Oct. 27, 1936. S. Z. BEAR 2,058,398

PRINTING TELEGRAPH SYSTEM

Filed July 16, 1934 2 Sheets-Sheet 1

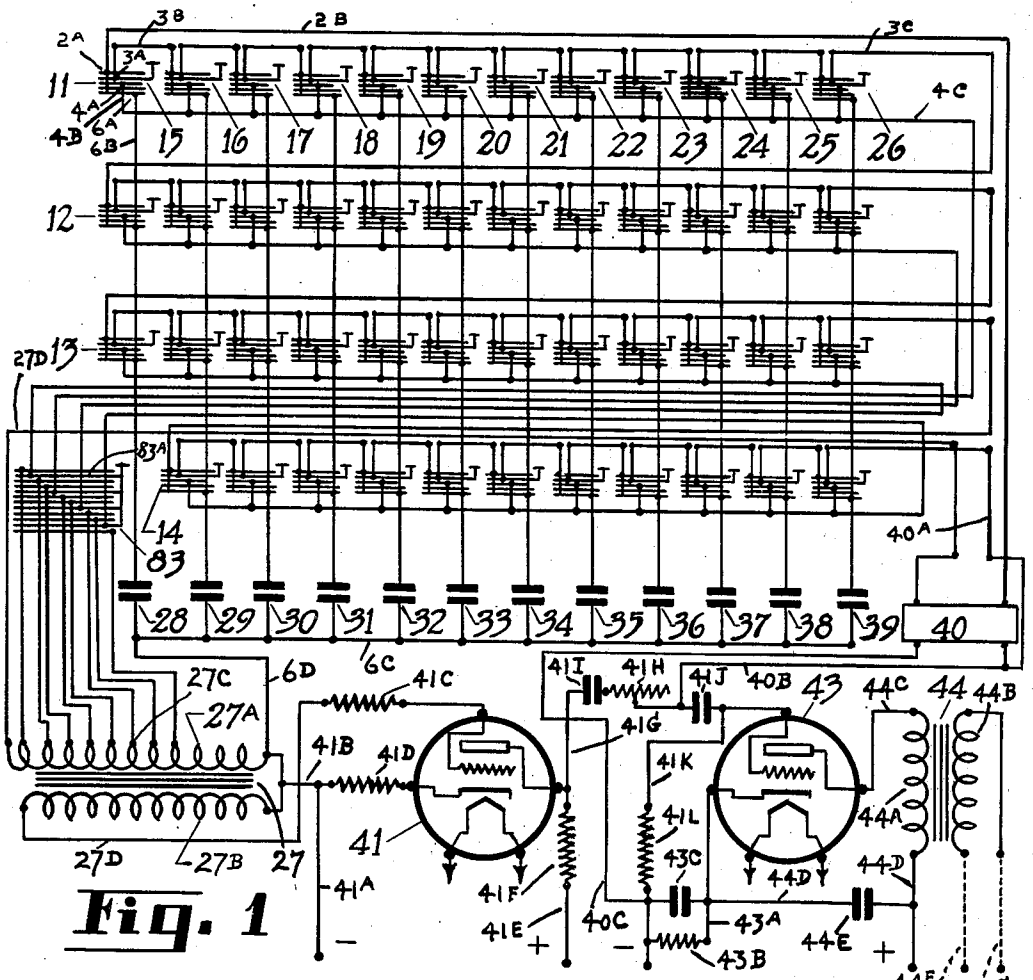


Fig. 1

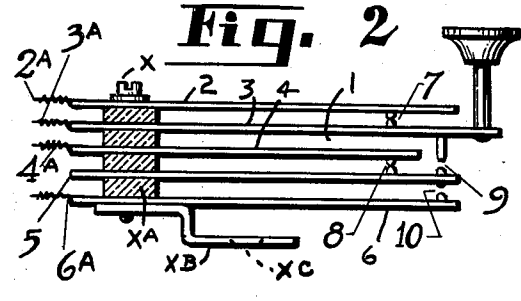


Fig. 2

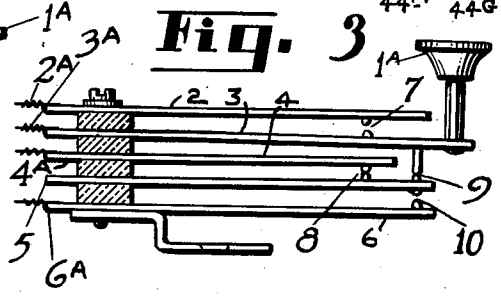


Fig. 3

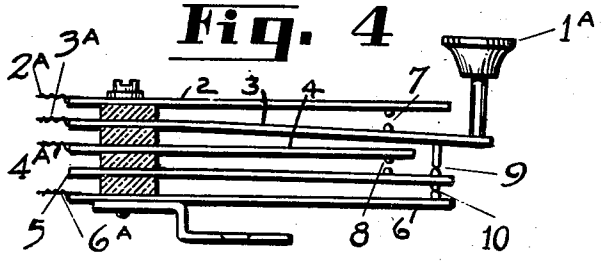


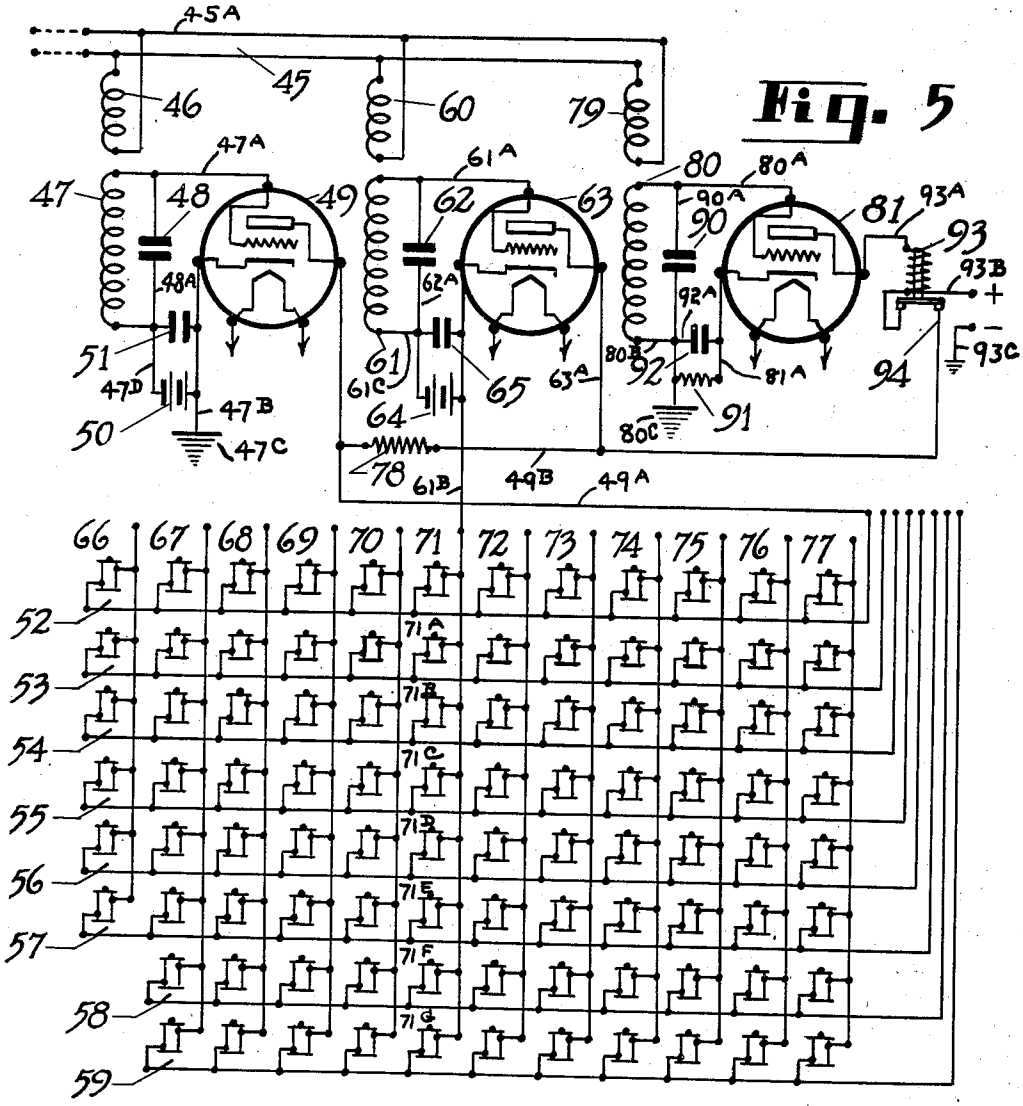
Fig. 4

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PRINTING TELEGRAPH SYSTEM

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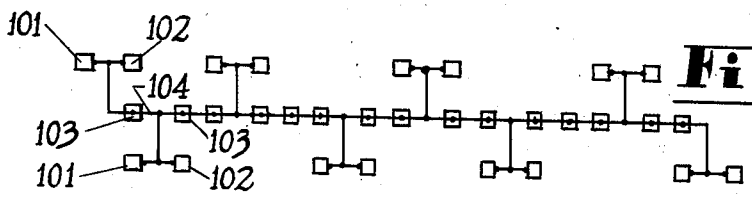
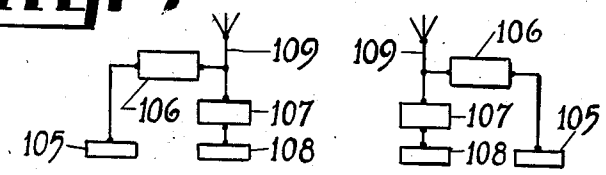


Fig. 6

Fig. 7



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UNITED STATES PATENT OFFICE

2,058,398

PRINTING TELEGRAPH SYSTEM

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Application July 16, 1934, Serial No. 735,417

8 Claims. (Cl. 178—31)

(Granted under the act of March 3, 1883, as amended April 30, 1928; 370 O. G. 757)

This invention relates to improvements in printing telegraph systems and the like, and more especially to communication systems of the printing telegraph type using either wire or radio between stations.

