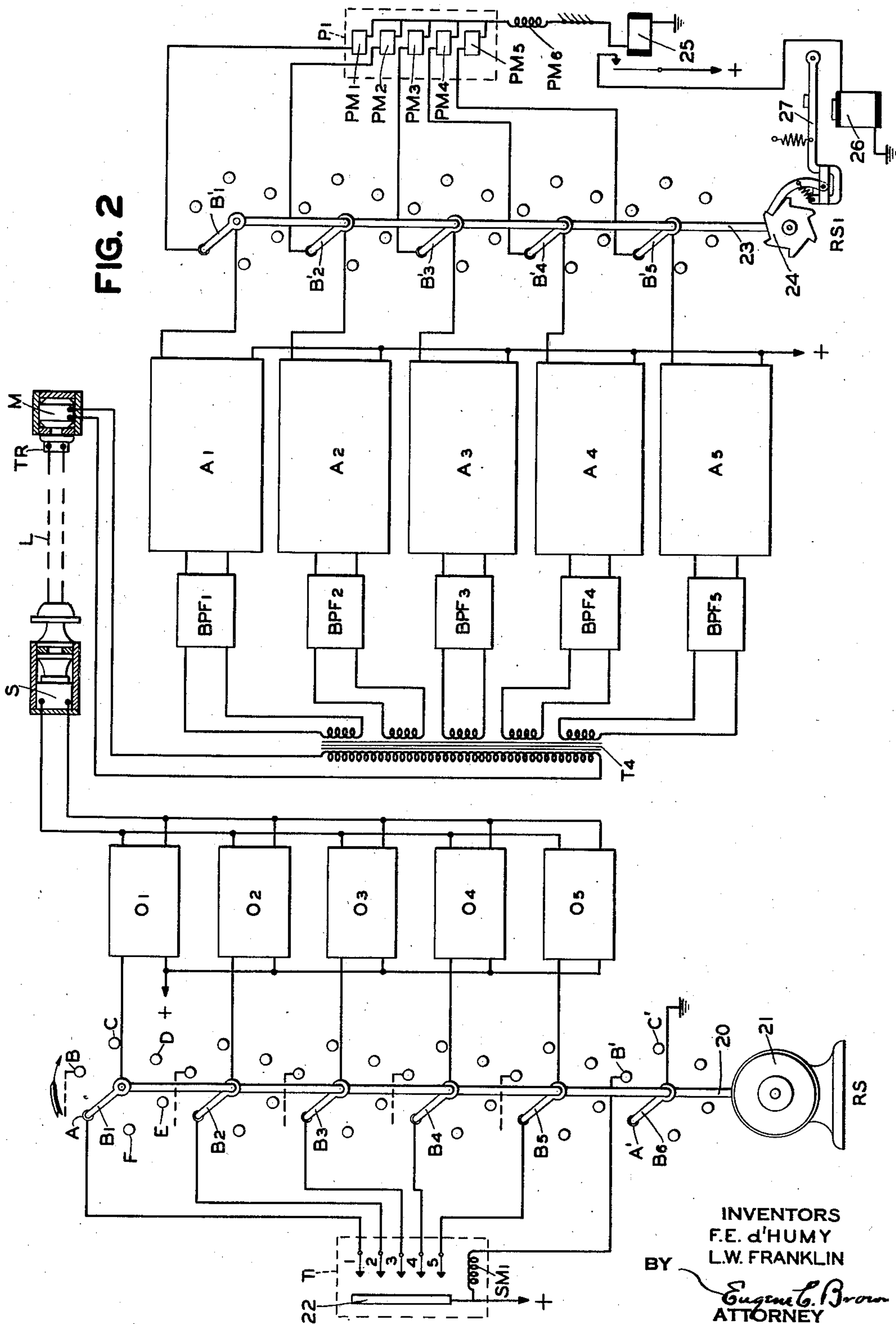
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FIG. 3

