

Jan. 9, 1940.

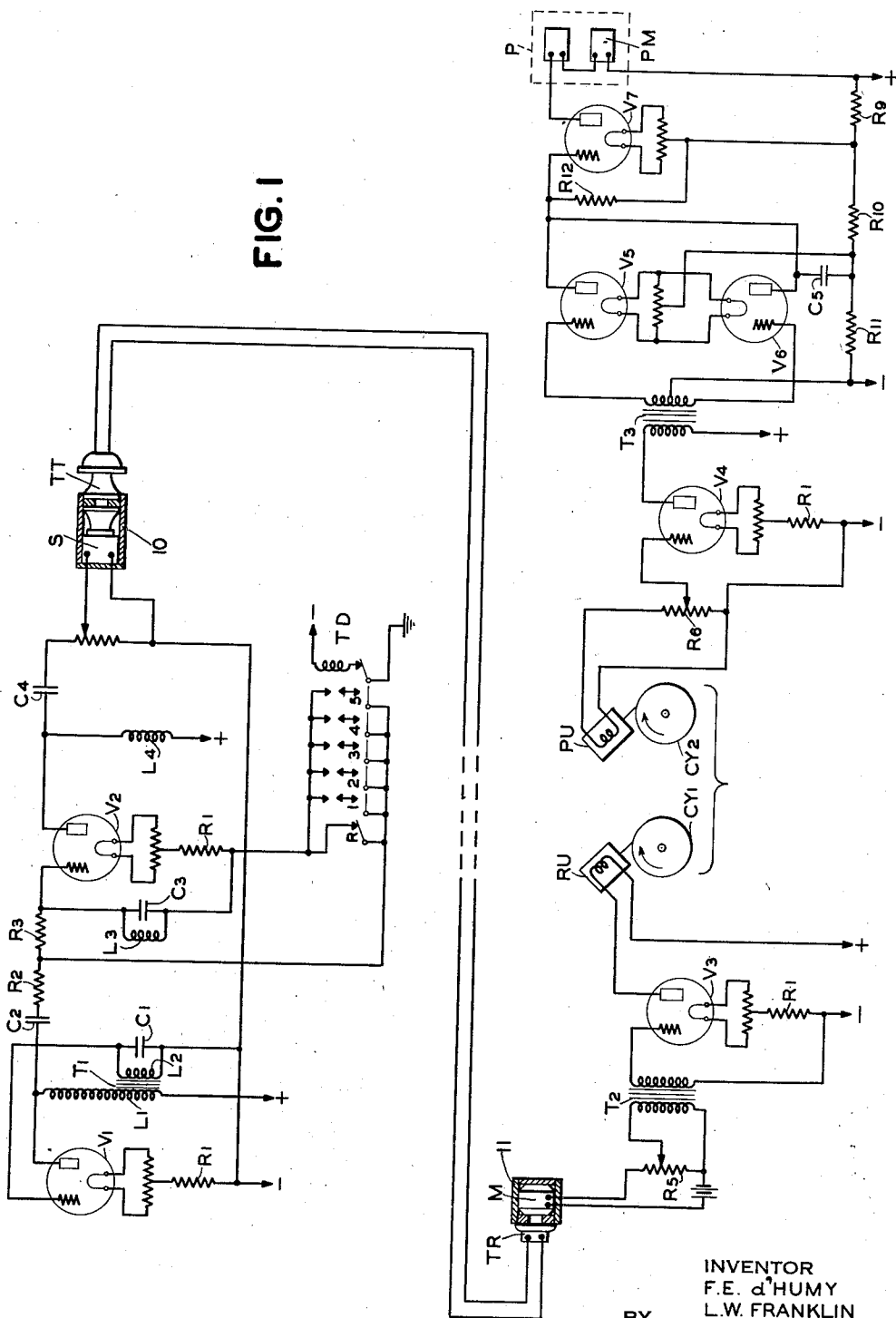
F. E. D'HUMY ET AL

2,186,898

TELEGRAPH STORAGE SYSTEM

Original Filed Sept. 5, 1935 3 Sheets-Sheet 1

FIG. 1



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