The objects of the invention are to provide a system by which printed characters may be produced by an electrical typewriter operated by a remote key-board; to provide a system by which alternating currents of audio frequency may be used as an actuating medium; to provide a system for translating the double signal into a type-bar actuating impulse; to provide a system by which two or more signals of different frequency may be used for each character transmitted; and to provide a system employing means for sending out a double signal impulse by a key movement.

While the character of the system herein disclosed may be embodied in various forms or arrangement of structure, the invention may be understood best by reference to the one preferred form as shown in the drawings which are a part of this application and of which the Figure 1 shows a key-board connection to the oscillators and amplifier; the Figure 2 illustrates a detail of a key mechanism in normal position; the Figure 3 illustrates the same key mechanism in partially depressed position; the Figure 4 illustrates the same key mechanism in a wholly depressed position; the Figure 5 shows the connection between the selecting circuits and the type-bar-operating solenoids; the Figure 6 is a schematic arrangement of a line connected system; and the Figure 7 is a diagrammatic arrangement for a radio or wireless system, the Figures 1 to 4, both inclusive, having reference to the transmitting apparatus of the system, while the Figure 5 refers to the receiving apparatus thereof.

Referring more particularly to that part of the accompanying drawings relating to the transmitting apparatus, the key mechanism 1, as illustrated by the Figure 2, is one of several like key mechanisms with which a single key-board may be provided, said key mechanism being provided with the key 1A fixed to the resilient leaf 3 of the combination of resilient leaves 2, 3, 4, 5, and 6, the leaf 6 however may be rigid if desired, these leaves being secured together adjacent one end, as at X, by means of the insulation material XA and thereby insulated and spaced, each one from the others, in parallel relation. The contact 7 comprises the normally interengageable projections with which the leaves 2 and 3 are provided. The contact 8 comprises the normally interengageable projections with which the leaves 4 and 5 are provided. The contact 9 comprises the projections normally relatively spaced and with which the leaves 3 and 5 are provided. The leaves 2, 3, 4, and 6 are provided with the terminals 2A, 3A, 4A, and 6A, respectively, and the entire key mechanism 1 is provided with the support XB having the attaching means XC by which the key mechanism may be mounted in erect position upon a frame or platform (not illustrated). The key mechanism 1, above described is intended to be supplied in sufficient quantities to equip a frame or platform of a transmitting apparatus with multiple rows, such as 11, 12, 13, and 14, of said key mechanisms, as shown in the Figure 1, the twelve key mechanisms of the row 11, for instance, being designated as the key mechanisms 15, 16, 17, 18, 19, 20, 21, 22, 23, 24, 25, and 26. The key mechanisms of each of the several rows 11 to 14 are connected in series, the terminal 3A of the leaf 3 of each of the mechanisms 15 to 26 is connected to the terminal 2A of the leaf 2 of each succeeding mechanism in the row 11 by means of the line 3B, while the terminal 2A of the leaf 2 of the mechanism 15 is connected by means of the line 2B to an oscillator the location of which is at 40, and the terminal 3A of the leaf 3 of the mechanism 26 is connected by means of the line 3C to the terminal 2A of the leaf 2 of the mechanism 15A in the next row 12. The terminals 4A of the leaf 4 of the several mechanisms 15 to 26 of the row 11, and also of the rows 12, 13 and 14 are each connected by means of the lines 4B and 4C to the tap leads 27C which are brought out from the primary winding 27A of the inductance coil 27, the capital shift key 83, with its mechanism hereinafter explained, being inserted in these lines 4C, this shift key 83 being designated by symbol in the Figure 1, its spring arms 83A being in neutral positions. The terminal 6A of the leaf 6 of each of the key mechanisms 15 to 26 of the several rows or groups 11 to 14 having a common connection, by means of the lines 6B, 6C and 6D, with the right-hand end of the primary winding 27A of the inductance coil 27, the tuning condensers 28 to 39, respectively, being inserted in the lines 6B. The left-hand end of the primary winding 27A is connected, by means of the line 27D, to the spacing oscillator at 40, said oscillator being connected, by means of the line 40A, to the terminal 3A of the leaf 3 of the key mechanism 26C and also to the grid of the amplifier tube 43 by means of the line 40B, the fixed condenser 41J being inserted in the last men-

