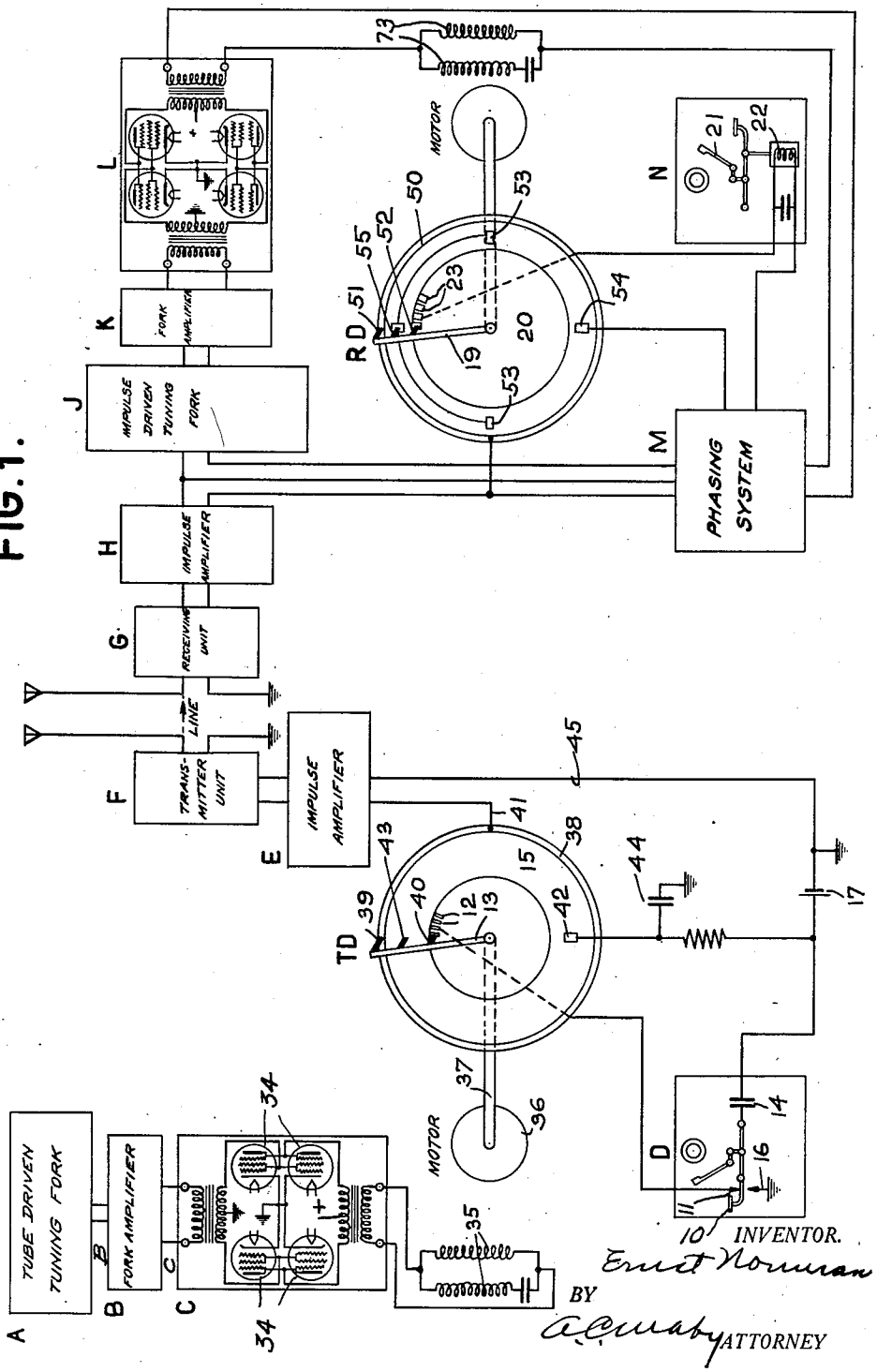
June 14, 1938. E. NORRMAN 2,120,371

COMMUNICATION SYSTEM

Filed Oct. 4, 1934 3 Sheets-Sheet 1

FIG. 1.



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COMMUNICATION SYSTEM

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FIG. 2.