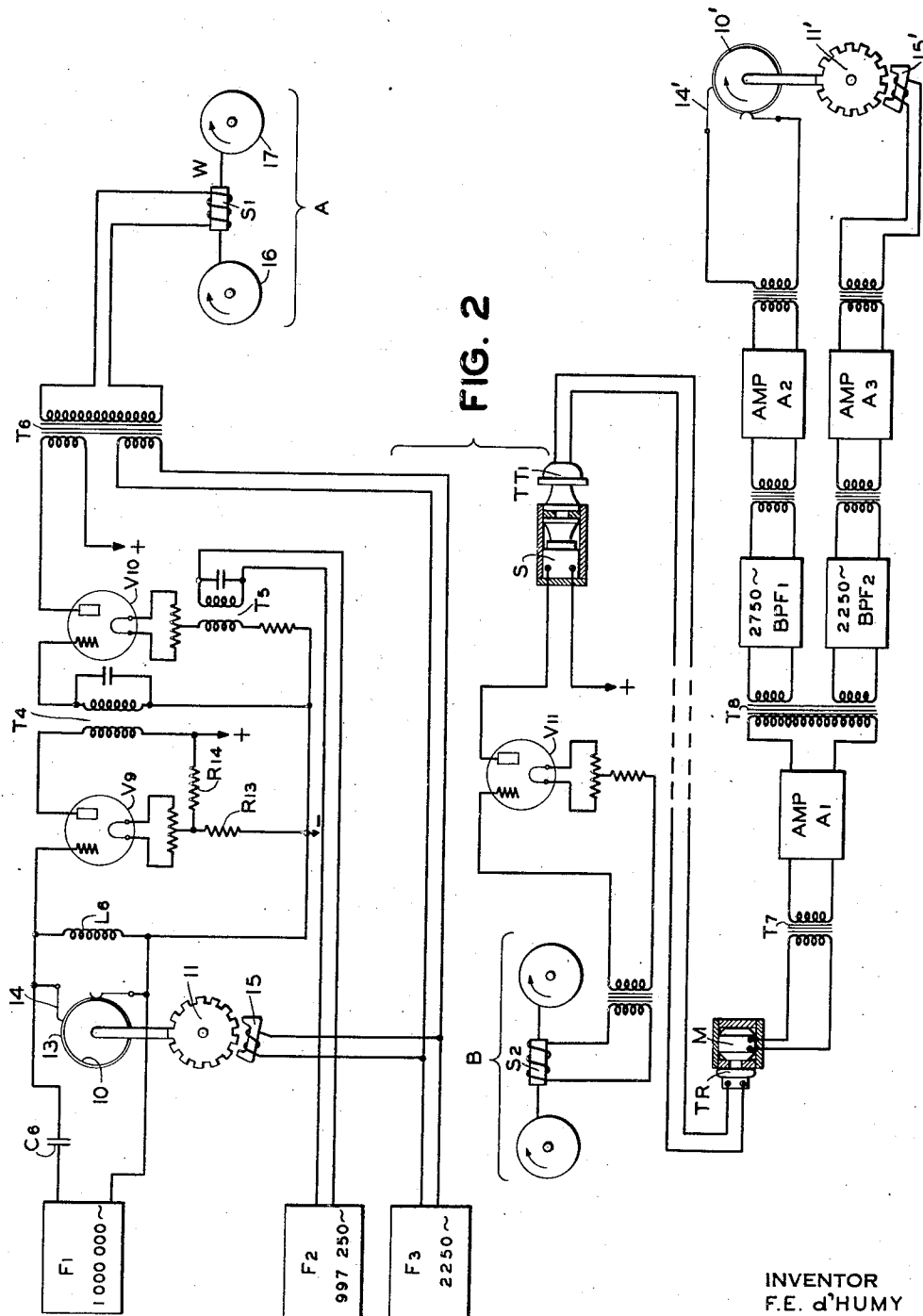
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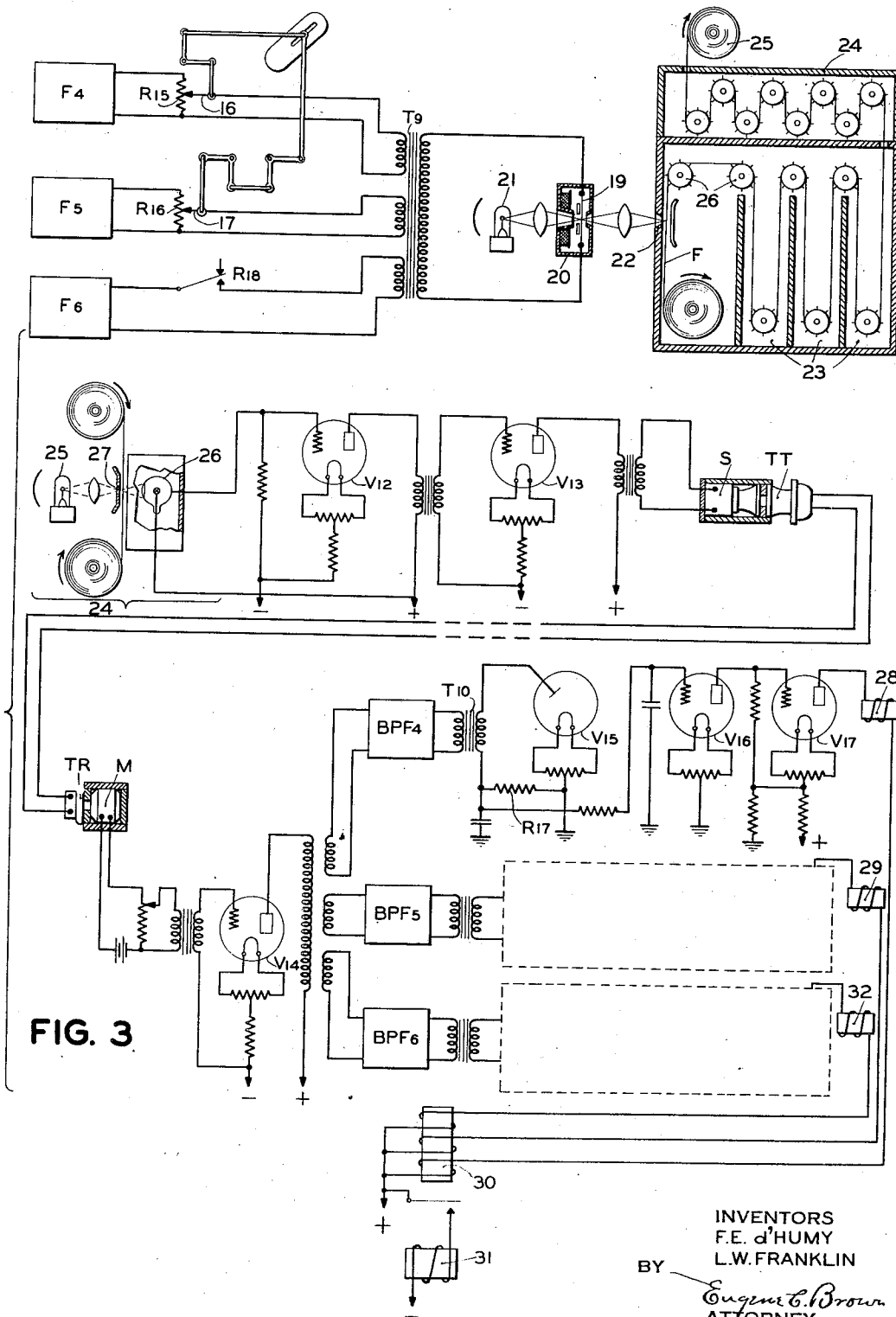
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TELEGRAPH STORAGE SYSTEM