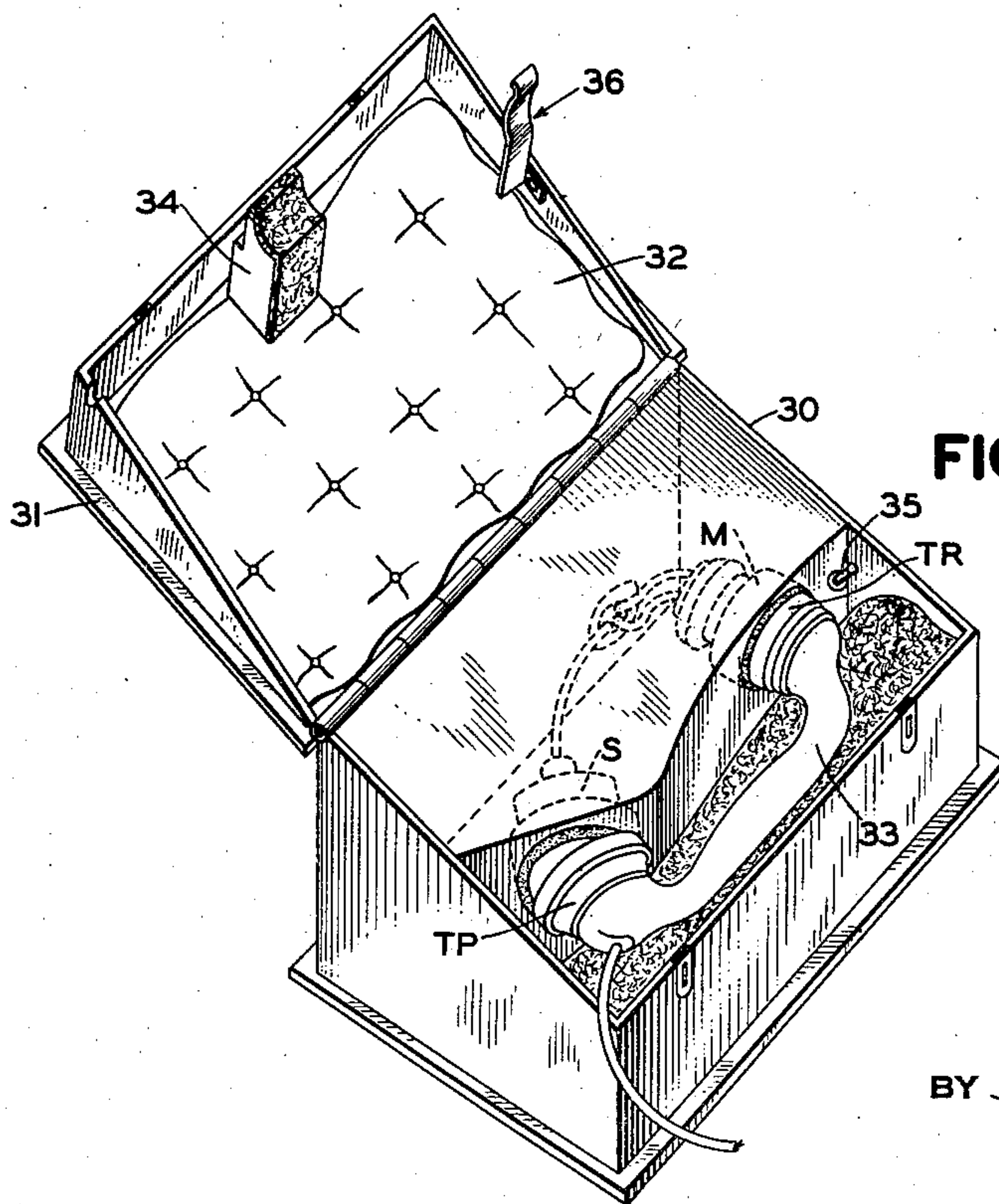
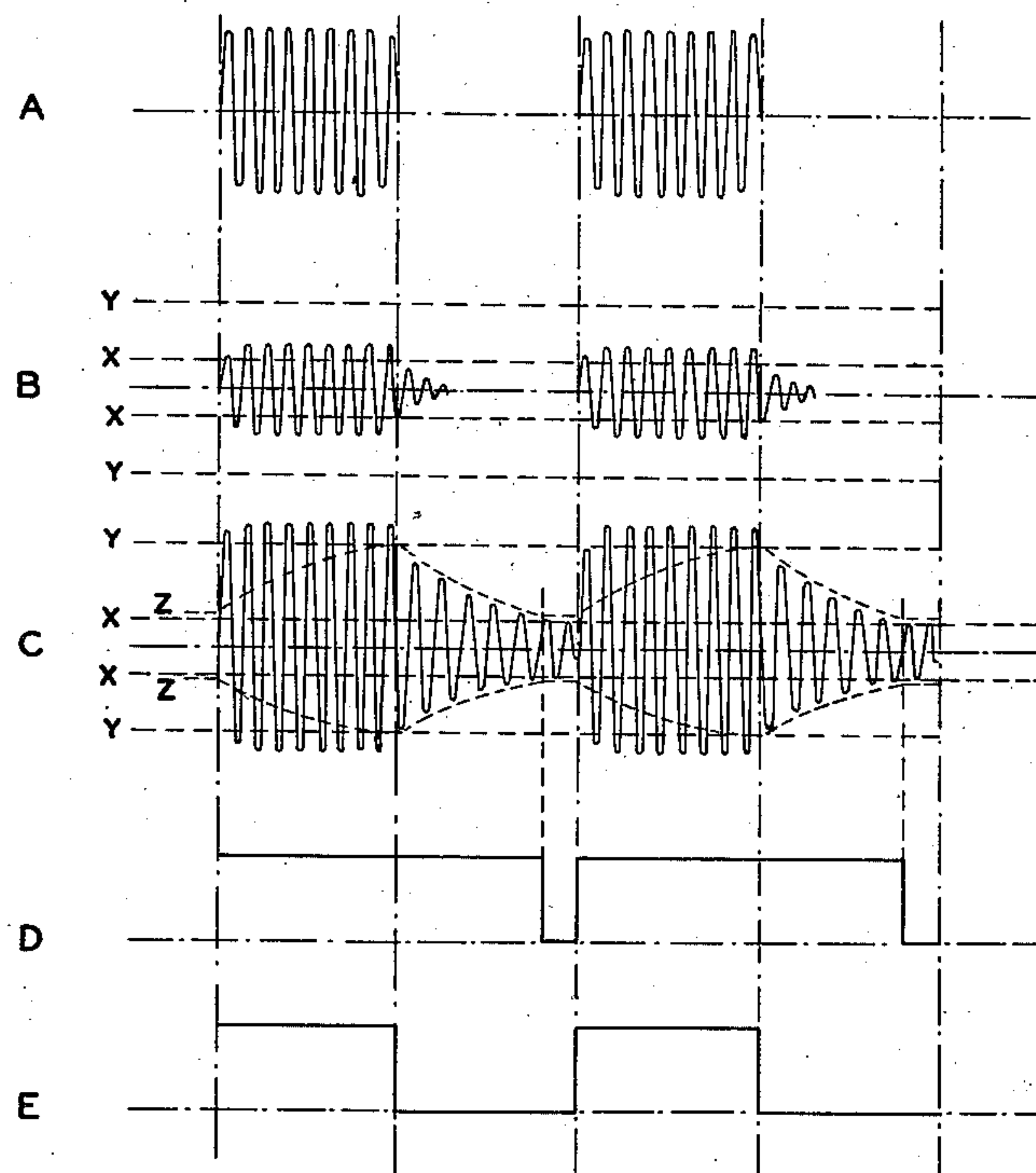