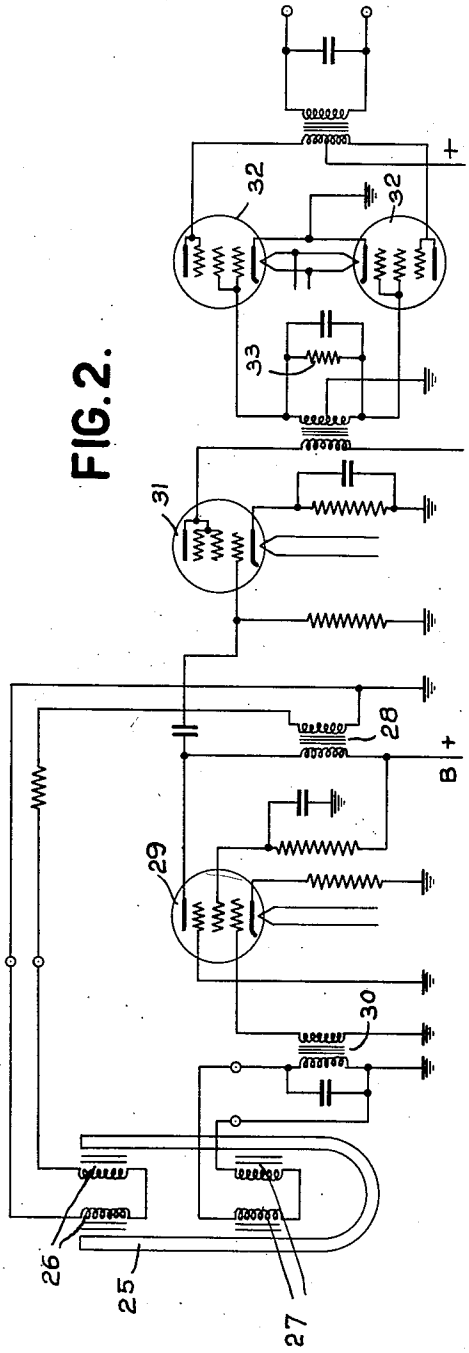
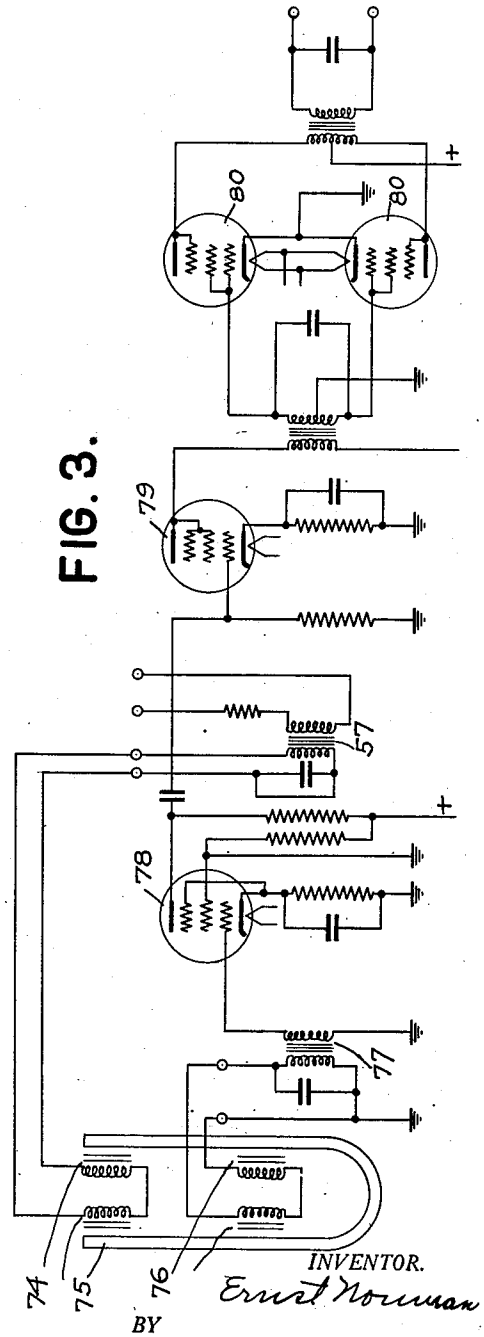


FIG. 3.