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7 Claims. (Cl. 178—5.6)

This invention relates to a telephone-telegraph system of communication and more particularly to such a system in which storage of signals is effected either prior to or subsequent to the transmission thereof over the telephone system.

It is possible to transmit telegraph signals over a telephone circuit at much higher speeds than can be employed for the operation of ordinary start-stop code telegraph recorders, telautograph equipment or similar telegraph apparatus. It is also desirable to be able to transmit or set up such telegraph messages facsimile telegraph signals, etc., on a storage device at times when a telephone channel is not immediately obtainable and as soon as such channel is obtainable to transmit the subject matter thereover at the high speed of which the telephone circuit is capable. It is also desirable in certain systems to receive these messages at the high speed of transmission obtainable over the telephone circuit and to record them at leisure at ordinary telegraph recorder speeds.

One of the objects of the present invention is, therefore, to provide storage of the audio frequency signals utilized in telephone-telegraph communication intermediate their production and their visible recordation decoding.

Another object is to provide means for producing telegraph signals at one rate and for transmitting them over a standard telephone system at the same or at a different rate and to record them, if desired, at a still different rate.

Another object is to provide means for permitting the telephone transmission of signals to occur in timed space relation to the production thereof or to the visible recording thereof.

Other objects and advantages of the invention will hereinafter appear.

Three systems of telegraph communication are disclosed in the present application relating, respectively, to a code telegraph system, a telautograph system and a facsimile recording system. The term "telegraph communication" or "telegraph system" is employed herein to refer to each of these different systems, and the term "telegraph signals" is employed in reference to the signals utilized in each of these various forms of telegraph systems.