FIG. 4

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TELEGRAPH SYSTEM

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Application November 30, 1935, Serial No. 52,408

14 Claims. (Cl. 179—4)

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

5 In copending applications of F. E. d'Humy and L. W. Franklin, Serial Nos. 17,842 and 27,238, there are disclosed systems for carrying on telegraph correspondence over a standard telephone circuit by tone or audible signals, in which an oscillating current or a plurality of oscillating currents of different frequencies within the audible range are produced, keyed or modulated in accordance with telegraph signals, utilized to produce audible tones and such tone or tones transmitted over a standard telephone system. 10 In the inventions of the aforesaid applications where more than one frequency is employed, the oscillations of each frequency constitute one channel of telegraph communication, being keyed or modulated by individual telegraph transmitters, the tones or audible signals produced by the keyed oscillations of each frequency being combined for concurrent transmission over the telephone circuit, and being separated from 15 each other at the distant end for controlling the operation of telegraph printers individual to each source of oscillations. The trains of oscillations corresponding to each impulse of the telegraph code are transmitted sequentially over the telephone circuit and at the receiving end must be distributed to the receiving elements of the printer. If single magnet printers are employed, the selecting cam shaft in cooperation with the selecting magnet and the selecting levers constitutes the receiving distributor and must operate in substantial synchronism with the transmitting distributor employed to key the oscillations. Whatever the type of equipment employed, some means must be provided for maintaining synchronism between the transmitting and receiving apparatus. 20 25 30 35 40

An object of the present invention is to provide a telegraph system adapted for association with a standard telephone circuit, in which the necessity for maintaining synchronism between the transmitter and the receiver is eliminated. 45

Another object of the invention is to transmit each selecting condition of the telegraph code simultaneously over the telephone circuit.