tioned line. The left-hand end of the secondary winding 27B of the inductance coil 27 is connected, by means of the line 27D, to the grid of the oscillator tube 41, a resistor 41C being inserted in this connection, while the right-hand ends of both primary and secondary windings 27A and 27B of the inductance coil 27, and the minus side of the "B" power supply, are connected, by means of the lines 41A and 41B, to the cathode of the tube 41, a resistor 41D being inserted in the line 41B. The plate of said tube 41 is connected, by means of the line 41E to the plus end of the "B" power supply, a resistor 41F being inserted in the line 41E. The line 41G connects 41E from said plate to the grid of the amplifier tube 43, a variable resistor 41H, together with fixed condensers 41I and 41J upon either side thereof, being inserted in the line 41G. At this grid connection-line 41G there is also a line connection by means of the line 41K to the minus side of the "B" power supply, a resistor 41L being inserted in this last mentioned line adjacent the grid of the tube 43. Also from the minus side of the "B" power supply there is the connecting line 43A to the cathode of the tube 43, a by-pass condenser 43C shunted by a resistor 43B being inserted in said line 43A. The plate of the amplifier tube 43 is connected by means of the line 44C to the upper end of the primary winding 44A of the output transformer 44, while the lower end of said primary winding 44A is connected by means of the line 44D to the plus side of the "B" power supply, said lower end of the primary winding 44A being also connected by means of the line 44D to the cathode of the tube 43, the fixed condenser 44E being inserted in this last mentioned line. There is a connection by means of the line 40C from the minus side of the "B" power supply to the spacing oscillator at 40. The ends of the secondary winding 44B of the transformer 44 are connected by means of the lines 44F and 44G to the transmission circuit which transmits to the receiving apparatus hereinafter explained. The above described structure is thus grouped and connected to provide a transmitting apparatus having a multiple combination of key mechanisms in groups and subgroups; a tuning circuit comprising the condensers 28 to 39 and the induction coil 27; the oscillator tube 41 and the amplifier tube 43 with coupling resistances and fixed condensers and resistors; the place 40 reserved for a tube with coupling resistance and necessary fixed condensers and resistors similar to that of the tube 41; an output transformer 44; a "B" power supply having a transformer, rectifier tubes, necessary condensers and choke-coils for a filter system; and a shift-key double throw four-pole switch mechanism 83.

Referring to that part of the drawings relating to a receiving apparatus of this improved system, the three primary coils 46, 60, and 79, as illustrated by the Figure 5, are connected in parallel, the lines 45 and 45A both designate the input circuit of the receiver and connect the said coils 46, 60, and 79 in parallel relation. These primary coils 46, 60, and 79 are so relatively placed as regards the secondaries 47, 61, and 80, respectively, that they are inductively coupled to transfer energy from the input circuit to the tuning circuit. While these primary and secondary coils are illustrated in single sets, it is to be understood that, of the group relay, consisting of parts 46, 47, 48, 49, 50, and 51, there are in all eight of such relays, and of the character relays, consisting of parts 60, 61, 62, 63, 64, 65, and 78, there are in all twelve relays, and of the special relay, consisting of parts 79, 80, 81, 90, 91, and 92, there is but one relay, and of the ordinary relay 93 there is but one relay. Besides the primary and secondary windings 46 and 47, the group relay comprises the thyratron tube 49 the grid of which is connected by means of the line 47A to the upper end of the secondary winding 47, while the cathode of the tube 49 is by means of the line 47B grounded at 47C. The lower end of the secondary winding 47 is connected by means of the line 47D to the ground line 47B, the battery 50 being inserted in the line 47D, and the by-pass condenser 51 also being placed in parallel with said battery 50, a tuning condenser 48 being inserted in parallel with the secondary winding 47 by means of the line 48A connecting the line 47A with the line 47D adjacent the lower end of the secondary winding 47. The plate of the gas tube 49 is connected by means of the line 49A to the lower end of each of the solenoids 66, 67, 68, 69, 70, 71, 72, 73, 74, 75, 76, and 77 of the row 52, as shown in the Figure 5, this line 49A having a connection by means of the line 49B to the ordinary relay 93, the resistor 78 being inserted in this last mentioned line. Besides the primary and secondary windings 60 and 61, respectively, the character relay comprises the tyratron tube 63 the grid of which is connected by means of the line 61A to the upper end of the secondary winding 61, while the cathode of the tube 63 is connected by means of the line 61B to the upper portion of each of the solenoids 71, 71A, 71B, 71C, 71D, 71E, 71F, and 71G in the rows 52, 53, 54, 55, 56, 57, 58, and 59, respectively. The lower end of the secondary winding 61 is connected by means of the line 61C to the line 61B, the battery 64 being inserted in the line 61C and the by-pass condenser 65 being placed in parallel with the said battery 64, the condenser 62 being inserted in parallel with coil 61 by means of the line 62A connecting the lines 61A and 61C. The plate of the gas tube 63 is connected by means of the line 63A to the line 49B. Besides the primary and secondary windings 79 and 80, respectively, the single set of special relay comprises the ordinary vacuum tube 81 the grid of which is connected by means of the line 80A to the upper end of the secondary winding 80, while the cathode of the tube 81 is connected by means of the line 81A to the resistor 91. The lower end of the secondary winding 80 is connected by means of the line 80B to the line 90A which connects the line 80A to the line 80B and is grounded at 80C, the line 90A having inserted therein the condenser 90 in parallel with the secondary winding 80, and the by-pass condenser 92 being connected by means of the line 92A to the lines 90A and 81A and in parallel with the resistor 91. The plate of the vacuum tube 81 is connected by means of the line 93A to the ordinary relay 93. The relay 93 has a connection, as at 93B, with the plus side of a "B" power supply, the minus side of said "B" power supply being grounded as at 93C. The above described structure is thus grouped and connected to provide the improved system with one or more receiving apparatus, each apparatus comprising actuating relays selectively giving energy to solenoids which operate typebars.