In accordance with the present invention, a source or sources of electrical oscillations are employed, which oscillations are keyed, modulated, or otherwise varied in accordance with the subject matter to be transmitted whether code telegraph, facsimile reproduction, or telautograph signals, and at the normal rate of operation of

the transmitting mechanism of such telegraph systems. The signal oscillations may be converted as they are produced into sound, light, magnetic or similar forms of energy, and stored upon suitable storage devices such as phonograph records, photofilms, magnetic wires, etc. The stored impulses may be subsequently reproduced at the same or at a different rate, translated into sound or audio waves and transmitted over a standard telephone system. At the receiving terminal of the telephone system, the received sound signals may be again stored upon a sound storage device or transmitted into another form of energy such as light, heat or magnetism, and stored upon suitable storage devices from which the signals may again be reproduced at a desired rate for the operation of a telegraph recorder such as a code printer, a facsimile reproducer or a telautograph receiver. Storage of the signals may be omitted at the transmitting station and the signal oscillations as produced translated directly into tone signals which are applied to the transmitter of the telephone system or, if desired, storage may be omitted at the receiving station and the telephonically received signals converted into electrical current variations which may be directly 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 code telegraphic-telephone transmitting and receiving system employing phonographic storage;

Fig. 2 is a circuit diagram of a facsimile telegraph system employing magnetic wire storage; and

Fig. 3 is a circuit diagram of a telautograph system employing photographic or photofilm storage of the telegraph signals.

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 continuous 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 R1 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. The output of this oscillator or frequency generator is fed through the condenser C2 and the resistances R2 and R3 to the grid of an amplifier tube V2. A tuned circuit including the inductance L3 and capacity C3 is used in place of the conventional grid leak for the amplifier tube V2, the purpose of which is to properly shape the signals in the output circuit of the tube V2 so that they may be more efficiently transmitted over a telephone circuit with a minimum of interference with adjacent circuits. The output circuit of the amplifier tube V2 is coupled by means of an inductance L4 and a condenser C4 to a sound producing device S. A variable resistance or potentiometer R4 is placed across the sound producing device S for adjusting the amplitude of the outgoing signals. Keying of the oscillations is accomplished by opening and closing the connection between the junction of the resistances R2 and R3 and the negative pole of the battery. A tape controlled telegraph code transmitting distributor TD is included in the connection just referred to for keying the oscillations in accordance with a permutation code. However, in place thereof any suitable type of telegraph transmitter may be employed or a relay having its contacts in said connection and controlled by various types of signals, such as standard speed start-stop signals, multiplex signals, etc. can be used to key the oscillations supplied to the sound producer S. The transmitter TD 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 usual telegraph line. Keying is accomplished by grounding the junction point of R2 and R3 to the negative battery, or other unipotential point. When this point is grounded, the energy stored in the tuned circuit L3—C3 is dissipated into R3 over the next few succeeding cycles. When the transmitter contacts are opened, the tuned circuit has to charge up through the resistances R2 and R3, so consequently require a few cycles to reach the maximum value. Consequently the signals which are applied to the grid of V2 will be sufficiently rounded to cause no interference to adjacent circuits, this rounding being a function of the sharpness of tuning of the L3—C3 circuit as well as of the values of R2 and R3.

As a result of the above connections the code signals produced by the transmitting distributor T are inverted, no signals appearing in the plate circuit of the tube V2 when the contacts are closed, that is, in response to marking conditions and an oscillating current flowing in the plate circuit of tube V2, 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 con-

tact R of the transmitting distributor T opens when the distributor sends a start signal of spacing character, remaining open during the successive closing of the code contacts 1 to 5.

The tone producing device S connected across the resistance R4 produces a tone of the frequency of the oscillations of the current in the input circuit of the tube V2 and keyed in accordance with the telegraph code.

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 transmitting 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.

If the microphone is of the carbon button type, a battery or other source of microphone current is necessary. A potentiometer or manual gain control R5 is included in the microphone circuit to adjust the input to the amplifier tube V3, coupled thereto through the 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 the tube V3 are applied to a phonograph recording unit RU which records the tones as picked up by the microphone M on a wax cylinder CY1 in a manner similar to that used in the common dictaphone or phonograph recorder. Thus it will be seen that the signals may be recorded at the high speed of transmission of which the telephone circuits is capable, which may be several times the ordinary speed of the printer system used.

After the transmission is completed, the wax cylinder is placed in reproducing position shown at CY2 and operated at a lower speed corresponding to the normal rate of operation of a standard telegraph printer. Speed relationship between the recording cylinder CY1 and the reproducing cylinder CY2 is the same as the relation between the transmitting speed of the transmitting distributor TD and the normal speed of transmission for which the printer P is adapted, whether it be start-stop, multiplex, or other type of telegraph printer.