A still further object is to provide a telephone-telegraph system utilizing a different frequency for each selecting condition of the telegraph code. 50

A further object is to provide a multi-message telegraph system in which the selecting conditions of each character code combination are transmitted simultaneously and received simultaneously. 55

Other objects and advantages of the invention will hereinafter appear. 60

In accordance with our present invention we produce a plurality of currents of different frequencies, all within the audible range, and corresponding in number to the number of selecting conditions in the telegraph code employed. For a five-unit permutation or Baudot code, currents of five distinct and predetermined frequencies are utilized. Keying means is provided for the current of each frequency whereby various combinations of electric currents of different frequencies may be produced. The combined currents are then utilized to produce composite tone signals which are impressed upon the transmitter of a telephone system. At the distant end the received tones are converted again into electrical oscillations, filtered, rectified and applied simultaneously to the individual selecting magnets of a telegraph printer. If desired, the successive characters thus transmitted may constitute the successive characters of a single message and be received upon a single printer or the successive characters may originate at different transmitters and be received on individual printers corresponding thereto. In this latter case a collator or switch is required at both the transmitting and receiving telegraph stations to associate the corresponding transmitters and recorders, in turn, with the communication circuit or circuits. 5 10 15 20 25 30

The invention will be more fully understood by reference to the accompanying drawings in which: 30

Fig. 1 is a circuit diagram of a telegraphic-telephone transmitting and receiving system for single message operation; 35

Fig. 2 is a modified circuit diagram for multi-message operation; 35

Fig. 3 illustrates the current waves in the system under different conditions; and

Fig. 4 is a view in perspective of apparatus that may be employed in obtaining acoustic coupling between the printers and the telephone system. 40

Referring first to Fig. 1, there is shown a vacuum tube oscillation generating and amplifying unit O1 of the inductively coupled feed back type, comprising a vacuum tube V1, feed back coil L1 inductively coupled to a tuned grid circuit including the grid coil L2 and associated tuning condenser C2. A grid condenser C3 and leak resistance R3 may also be included in the grid circuit. The output circuit of the oscillator tube V1 is coupled through the condenser C1 and resistance R1 to the grid circuit of an amplifying tube V2 and the anode circuit of tube V2 is completed through the choke coil L3 to contact 1 of a telegraph transmitter T1, the common or bus contact 10 thereof and by conductor 11 to battery. The output circuit of the amplifier tube 60

V2 is coupled to a sound producing device S through the coupling condenser C5.

It will be evident that by opening the contact 1 of the telegraph transmitter, the plate voltage of tube V2 is removed, no current will flow through the anode circuit of V2 and consequently no tone will be transmitted to the sound producing device.

Similar oscillators O2, O3, O4 and O5, are provided for the contacts 2, 3, 4 and 5 of the transmitter T1, the output of each oscillator being similarly coupled to the sound producing device S. Each oscillator is tuned to a different frequency so as to produce its distinct tone in the sound producer S. By closing the contacts 1 to 5 of the transmitter T in various combinations, correspondingly combined tones are produced in the sound producer S.

The transmitter T1 may comprise a series of keyboard controlled contacts but is shown as a tape transmitter such, for instance, as shown in patent to G. R. Benjamin, No. 1,298,440, granted March 25, 1919. The stepping magnet SM of the transmitter is operated periodically by a cam switch 12 driven by a continuously running motor 13. Upon each revolution of the cam the pins of the tape transmitter are withdrawn, opening all contacts 1 to 5, the tape advanced and the pins released to again engage the tape or to pass therethrough whereby to selectively close the contacts 1 to 5. During closure of the contacts a combination of tones is produced by the speaker S corresponding to the frequency source or sources associated with the closed contacts. Upon withdrawal of the tape pins, the sound producer is silent, and upon repositioning of the transmitter contacts, a different combination of tones is produced. Each combination of tones represents a character code, the character tone signals being spaced by intervals of silence.

The sound producing device S is preferably enclosed within a sound deadening container 14 disposed in sound transferring relation to the transmitter TT of a standard telephone system for the transmission of voice frequency currents so that the character tone signals are transmitted over the telephone line L and reproduced by the distance telephone receiver TR. The telephone system may comprise a transmission channel of any usual character or series channels of different types.

In the receiving means for operation in connection with the transmitting means just described, the tones are picked up by a microphone M and applied through a transformer T2 and separate band pass filters BPF1 to BPF5 to a separate demodulator system and relay tube for each tone frequency used. The operation of the demodulator is as follows: When a signal is received through the filter BPF1, it is applied to an amplifier tube V3. The signals which have been amplified by tube V3 are applied in push-pull to the grids of tubes V4 and V5 through a transformer T3, which has a center-tapped secondary. The function of tubes V4 and V5 is to rectify the signals full wave, amplify them and apply the resulting direct current signals to the first pulse magnet PM1 of the printer P. These functions are performed in the following manner:

A bleeder circuit is provided from positive battery through resistances R4 and R5 to ground return, or negative battery, as shown. Tubes V4 and V5 obtain their plate voltage from positive battery through the printer magnet PM1.