In the normal at-rest position of the key mechanism illustrated by the Figure 2, the contact 7 is closed while the contacts 9 and 10 are open.

The contact 8 has no electrical significance excepting through the contact 9.

Preparatory to the operation of the keys 1A of the transmitting apparatus, the apparatus is connected to a source of electrical energy conducted into the circuit which includes the contact 7 and the terminals 2A and 3A of the several key mechanisms in series. In each key mechanism the contact 7 is normally closed to establish said circuit as a spacing circuit which energizes the oscillator at 40 to send out a frequency impulse to automatically operate a spacer in the receiving apparatus which is in tune with said frequency impulse, the plate current in the spacer frequency tube 81 dropping to zero, and the relay 93 in its plate circuit closing the contacts which feed current to the thyratron tubes 49 and 63. These tubes are thus made ready to be operated by the excitation of their respective grids.

Each manually or otherwise operated key mechanism 1 has a multiple function:—

A slight downward movement of any selected key 1A opens the contact 7 of that particular key mechanism and interrupts and suspends the spacer frequency impulse during the further downward movements of the said key 1A.

A further downward movement of the said key 1A closes the contact 9, the contact 8 remaining closed and the closed contact 9 (through the medium of the closed contact 8) completing a group frequency circuit which includes the terminals 3A and 4A of the leaves 3 and 4 of the operated key mechanism, and, with turns in the inductance coil 27 short-circuited by the particular tap connection, the proper resonance of the particular group frequency will occur and oscillation of that frequency will be sent out to the receiving apparatus.

A slightly further downward movement of the said key 1A will open the contact 8 to break the group frequency oscillator circuit, but will not affect the relay at the receiving apparatus because the grid cannot stop the plate current of a thyratron tube.

A final and complete downward movement of the said key 1A will close the contact 10 to establish the individual character circuit which includes the terminals 3A and 6A of the operated key mechanism, said circuit also including a particular one of the condensers 28 to 39 which tunes the oscillator 41 to a particular frequency. The inductance for this frequency is always the same and is in circuit at all times. At the receiving apparatus the oscillator of the individual character frequency will operate the proper group relay tube.

Upon the release of the thus operated key 1A, the individual character frequency relay is stopped, but the thyratron action of the relays holds the type-bar solenoid in action and, while the group frequency circuit (through contacts 8 or 9) thereby will be closed and opened again, no change occurs because of said thyratron action which holds the solenoid circuit closed until the plate current is interrupted. A full return of the key 1A of the operated key mechanism to its normal at-rest position, the contact 7 is made to close the spacer circuit whereupon the spacer frequency signal is sent to the receiving apparatus where this oscillation will operate the special relay which operates to open the plate circuit of the thyratron tube 63 and releases the type-bar or other mechanism by stopping the solenoid action. The improved system is then ready for the transmission of other characters.

It will be noted that no synchronizing means are used with my invention and the various troubles encountered with this class of apparatus are limited. If precautions are taken to avoid interference caused by beat frequencies of substantially the same frequencies as the regular signal, the simultaneous transmission of the group and individual frequencies may be used with greater speed of transmission. Instead of the eight groups as shown, arrangements may be used to shift the type-bars as in the ordinary typewriter and a smaller number of frequencies only will be necessary.

The invention above described includes a keyboard, multiple switches, each actuated by a key mechanism, and an oscillator 41 whose frequency is changed by the selective operation of these key mechanisms, the successive pulses of different frequencies being amplified by the vacuum tube amplifier 43 and sent over a line to the receiving apparatus or used to modulate a carrier frequency which is also sent over a wire line to the distant receiver. The initial pulse may also be used to modulate a high or radio frequency wave and antenna used to transmit the message to the receiver by broadcasting.

If a wire line is used to transmit the massage, either directly or by the use of a modulated carrier frequency, then amplifying repeaters may be used to keep the signals at proper strength throughout the line to avoid interference with other lines or the picking up of extraneous signals.

At the receiving station, which may be one of several which pick up the message at one and the same time, the signals are brought back to their original form by the well known means and are impressed on the input circuits of several discharge tube relays. Each of these input circuits is tuned to one of the several frequencies used. The tube whose input circuit is tuned to the particular frequency being transmitted at the moment will have its grid swung sufficiently positive by the combined action of bias and signal that the plate current will flow therein.

With any ordinary form of communicating systems it is necessary to use sharply tuned input circuits if any large number of characters are to be transmitted within a narrow band of frequencies. For straight wire transmission the cost of line structure and maintenance is proportioned to the band width transmitted. For carrier current work multiple use of a line is limited by the band width and it is therefore essential that the number of different frequencies used be cut down to the limit. For reasonable quality the number of characters required will be thirty-five and the same number of separate frequencies will be required. For better quality of the printed output more characters would be used with either a broader band of frequencies or more crowding together of those used. In any case, a system which uses less frequencies is to be preferred.