The signals stored in the wax cylinder are reproduced by the phonographic pickup unit PU and applied through a potentiometer R6 to the input of amplifying tube V4. The signals amplified by the tube V4 are applied in push-pull to the grids of tube V5 and V6 through a transformer T3, which has a center-tapped secondary. The function of tubes V5 and V6 is to rectify the

signals full wave, amplify them, and, in combination with the output tube V7, 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 V5 and V6 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 resistances R9 and R10 and is also the point of the filament return of the output tube V7. The rectifier tubes V5 and V6 have their filament return connected 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 V5 and V6 is the voltage drop across the resistance R11; the plate voltage applied to tubes V5 and V6 is the voltage drop across the resistance R10, less the voltage drop across resistance R12 (if any). The grid bias on the output tube V7 is the voltage drop across resistance R12 (if any) and the plate voltage applied to tube V7 is the voltage drop across resistance R9, less the voltage drop of the selecting magnets PM of the standard telegraph printer P. The value of resistance R11 is such that the plate current with no signal applied to the grids is cut off or nearly so in tubes V5 and V6. 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 output tube V7. Maximum plate current will flow through the printer selecting magnet PM at this time, the value of the current being determined by an appropriate choice of the values of resistances R9 and R12 and the characteristics of tube V7.

When a signal is received from the record cylinder CY2 indicating what is normally a spacing or no-current signal, this signal is amplified in the tube V4 and applied to the grids of tubes V5 and V6. On one half cycle the grid of tube V5 is either positive, or at least less negative than before. Therefore, plate current will flow through this tube and through resistance R12. On alternate half cycles the grid of tube V6 becomes less negative, and also passes current through resistance R12. A small condenser C5 is connected between the paralleled plates of tubes V5 and V6 and 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 V7 at an essentially constant value during the period of any pulse, without seriously affecting the general shape of the printer signal.

In Fig. 2 a facsimile telegraph system is shown in which the facsimile telegraph signals produced at the normal rate of operation of the facsimile system are stored at the transmitting station on a magnetic wire and subsequently transmitted at a high speed over the telephone system. The picture or message to be reproduced is prepared in conducting ink or other conducting medium upon an insulating background 13, such as paper, which is wrapped about a cylinder 10. A stylus 14 is

moved longitudinally along the drum 10 in any suitable manner as by a screw (not shown) as the drum rotates, so as to trace a helical path on the sheet 13. The drum 10 is of metal or other conducting substance and is insulated from the stylus 14.

The system of the invention operates most effectively when transmitting from subject matter embodying an image-bearing surface upon which the images, such as words or pictures, are delineated by alternate conductive and non-conductive area. Such subject matter may be provided, for example, by printing, writing or drawing with a conducting ink or other conducting substance upon a non-conducting or dielectric substance, such as paper. Matter written with an ordinary graphite or lead pencil or like conductive material deposited upon the paper may also be employed. Messages typewritten with a ribbon impregnated with conducting ink or by carbon paper is another form which the subject matter may assume.

Subject matter of this character comprises areas of a conductive layer or coating, for example, the letters or words of a telegram, separated by areas which are substantially non-conductive, as the blank portions of the paper sheet on which the telegram is written. The conductive areas are for the most part separate individual areas varying through a wide range of sizes from a minimum useful size upward, which minimum useful size may, in the case of printed or written matter, be regarded as the dot for a small letter "i" or a period.

In accordance with the invention, the area of subject matter of the character described is disposed upon or brought near a conductive surface of appreciable size, such as the cylinder 10 or other metallic plate, with the conductive surface areas spaced from the larger surface or plate by a dielectric substance, as the paper of the telegraph blank. In this manner each of the individual conductive areas of the subject matter together with the plate form the two plates of a small condenser. When the metallic drum 10 is connected to one side of the grid circuit, and the electrode or stylus 14 is connected to another side of the grid circuit and is disposed in opposed position to the plate and arranged to engage the image surface of the subject matter between it and the plate, and when relative movement between the stylus and subject matter is effected in such a manner as to produce scanning action, the individual conductive areas of the subject matter are successively connected in circuit with the stylus 14 and vary the capacity of the circuit.