Tubes V4 and V5 have their filament return to the junction of resistors R4 and R5. The grid return from the center-tap of the secondary winding of transformer T3 is made to the grounded end of the bleeder circuit. Therefore, the negative grid bias on tubes V4 and V5 is the voltage drop across the resistance R5; the plate voltage applied to tubes V4 and V5 is the voltage drop across the resistance R4, less the voltage drop through PM1 (if any). The value of resistance R5 is such 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 the printer magnet PM1.

When a tone is received over the telephone line from the source O1, indicating what is normally a marking 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 and therefore plate current will flow through this tube and through the printer magnet PM1. On alternate half cycles the grid of tube V5 becomes less negative and also passes current through the printer magnet PM1. A small condenser C6 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 magnet PM1, and the discharging of the condenser during the time that either tube is passing current through magnet PM1, will effect a filtering action which will hold the current through the magnet PM1 at an essentially constant value during the period of any pulse without seriously affecting the general shape of the printer signal.

Similarly, signals originating at the oscillators O2 to O5 will, after transmission over the telephone system, be passed through selective or band pass filters BPF2 to BPF5, and individual amplifiers A2 to A5 where the signals will be amplified and fed to the corresponding printer magnets PM2 to PM5 of a standard multiplex printer P. A sixth pulse magnet PM6 in the common return of each of the magnets PM1 to PM5 is energized whenever a selecting magnet is operated to effect the printing, as is well known in the art.

In Fig. 2 an arrangement is shown for operating a plurality of transmitters over five channels. A rotary switch RS is provided having a plurality of blades B1 to B6 on a common shaft 20 continuously driven by a motor 21. The number of blades depends on the particular code employed, the blades B1 to B5 corresponding to the units of the conventional five-unit Baudot code. Blade B6 is provided for sequencing the various transmitters employed in the system, as will hereinafter appear. The switches are shown with six contacts or positions A to F, although obviously any number of positions may be provided. The corresponding contacts A of each of the blades B1 to B5 are connected to the tongues 1 to 5 of a tape transmitter T1, the common bus bar 22 of the transmitter being connected to positive battery. The succeeding contact of blade B6 is connected through a stepping magnet SM1 of the transmitter T1 to ground. While only one transmitter is shown, it is to be understood that a separate transmitter is provided for each of the six contacts or positions A to F of the switch RS.

The blades B1 to B5 are individually connected to the keying circuits of corresponding frequency generators O1 to O5. The speed of the motor 21 may be constant or if desired, it may be variable so that different line signaling speeds may be obtained. The frequency generators O1 to O5 are similar in form to the frequency generator O1 of Fig. 1 and therefore have been shown only diagrammatically.

As the switch RS is rotated by the motor 21, the blades B1 to B5 pass over the various switch contacts A to F in succession closing circuits from the various transmitters to the frequency generators. Assuming the blades to have just engaged the switch contacts A with a combination set up in the contacts of the transmitter T1, positive battery will be applied through the selectively closed contacts of the transmitter T1 and the corresponding blades B1 to B5 to the corresponding frequency generators O1 to O5, thereby transmitting oscillations of frequencies corresponding to the combination of contacts closed in the tape transmitter. These oscillations are applied to the sound producer S to produce tone signals as in the case of the modification of Fig. 1, the tone signals continuing as long as the blades remain in engagement with the A contacts. As soon as the blades leave these contacts, the tones are interrupted and upon engagement of the switch blades with the B contacts, similar circuits will be established from a second tape transmitter associated with these B contacts. Blade B6 upon engagement with its B contact, closes an operating circuit to the stepping magnet SM1 of the tape transmitter T1, thereby setting up a new combination in the tape transmitter in readiness for the next engagement of the blades B1 to B5 with their A contacts.