In this improved form of printing telegraph systems two frequencies are used for each character. These two frequencies are not transmitted simultaneously but preferably with a slight time interval between them, as timed by the operation of the key mechanisms as already explained. I do not intend to disclaim the simultaneous transmitting of the two frequencies, but do point out that in this case the beat frequencies of the two signals must be arranged as to not interfere or operate as other characters.

In the improved form the characters are arranged in rows or groups in the same manner as the keys of a typewriter. The first of the two frequencies transmitted upon the partial operation of a key will select the group and the second of said two frequencies upon a full operation of said key will determine the number or position of the characters in the group. In this way a much smaller number of frequencies will be required; for instance, for one hundred characters one hundred frequencies would be required in the ordinary form of system, but in the improved form the characters may be divided into ten groups of ten characters each and only twenty frequencies will be required with a saving of eighty percent of the band width.

Instead of the two successive frequencies a larger number could be used. If five main groups were used, with five subgroups and five characters per group, then one hundred and twenty-five characters could be produced with fifteen frequencies with a saving of about ninety percent of the band width used when a single frequency is used for each character. Greater savings will be found with more successive impulses per character, but the speed of transmission would be reduced and probably balance any gain in reduction on band width.

For high quality of output all the letters of the alphabet would be required twice. One for capital letters and another for each small letter, making in all fifty-two characters. Ten numerals and about twenty-four punctuation marks and special characters, as are commonly used on the standard typewriter, would also be required. In addition, other signals are required for the proper automatic operation of a typewriter, such as carriage return, carriage positioning, line spacing, word spacing, etc.

Provision has been made in the improved form, as above described, for ninety-five different operations to be performed by twenty different frequencies by using eight groups, of which six are used with twelve frequencies per group, and each of the remaining two groups with eleven frequencies, thus providing for ninety-five operations, the ninety-fifth operation being the controlling means of the special spacer frequency already explained. Of course a more elaborate system easily could be used having more groups or more characters per group and also a more simple arrangement could be used having less groups or less characters per group.

After suitable amplification or modulation successive impulses of audio frequency are sent over an intervening medium, such as a wire line or space between two antennae.

At the receiving apparatus the signals are demodulated if necessary and amplified to a standard value and impressed on a series of parallel connected coils **46**, **60**, and **79** which act as primaries to a number of tuned circuits. The number of these tuned circuits correspond to the number of different frequencies used in the system. Each tuned circuit is shunted across the input of a gas or vapor-filled hot cathode tube of the thyratron type, except one circuit which has a vacuum-type amplifying tube instead of a thyratron tube. This special tube and circuit is used for spacing, as has already been explained.

These tuned relays are arranged and connected so that the plate current of those tuned to the group frequencies are connected to the cathodes of those tuned to the individual character frequencies through a series of solenoids which actuate the type-bars of a typewriter. One connection of each solenoid in a group is connected to a group line **49A** which in turn is connected to the plate of the tuned group relay. The other connection of the solenoid is made, by means of the line **61B**, to the cathode of the tuned character relay, the same relative position in the group being connected to the same cathode. For the improved system there will be eight group relays and twelve individual character relays.

The high resistance **78** is shunted across the solenoid and individual character relays, preferably one from each group relay plate to the common plate end of the individual character relays. This resistance enables the voltage to be applied to the group tubes regardless of whether the individual character tubes are excited or not. During the operation, as already explained, the group frequencies are sent first for every signal and the proper tuned circuit will respond and swing the grid of the associated tube far enough positive to let the plate current flow. When this part of the signal stops, due to the final key movement already explained, the plate current does not stop because of the peculiar property of thyratron tubes which enables the plate current to flow regardless of the grid potential after once starting. The second impulse of the signal will set one of the individual character relay tuned circuits in resonance and swing its grid far enough to start the plate current. This action completes the circuit and the solenoid will actuate the proper type-bar. Upon release of the key nothing happens during the first phases of upward key movement wherein the group and individual character frequencies are stopped and started again because the thyratron action of the tubes used will keep the circuit closed regardless of the grid excitation as already explained. When the key reaches its normal position however a frequency impulse is sent out which resonates with the special relay using the vacuum-type amplifier tube **81** and this relay actuates the ordinary relay **93** opening the plate circuit. The solenoid then releases the type-bar.

For special operation, such as line spacing, any proper mechanical device may be actuated instead of the type-bar, but the sequence is the same. Of course, when the key is initially pressed, the special spacing relay circuit is broken because a thyratron tube is not used in this case and the loss of grid excitation will stop the plate current as this tube is biased at the plate current cut-off point. If sufficient energy to operate the relay is not obtained, then other tubes connected in cascade may be used to increase the output to the desired point.

I have found that about three cycles of operation are necessary to complete the action in the most unfavorable cases and as the lowest frequency used will be of the order of two hundred and fifty cycles per second and two sets of impulses are required per character, the time for characters will be of the order of one-fortieth of a second for the longest signal. Allowing the same time for key return as for depression a total of one-twentieth of a second per character is required or twelve hundred characters per minute may be transmitted. As this speed is rather high for manually operated keyboards, a tape may be used if desired to send the impulses over the transmitting medium in order to keep it fully occupied. The tape perforating and sending mechanism may be of similar type to those used in ordinary practice and those skilled in the art

can readily see the application without detailed explanation.