A source of high frequency oscillations F1 is employed, which by way of example, may be 1,000,000 cycles. The output of the oscillator F1 is fed to a vacuum tube amplifier V9 through a condenser C6, although if desired, other coupling means may be employed. The conventional grid leak between the grid and the ground or source of negative voltage of the tube V9 is replaced by a tuned circuit comprising the inductance L6 and the capacity existing between the scanning stylus 14 and the sending drum 10. The value of the inductance L6 is chosen relative to the value of the capacity existing between the stylus 14 and the drum 10, when the stylus is on a non-conducting or background portion of the image bearing surface, so that this circuit is tuned to the frequency of the oscillator F1. When the stylus crosses a conducting portion of the image, the capacity of this tuned circuit increases, re-

sulting in the circuit being tuned to a lower frequency than F1. Since in this latter case the impedance of the tuned circuit is less at the frequency of the source F1, the voltage applied to the grid of the vacuum tube amplifier V9 will be less with the stylus on a conducting portion of the image bearing surface than when on the non-conducting or background portion thereof. Consequently, the amplitude of the oscillating currents of the frequency of source F1 will be less when the stylus 14 traverses the conducting portions of the characters or images being transmitted than when it traverses a non-conducting portion. As in the system shown in Fig. 1, the inertia effect of the tuned circuit formed by the inductance L3 and the capacitance between the stylus 14 and the cylinder 10 prevents abrupt changes in the signals and produces rounded signals of a character that can be accurately recorded and transmitted over a telephone circuit without interference with adjacent circuits.

The output of the tube V9 is coupled through the radio frequency transformer T4 to the input circuit of a vacuum tube V10. The amplifier tube V9 may be biased to slightly beyond cut-off, by the resistances R13 and R14 so as to suppress the low amplitude oscillating currents corresponding to the scanning of conducting areas of the image. A second source of high frequency oscillations F2, the frequency of which may be by way of example 997,250 cycles per second, is also impressed on the input circuit of the tube V10 through the radio frequency transformer T5. The oscillations from the sources F1 and F2 are mixed in the tube V10, producing in the plate circuit of the tube oscillating currents of the frequency of F1, F2 F1 plus F2 and F1 minus F2, or frequencies of 1,000,000, cycles 997,250 cycles, 1,997,250 cycles, and 2750 cycles. The plate circuit of the tube V10 is coupled through the audio frequency transformer T6 to a recording coil S1 of a signal storage device. The 2750 cycle oscillations are the only ones which will be passed by the audio transformer T6 to the recording coil S1, the remaining or higher frequencies being suppressed.

The drum 10 is driven at a constant predetermined speed by a phonic motor 11 having a driving coil 15 supplied with alternating current from an oscillator or frequency source F3. The source F3 may be of a frequency of 2250 cycles per second although of course, any other suitable frequency may be employed. The desired scanning speed of the drum 10 may be obtained by selection of the proper number of teeth on the rotor of the phonic wheel or by appropriate gearing between the motor 11 and the drum 10.

The synchronizing oscillations from the source F3 may also be applied through the transformer T9 to the recording coil S1.

The recording mechanism A shown is of the Poulsen wire type where the moving wire W is magnetized with different intensities by the alternating current impressed upon it by the current through the coil S1, as it is sent from one spool 13 to the other spool 17. The recording of the picture on this wire may take place at a relatively slow speed and the subsequent transmission over the telephone circuit may be carried on at a much higher speed.

After the picture signals have been stored on the wire, the spool with the wire thereon may be placed on the transmitting mechanism B which is essentially similar to the recording mechanism A. If desired, the wire may be rewound so that as it is run off of the spool, the signals will be

reproduced in the same sequence in which they were recorded, although this is not necessary with facsimile transmission providing the receiving recorder is rotated in the proper direction. In the use of this form of storage for code telegraph signals, it is necessary to rewind the wire before transmission is started.

The wire W containing the stored facsimile signals, either with or without previous winding, is passed through the transmitting pickup coil S2 of the reproducing mechanism B, the variations of magnetism of the wire creating variations in current through the coil S2. These current variations are then amplified by the tube V11 and applied to a sound producing device S disposed in acoustical relationship to the transmitter TT of a standard telephone system. The sound signals are transmitted over the telephone system and at the distant end thereof actuate the diaphragm of the telephone receiver TR.

The receiver TR is disposed in sound transferring relation to a microphone M in turn coupled through a transformer T7 to an amplifier A1 and thence through a transformer T8 to the band pass filters BPF1 and BPF2. Filter BPF1 is designed to pass only the signals which constitute the picture itself, while the filter BPF2 is designed to pass only the synchronizing signals from the frequency source F3.

The facsimile signals transmitted by the band pass filter BPF1 are applied through an amplifier A2 to the stylus 14' and drum 10' of the facsimile receiver. The synchronizing signals passed by the band pass filter BPF2 are applied through an amplifier A3 to the driving coil 15' of the phonic wheel 11' to drive the receiving drum 10' in synchronism with the transmitting drum 10.