The tone signals keyed by each of the transmitters in succession are transmitted over the telephone line L and are received at the distant station on the telephone receiver TR and applied to the microphone M, whereby they are reconverted into electrical oscillations. The output of the microphone M is coupled through the transformer T4 to five band pass filters BPF1 to BPF5, each tuned to the frequency of the corresponding oscillators O1 to O5. Each of the band pass filters has associated therewith an individual amplifier A1 to A5, the output circuits of which are connected to the blades B'1 to B'5 of a rotary receiving switch RS'. These blades B'1 to B'5 are mounted upon a common shaft 23 driven by a ratchet wheel 24, as will presently appear. Each of the blades is adapted to engage a plurality of contacts corresponding in number to the contacts of the transmitting switch RS and the corresponding contacts of each of the blades are connected through the selecting magnets PM1 to PM5 of a plurality of printers, only one of which is shown. A sixth pulse magnet PM6 is in the common return of each of the printer magnets and a relay 25 is in the common return of all the printers.

The shaft 23 of the switch RS1 is driven in proper phase relation to the transmitting shaft 23 by a stepping magnet 26 and stepping pawl 27 cooperating with the ratchet wheel 24. Magnet 26 is energized from the contacts of relay 25 each time a character is printed.

As stated, an individual printer is provided for each of the transmitters and it will be understood that when the rotary switches RS and RS' are maintained in phase, the signals originating

at each of the transmitters will be recorded upon the printer which is individual thereto.

The amplifiers A1 to A5 of Fig. 2 may be of similar construction to the amplifier A1 of Fig. 1 and therefore have not been shown in detail.

In systems of this kind a problem often encountered is the tendency of "tails" to form at the end signals. The current impulses received are not cut off sharply and this distortion may be sufficient to limit the operating speed considerably below that desired. This effect is quite noticeable in sharply tuned filter circuits, and is also noticeable where there is a mechanical or acoustical link in the circuit, such as the diaphragms of the telephone sets and of the microphones and loud speakers used in this system. When a signal which has been impressed on the system is suddenly stopped, there is a tendency for the diaphragms to keep on vibrating, the amplitude dying out at a rate dependent upon the damping of the diaphragm. The same inertia effect takes place in a sharply tuned filter, since the damping is low, the oscillating energy being electrical in this case rather than the energy of mechanical motion. The effect of this "tailing" can be compensated for manually, by adjusting the biasing effect somewhere in the system to a value intermediate to the maximum value of the signal and the "tail" amplitude. However, it is desirable to have means which will automatically compensate for this effect, and such an arrangement is shown in the amplifier of Fig. 1, in the combinations of resistance and capacity shown as R6—C8, and also as R7—C9.

By referring to Fig. 3, the effect of this "tailing" may be more easily understood. In curve 3A is shown the signals as they are sent to the sound producer S. Curve 3B shows a rather weak signal as it might be received at the distant end of a long circuit, or one with high attenuation. The signals shown in curve 3C are similar to those in curve 3B except that the amplitude is much higher, such as might be received from a nearby sending station over efficient circuits. For the proper reception of signals as shown in curve 3B, the grid bias of tubes V4 and V5, which may be the fixed voltage drop across resistance R5, would be such that plate current would be increased in the tubes V4 and V5 whenever the amplitude of the signal impressed upon the grid of said tubes passed above the dotted lines $x-x$ representing the fixed bias of the tubes V4 and V5. However, when a signal of large amplitude is received, as shown in curve 3C, this bias must be increased to a value shown at $y-y$ in order to receive practically unbiased signals. Referring back to curve 3B, it is seen that with the bias set at level $y-y$ for reception of loud signals, the receiver would not respond to signals of small amplitude, since the bias at all times would override the signal. Conversely, if the bias were set at the level $x-x$, the optimum point for weak signals as shown in curve 3B, strong signals would be badly under-biased, due to the tailing effect and would appear in the output of tube V6 similar in form to that shown in curve 3D, and if the amplitude were much larger would not respond at all. Since it is desired that this system be workable without special adjustment on any telephone circuit, it becomes necessary to furnish means whereby the bias may be changed to correspond to the strength of the received signals automatically. Also, a "fading" effect is sometimes experienced on a telephone circuit

where the efficiency of the circuit will vary during a call, and automatic means for compensation become a necessity for this reason, also. At the transmitting speeds for which high-speed transmitters and printers are designed to operate, it is essential to maintain the duration and magnitude of the controlling impulses between definite limits.