The several taps 27C on the inductance 27 connected to the groups, as shown, will tune the circuit to resonate at eight different frequencies, already referred to as group frequencies, and twelve different character frequencies. The tube 41 is connected as an oscillator with the coil 27B as the feed-back device, feeding energy to the grid from the tuned-plate circuit. The tube 43 acts as an amplifier for all the frequencies produced, and the resistance coupling means shown has the property of passing all the frequencies generated with substantially uniform gain to the transformer 44.

The key 83, as already explained, is on the transmitting apparatus for manual operation as a capital shift key; that is, for each individual key in a group there is on the receiving end of the system a representation of two characters, and the change from one character to the other is accomplished at the sending end of the system by the different group frequency obtained upon the shifting of this key 83 manually operated as in the ordinary typewriter. This key is of the eight spring type functioning with the effect of a double throw four pole switch to change taps on the inductance 27. The switch operated by the key 83 is shown by symbol in neutral position, but when in the upper or normal position any one of four group frequencies will be transmitted, but when in the depressed position any one of another set of group frequencies will be transmitted.

The contact 7 is used to complete the circuit to the controlling means of the oscillator at 40 and as plate return lead to tube 41 and the spacer arrangement. The contact 8 is normally closed and, together with the contact 9, forms the group frequency fixing circuit, as it closes the circuit through one of the various taps on the tuning inductances. The contact 10 is used to complete the group position circuit through one of the various tuning condensers 28—39. In the Figure 2 the spacing contact 7 is closed and the other two circuits are open. In the Figure 3 the spacing circuit is open but the group circuit is closed. In the Figure 4 the spacing and group circuits are both open, but the group position circuit is closed.

In the Figure 5 the numeral 45 shows the line which is connected to numerous coils, such as 46, 60, and 79. There are eight coils 46 which feed energy into the group selecting arrangement in which 47 is the tuning coil and 48 is the tuning condenser. The numeral 49 shows the tube shunted across the tuned circuit with its grid biased by the battery 50 or similar well known means, with the by-pass condenser 51. This tube 49 is of the thyratron type and its plate current is started by excitation of the grid but continues after the grid voltage returns to the bias point. The plate of the group frequency selector tubes 63 is connected to one side of the group of solenoids which operate the type-bars of a typewriter or other mechanism, not shown. These connections are shown to be eight in number in the improved form as already explained. The primary coil 60 delivers energy to the tuned circuits formed of inductance 61 and the condenser 62. The thyratron tube 63 is connected across this tuned circuit as shown and the grid of the tube 63 is biased by the battery 64 and the by-pass condenser 65.

The cathode of this tube 63 is connected to a group position line of solenoids 71 and similar tubes and tuning circuits are connected to similar group position lines, such as 66 to 77, respectively. The resistance 78 is used to shunt the tube 63 and the entire set of relay solenoids in order to allow the tube 49 to start, but does not allow enough current to pass to operate the relays, the current allowed to pass being just sufficient to ionize the gas in the tube 49 and to insure thyratron action. Similar resistances are used for each of the other group relays. The primary coil 79 is used to transfer energy to the tuning circuit formed of coil 80 and the condenser 90. The tube 81 is shunted across this tuned circuit and its grid is biased by the resistor 91 and the by-pass condenser 92. This tube 81 is an ordinary amplifying tube in which the grid retains control at all times and can stop the plate current as well as start it. In the plate circuit of this tube 81 is a relay at 93 which is adapted to operate contacts 94.

In the Figure 6 the numeral 101 designates a complete sending set such as is shown in the Figure 1, while the numeral 102 designates a receiving arrangement as illustrated more in detail by the Figure 5. The numeral 104 designates the connecting line, while 103 designates a repeating arrangement for increasing the amplitude of attenuated signals in the usual manner.

In the Figure 7 the numeral 105 designates a sending arrangement with an amplifier to bring the signals up to high power, while 106 designates a carrier frequency transmitter and modulator for putting the signals as modulated radio frequency on the antenna 109. A receiving and de-modulating arrangement is shown at 107, and the low frequency selector and typewriter is designated at 108.

Among the outstanding advantages of the improved printing telegraph system, one form of which is above disclosed, it will be noted that, in the transmission of each character by the sending out of two impulses, one of which determines the group to which the character belongs and the other the position in that group, the method herein described accomplishes its novel purpose without necessarily synchronizing the signals. It also will be noted that, the novel method of transmitting two or more impulses by a single operation of a key, provides for unlimited speed in the transmission of the characters, and that this speed may be accomplished also by the use of perforated tape contacts. And it will be noted further that, in the transmission of the characters by this improved system, no coding is required for secrecy; for great secrecy is assured alone by the use of two signals for one character transmitted, it being impossible to interpret either the group selecting signal or the group position signal, both of which are signals for the mere selection and operation of some mechanical movement actuated by electrical impulses.