It is to be understood that while the motors 11 and 11' have been shown driven directly by the oscillating current supplied by the frequency source F3, other means of controlling the speed of operation of the drums 10 and 10' from these signals may be employed. For instance, the 2250 cycle oscillations may be modulated by a sixty cycle current and a sixty cycle current may be used to operate or control the phonic motors.

Another variation of the invention is shown in Fig. 3 in which recording is on a light sensitive film in connection with a telautograph method of transmitting intelligence. Briefly, this method consists of varying the amplitude of currents of two separate frequencies in accordance with the writing to be transmitted and interrupting current of a third frequency for performing the function of lifting the pen from the paper as between words, while a combination of the above with suitable relays performs the function of paper feeding, as will be apparent hereinafter. Currents of all three of these frequencies are recorded optically on a light sensitive film as they are controlled by the movement of the transmitting stylus. The film may then be run at a high speed and the intelligence stored thereon converted into tone signals and transmitted over an ordinary telephone system.

The three sources of oscillations F4, F5 and F6, shown diagrammatically, are within the audible range of transmission over telephone circuits, that is, between 300 and 3000 cycles per second. The output of the source F4 is connected to the outside terminals of a potentiometer R15 and the arm 16 of the potentiometer is connected through suitable linkage mechanism so that as the writing stylus passes horizontally across the paper, the movement is transmitted to the po-

tentiometer arm 16. Similarly, the potentiometer R16 is connected across the output of the frequency source F5 and the arm 17 of this potentiometer is linked to the writing stylus in such a manner that vertical movements thereof are transferred to the potentiometer R16. Thus any movement of the writing stylus corresponds to the writing movement of any one or both of the potentiometer arms. These two potentiometer arms vary the amplitude of the signals from the sources F4 and F5. The third source of oscillations F6 is provided with a switch 18 in series with the output, which switch is adapted to be operated whenever the pen is raised from the paper. The manner of operating the potentiometer arms 16 and 17 and the switch 18 by movement of the transmitting stylus is well known in the art and therefore is not shown in detail herein.

The output currents from the three sources of oscillation, F4, F5 and F6, are coupled through a transformer T9 to the movement element 19 of a light valve 20. The light from the source 21 is reflected through a narrow slot 22 onto a moving photographic film F, the amount of light which will reflect on the film being determined by the opening of the light valve 20 under the control of the current from the sources F4, F5 and F6. The developing mechanism 23 for the photographic film may be included in the recording assembly. After development, the film is passed through a suitable drying chamber 24 and rewound on a take-up reel 25. It is to be understood that the sprocket wheels 26 for conveying the film through the developing tanks and drying chamber are geared together to rotate in unison at the proper speed for recording.

After the telautograph signals have been recorded on the film, the film is rewound and then placed on a transmitting unit 24 for transmission over the telephone circuit. The film is driven at a constant speed which may be in excess of that of the recording mechanism and passes between a light source 25 and a photoelectric cell 26 or light sensitive device. A narrow slot 27 is provided so that only a narrow portion of the film is exposed to the light. The photoelectric cell is responsive to the variations of the light and dark portions of the film and the variable current produced by the cell is amplified by the vacuum tubes V12 and V13 and then applied to a sound producing device S in acoustic relation to the transmitter TT of the telephone system. The audible tones transmitted over the telephone system are picked up from the telephone receiver TR at the distant station by a microphone M. They are then amplified by the tube V14 and applied to band pass filters BPF4, BPF5 and BPF6. These filters pass the frequencies corresponding to those from the sources F4, F5 and F6, respectively.

The output side of the filter BPF4 is coupled through a transformer to a diode rectifier tube V15. The rectified voltage generated across the resistance R17 of the rectifier tube V15 is applied to the grid of an amplifying tube V16. The signals from the tube V16 are applied to the grid of an amplifier tube V7 thereby producing essentially direct current to the output circuit thereof, the amplitude of which varies in accordance with one component of movement of the transmitting stylus. The signals passed by the filter BPF5 are amplified and rectified in a similar manner, the output from this amplifier consisting of pulsating current of a frequency corresponding to the

source F5, and of an amplitude varying with the other component motion of the transmitting stylus. The oscillations passed by the filter BPF6 are rectified and amplified in the same manner, the output current from this amplifier being of a frequency corresponding to the frequency of the source F6 and of a constant amplitude but being keyed off whenever the controlling contacts 18 of the transmitter are open by raising of the transmitting stylus from the paper.