Consider the resistance R7 and the condenser C9 in the center-tap connection of the secondary winding of transformer T3. When no signal is being received, there is no current flowing through resistance R9 and therefore no voltage drop across this resistance. The grid bias on the demodulator tubes V4 and V5 is the voltage drop across the resistance R5 and is so adjusted that the demodulator tubes will respond to the weakest signals which will be encountered. On very weak signals the grids of tubes V4 and V5 will not be driven positive so no current will flow through the resistance R7 and the minimum bias will still be applied to tubes V4 and V5. However, when a loud signal is received, the grids of tubes V4 and V5 are driven positive, allowing grid current to flow, which will create a negative potential with respect to ground on the grids, due to the direct current flowing through the resistance R7. This voltage is more or less proportional to the strength of the received signals, so that the bias on tubes V4 and V5 is automatically varied, the bias increasing when a signal is received, and approaching the minimum bias set by resistance R5 when no signal is being received. The action of this resistance alone would not be sufficient, as it would not cut off the "tails" of the signal, since the bias drop would be practically instantaneous. However, by timing this change in voltage across resistance R7 by means of the condenser C9, the decay of this added bias across resistance R7 may be made slower than the decay of the "tail" of the signal. The effective bias will be as shown at $z-z$ of curve 3C for loud signals, and will drop to the value shown at $x-x$ for very weak signals. Consequently, both weak and strong signals are made to appear in the output of the tubes V4 and V5 of substantially the form shown in curve 3E, that is, as unbiased impulses.

The resistance R5 and condenser C3 exert a similar control over the amplifying characteristics of tube V3 when the signal input is sufficiently large. For ordinary signals there will be no grid current flow in the input circuit of this tube and thus the grid bias will not be affected.

In Fig. 4 an improved type of adapter is shown for acoustically coupling the microphone and loudspeaker unit of this system to the standard telephone hand-set. A box 30, substantially as shown, has the pickup microphone M and the sound producer S imbedded in sound deadening material. The cover 31 of the box, hinged at the rear, is also lined with sound deadening material 32. A recess in the front is designed to receive a standard hand-set 33 and is of such shape that the mouthpiece TP and the receiver TR of the hand-set will be in sound transferring relation to the loudspeaker S and microphone M, respectively, of the adapter. All surfaces on the inside of this box are lined with plush, both to prevent scratching of the telephone hand-set and also to aid in preventing extraneous noises from reaching the pickup microphone or the mouthpiece of the hand-set when it is in position. The cover of the box is so padded that most of the unused space is filled with sound absorbing material. As

the cover of the box is closed on the hand-set, a padded projection 34 on the front inside of the cover engages with the hand-set and presses the hand-set into intimate contact with the openings leading to the diaphragms of the loudspeaker S and microphone M. A switch 35 may be provided, operated by a spring clip 36 upon the closing of the lid of the box to close the microphone circuit. When the box is open, the switch 35 will open the microphone circuit so that the receiving printer will not respond to extraneous noises before the telephone connection has been made and the hand-set placed in the adapter and the lid closed. This is an added safeguard against noise interference.

It will be understood, of course, that the apparatus and circuit arrangements shown and described refer to certain preferred embodiments only of the invention and that the invention is susceptible to various other embodiments and changes within the scope of the following claims. No claim is made herein to methods of or means for reducing amplitude and/or bias distortion, these features being claimed in our copending application Ser. No. 114,460, filed December 5, 1936.

What we claim is:

1. The method of telegraph communication between telephone substations comprising converting the impulses of a uniform impulse signal code into trains of electrical oscillations of different frequencies, each of said frequencies representing one of the impulses of the code, utilizing said oscillations to produce tone signals consisting of a plurality of said oscillations of different frequencies, transmitting said tone signals through the transmitter of a substation of a telephone system, receiving said tone signals at the distant end of said telephone system and converting said received tone signals into electrical code signals.

2. The method of telegraph communication between telephone substations by means of a uniform unit code which comprises producing electrical oscillations of a different frequency for each unit of the code, keying said oscillations in combinations in accordance with the code, utilizing said keyed oscillations to produce audible tones consisting of a plurality of oscillations of different frequencies, impressing said tones on the transmitter of a substation of the telephone system and controlling a printer by the tones received at a remote substation.

3. The method of telegraph communication by means of a uniform unit code which comprises producing electrical oscillations of a different frequency for each unit of the code, keying said oscillations in combinations to produce groups of oscillations, utilizing said oscillations to produce audible tones, transmitting said audible tones representative of a single character code combination simultaneously over a telephone system, converting the tones received at the distant end of said telephone system into secondary groups of electrical oscillations and operating a recorder under the control of said secondary group of oscillations.

4. The method of telegraph communication by means of a uniform unit code which comprises producing tone signals of a different frequency for each unit of the code in combinations in accordance with a standard telegraph code, transmitting the resultant audible tones representative of individual character code combinations over a telephone system, converting the tones received

at the distant end of the telephone system into electrical code signals and operating a recorder under the control of said code signals.