In Fig. 1 of the drawings, the windings 27*a* and 27*b* of the transformer 27 are shown as having substantially the same number of turns but it is to be understood that the number of turns of the secondary or the primary may be changed to provide any desired ratio of transformation and the iron core of the transformer may be eliminated where it is desired to operate at high frequencies.

In the specification above, the term thyraton has been used to denote a discharge tube of the mercury vapor type including at least a cathode and anode and a control grid. In this tube an electron emission is obtained from a cathode consisting of an oxide coated filament or other type

of electron emitter. The mercury in the tube produces a vapor pressure depending upon the coolest part of the tube. Electrons emitted by the cathode collide with the mercury vapor atoms and produce ionization. Positive mercury ions are attracted toward the cathode and neutralize the normally negative space charge around the cathode. This action results in a relatively low voltage drop between the anode and the cathode with consequent low loss in the tube.

The function of the grid is to control the starting of the anode current. A negative grid potential of sufficient value with respect to the cathode will prevent the occurrence of a discharge. Once the discharge has started, the grid potential has no appreciable effect on the anode current; control is restricted to the grid only when the discharge ceases long enough for the mercury to deionize.

The invention herein described may be manufactured and used by or for the Government of the United States of America for governmental purposes without the payment of any royalties thereon or therefor.

I claim:

1. A printing telegraph system including a keyboard, multiple switches operated by keys, an oscillator the frequency of which is altered by the switches, a separate oscillator for the generation of a spacing frequency, a transmitting line connected to parallel selecting tuned circuits, thyratron tubes shunted across these tuned circuits, solenoids in series with the thyratron plate circuits and adapted to operate type-bars, and spacing means actuated by a back-contact of the transmitting key which thereby sends a special frequency signal over the line and operates a tuned relay to open the plate circuit of the thyratron tubes and restores the type-bars to non-printing position.

2. A printing telegraph system having a keyboard with one character key for each two characters, a shift key for selecting either one of the two characters, three single-throw switches operated by each character key, a four pole double-throw switch operated by the shift key, a tuned circuit whose resonant frequency is altered by said switches, an oscillator whose frequency is set by the tuned circuit, an amplifier for increasing the amplitude of a signal, a line between the transmitting apparatus and a receiving apparatus adapted to receive a transmitted signal and having tuned circuits arranged to oscillate in resonance with the received signals, tubes shunted across the tuned circuits and arranged to control the current flow in one of a multiplicity of solenoids to operate a type-bar with which the particular solenoid is associated responsive to the conjoint energization of two of said tubes.

3. In a device for telegraphically printing characters at a distance in which a plurality of circuit opening and closing keys are employed at a transmitting station and a plurality of groups of frequency selective thyratrons are employed at a receiving station, the method of energizing a selected pair of said thyratrons which comprises translating the movement of a key at the transmitting station into a signal of successive impulses of alternating current of different frequencies, rendering one of said thyratrons of one group conductive responsive to one of said impulses and rendering one of said thyratrons of another group conductive responsive to the conjoint action of another of said impulses and the precedent energization of one of the thyratrons of the first mentioned said group.

4. In a printing telegraph transmitter having character keys, means for transmitting a plurality of frequencies in succession responsive to the depression of any character key comprising an oscillation generator and means for connecting into the frequency determining circuit of said oscillation generator selected values of inductance and capacity at a plurality of degrees of depression of said keys.

5. In a printing telegraph transmitter having character keys, means for transmitting a plurality of frequencies in succession responsive to the depression of any character key comprising an oscillation generator and means for connecting into the frequency determining circuit of said oscillation generator selected values of inductance and capacity at a plurality of degrees of depression of said keys, and means for transmitting a spacing frequency responsive to the return to normal position of any one of said keys.

6. In a telegraph printer in which a character is printed responsive to the receipt of a plurality of successively transmitted different frequencies, a plurality of parallel frequency selective circuits each of which is included in the control circuit of a thyratron tube and means responsive to the energization of any one of a first group of said thyratron tubes responsive to the receipt of a first frequency for preparing a circuit for a second group of said thyratron tubes, and means for energizing one of the thyrathon tubes of said second group responsive to the receipt of a second frequency.

7. In a telegraph printer in which a character is printed responsive to the receipt of a plurality of successively transmitted different frequencies, a plurality of parallel frequency selective circuits each of which is included in the control circuit of a thyratron tube and means responsive to the energization of any one of a first group of said thyratron tubes responsive to the receipt of a first frequency for preparing a circuit for a second group of said thyratron tubes, and means for energizing one of the thyratron tubes of said second group responsive to the receipt of a second frequency, and means comprising a solenoid included in the circuit of said thyratrons for actuating a character printing device.

8. In a printing telegraph system wherein a character is printed responsive to the receipt of a series of successively transmitted signals of more than one frequency, a plurality of parallel connected frequency selective circuits, each circuit being so proportioned as to resonate to currents of characteristic frequency, means responsive to the receipt of a first frequency of a series for closing a point in a circuit corresponding to the group to which the signal belongs, means responsive to the receipt of a second frequency of the series for closing a point in a circuit corresponding to the sub-group to which the signal belongs, and means responsive to the receipt of all of the frequencies of the series for energizing a solenoid corresponding to the character of said series.

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