The receiving telautograph equipment is in the usual form comprising a pair of pen tracing solenoids 28 and 29, a paper feed relay 30, associated paper feed magnet 31, and a pen lifting magnet 32.

The frequency which is passed by the filter BPF4 and which corresponds to the frequency of the source F4 is applied to the horizontal movement magnet 28 of the telautographic recorder and the currents which are passed by the filter BPF5 corresponding to the frequency of the source F5 are applied to the vertical movement magnet 29 of the telautographic recorder. The oscillations from the source F6 which are controlled by the switch 18 and operated by the lifting of the pen from the paper at the transmitting end of the circuit passes through the filter BPF6 and after demodulation to the pen lifting magnet 32. The pen lifting function may be controlled either by opening or closing the switch 18, but as shown, the switch 18 is closed while the pen is in contact with the paper. Variations in signals caused by the lifting of the pen from the paper result in the magnet 32 being deenergized.

The paper feed function is accomplished by moving the transmitting stylus out of the regular writing field to one corner thereof. This movement produces a minimum operating current for the magnets 28 and 29. The paper feed relay 30 has three windings, one each in series with the magnets 28, 29 and 32. This relay is adjusted so that it will be released when the transmitting stylus is off the paper and in the aforesaid out-of-writing position so that the current passing through the magnets 28, 29 and 32 is at a minimum value. The paper feed function may be performed directly by the relay 30 but preferably through the medium of the heavier operating magnet 31 through the contacts of the operating relay 30.

It will be noted that a telephone-telegraph system has been provided in which telegraph signals of various origins and consisting of variations in oscillating currents within the audible range may be produced and recorded at normal telegraph operating speeds and transmitted over a line at an entirely different rate, due to the provision of storage means intermediate the transmission line and the signal source and/or the point of destination thereof. It is to be understood that the invention is not limited to operation over a telephone system but is applicable to the transmission over radio beams, etc. Neither is it restricted to the use of signals of a frequency within the audible range, but the principles thereof may be applied to the storage and transmission of signals of any desired frequency.

What is claimed is:

1. A method of telegraphic communication which comprises producing a plurality of electrical oscillations of different frequencies, varying said oscillations in accordance with subject matter to be transmitted, recording said oscillations on a storing device at one rate, reproducing said oscillations from said device at a different rate,

utilizing said oscillations to produce tone signals, transmitting said tone signals over a standard telephone system and making a visible record in accordance with telephonically received signals.

5 2. A method of telegraphic communication which comprises producing a plurality of electrical oscillations of different frequencies, varying said oscillations in accordance with subject
10 matter to be transmitted, recording said oscillations on a storing device at one rate, reproducing said oscillations from said storing device at a different rate and making a visible record in accordance therewith.

15 3. A method of telegraphic communication which comprises producing a plurality of electrical oscillations of different frequencies within the audible range of frequencies, varying said oscillations in accordance with subject matter to be transmitted, recording said oscillations
20 electrically on a storing device at one rate, reproducing said oscillations from said storing device at a different rate, transmitting said tone signals over a standard telephone system and making a visible record in accordance therewith.

25 4. In combination with a telephone system, a plurality of sources of oscillations of different frequencies within the audible range of frequencies, means for modulating said oscillations in
30 accordance with subject matter to be transmitted, a storing device for recording said oscillations at a predetermined rate, means for reproducing said oscillations from said storage device at a different rate, means for producing tone signals in accordance
35 with said last produced oscillations, means

for applying said reproduced tone signals to a standard telephone system and a visible recorder associated with the receiver of said telephone system responsive to said received signals.

5 5. In combination, a plurality of sources of oscillations of different frequencies within the audible range of frequencies, means for modulating said oscillations in accordance with telegraph signals, a storing device for recording said oscillations at a predetermined rate, means for reproducing
10 said oscillations at a different rate and a telegraph recorder responsive to said reproduced signals.

15 6. In combination, a plurality of sources of oscillations of different frequencies within the audible range of frequencies, means for modulating said oscillations in accordance with subject matter to be transmitted, a transmission channel, a storing device at one end of said channel for recording said modulated oscillations at a predetermined rate, means for reproducing said stored
20 oscillations at the same or a different rate and a recorder responsive to said reproduced signals.

25 7. A communication system comprising two sources of supersonic frequency currents, means including said sources for producing signals having audible frequency components corresponding to the subject matter to be transmitted, means
30 for storing said signals at a predetermined rate, means for reproducing said stored signals at a different rate and a recorder responsive to said reproduced signals.

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