5 5. A system of communication comprising a plurality of oscillators, each adapted to produce oscillations of an individual frequency different from that produced by any of the other oscillators, means for keying said oscillations in combinations in accordance with a telegraph code, a
10 telephone system, means for producing tone signals corresponding to said keyed oscillations for transmitting over said telephone system, a receiving system associated with the telephone system comprising means for converting received
15 tone signals into electrical oscillations, a filter individual to each frequency adjusted to permit the passage of the current frequencies produced by said oscillator but to offer a substantial impedance to currents of other frequencies, a vacuum tube rectifier individual to each filter having
20 its input circuit connected to said filter, and an electromagnetic recording device in the output circuit of said rectifiers.

6. The method of telegraph communication which comprises generating a plurality of alternating currents of different frequencies, combining said currents selectively according to a telegraph code to produce character code groups, producing tone signals in accordance with said
25 currents, transmitting said tone signals over a telephone system to a receiving station, converting the received tone signals into alternating currents of different frequencies, distributing each of said currents simultaneously to a plurality of
30 rectifying devices to produce direct current impulses and actuating a receiving device by said direct current impulses.

7. The method of telegraph communication which comprises generating a plurality of alternating currents of different frequencies, combining said currents selectively in accordance with a telegraph code to produce character code groups, separating said character code groups of frequencies by intervals of no-current, producing tone
40 signals in accordance with said character code groups of frequencies, transmitting said tone signals over a telephone system to a receiving station, converting the received tone signals into alternating currents of different frequencies, distributing each of said currents simultaneously to
45 a plurality of rectifying devices to produce current impulses and actuating a receiving device by said direct current impulses.

8. The method of telegraph communication which comprises producing electrical oscillations of a plurality of different audible frequencies, impressing a current consisting of oscillations of two or more different frequencies upon a channel of a telephone system, separately rectifying
55 the components of each frequency and selectively operating a telegraph receiver in accordance with the character of said rectified currents.

9. A combined telegraph-telephone system comprising a telephone channel adapted to transmit voice frequency currents, means for impressing upon said channel current impulses composed of trains of oscillations of different audible-frequency components combined in accordance with a predetermined code, means connected to said channel for segregating and rectifying each component, recording means and means for selectively controlling said recording means in accordance with said current impulses.

10. A combined telegraph-telephone system comprising a plurality of telegraph transmitters, a telephone channel adapted to transmit voice frequency currents, means for impressing upon said channel current impulses composed of trains
5 of oscillations of different audible frequency components combined in accordance with a predetermined code, means for successively associating said transmitters with said means, a plurality of telegraph recorders controlled by said
10 current impulses and means for successively associating said recorders with said channel.

11. The method of telegraph communication which comprises generating a plurality of alternating currents of different frequencies, combining said currents selectively in accordance with
15 a telegraph code to produce successive character code groups, producing tone signals in accordance with said character code groups of frequencies, transmitting said tone signals over a telephone system to a receiving station, converting the received tone signals into alternating currents of different frequencies, filtering each code group into its individual frequencies, rectifying the same to produce code groups of impulses and
20 distributing each group of rectified impulses in order to a plurality of receiving devices.

12. A telegraph system comprising a plurality of alternating current generators for producing a corresponding number of different frequencies, a
30 a plurality of sets of permutation switches, a distributor for associating each set of switches in turn with said alternating current generators for combining said frequencies into selected groups, means for converting each selected group of frequencies into tone signals, a telephone system acoustically associated with said last means for transmitting said tone signals to a distant station, means at a distant station for converting the received tone signals into groups of alternating current frequencies, a receiving device individual to each of said sets of switches and means for successively associating each receiving device with the received groups of oscillations.

13. A combined telegraph-telephone system comprising a telephone channel, a telegraph transmitter, means associated with said transmitter for producing a plurality of audio-frequency currents of different frequencies, each corresponding to one impulse of the code utilized by said transmitter and means including said transmitter and independent of physical or electrical changes in said telephone system for impressing code signals on the telephone circuit, recording means associated with said telephone channel and means for selectively controlling said recording means in accordance with said audio-frequency currents transmitted over the channel.

14. A combined telegraph-telephone system comprising a telephone channel, a telegraph transmitter, a plurality of oscillators associated with said transmitter and means including said transmitter and independent of physical or electrical changes in said telephone system for impressing code signals on the telephone circuit, recording means associated with said telephone channel and means for selectively controlling said recording means in accordance with the oscillations transmitted over the channel.

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