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COMMUNICATION SYSTEM

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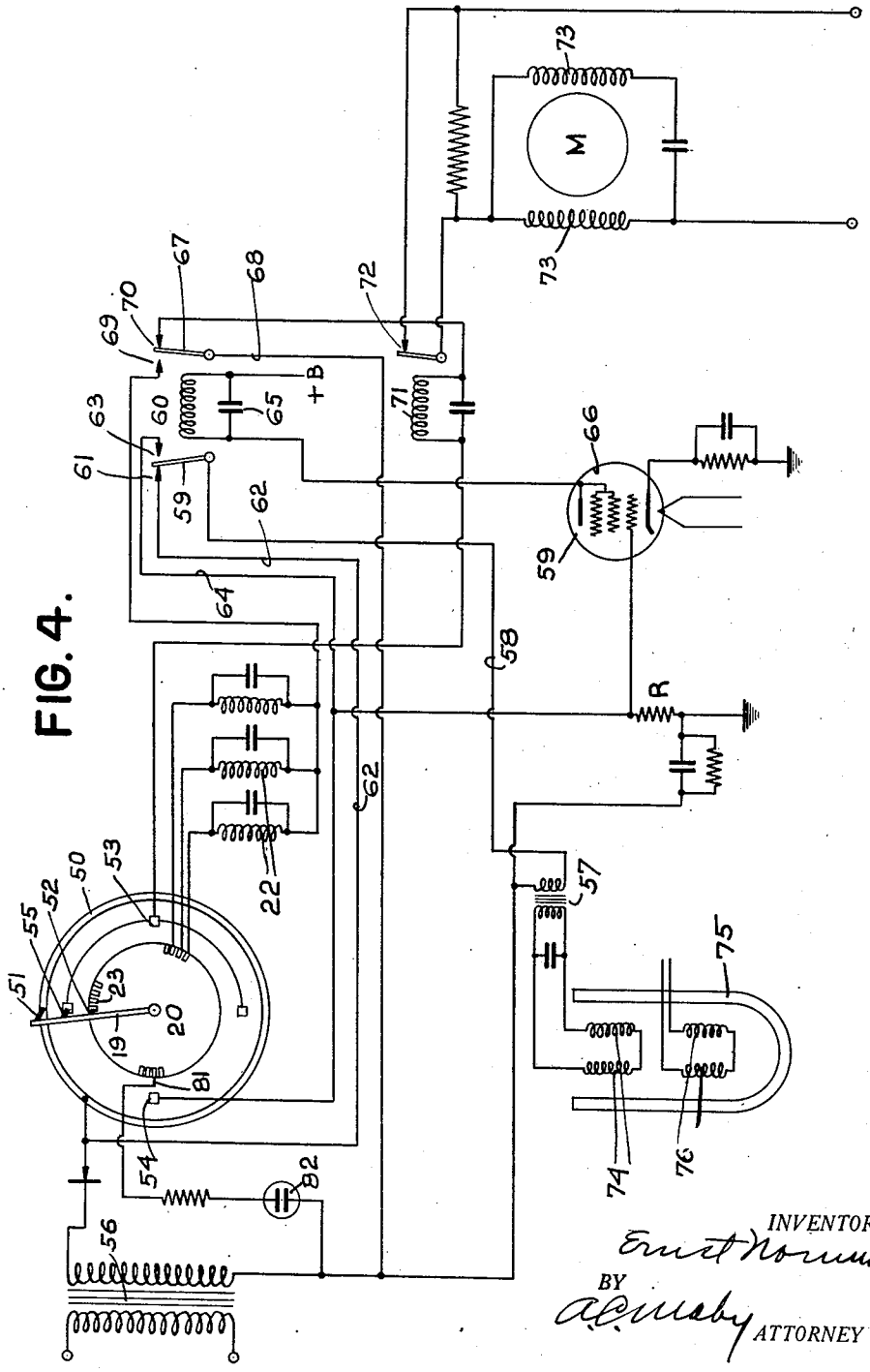


FIG. 4.

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2,120,371

COMMUNICATION SYSTEM

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Application October 4, 1934, Serial No. 746,903

10 Claims. (Cl. 178—69.5)

This invention relates to communication systems employing synchronous, inphase operation of a transmitter and a receiver, and applies particularly to systems wherein the intelligence is conveyed by electrical impulses identified by their timing with reference to an arbitrary time scale.

A general object of the invention is to maintain in a positive manner and with great exactness synchronism between transmitting and receiving apparatus at separate points.

Another object of the invention is the use of a vacuum tube vibratory fork for generating a constant frequency alternating current for driving a rotary distribution motor at the transmitting station.

Still another object of the invention is the use of a vacuum tube vibratory fork at the receiving station maintained in operation by transmitted impulses similar in characteristics to the character impulses.

Still another object of the invention is the employment of the amplifier system used for the character impulses to amplify the received synchronizing impulses.

Still another object is the provision of an automatic phasing system for bringing the receiving system in exact phase with the transmitting system.

The present invention will be explained in conjunction with a single impulse synchronous system, in contradistinction, to the combinational code systems such as the five unit code, and in which the different characters to be transmitted and received are represented by single impulse signals which are definitely allocated during particular timed intervals.

Heretofore, in synchronous telegraphy it has been the general practice to utilize receiving synchronous apparatus adjusted to run at a speed slightly different from that of the transmitting apparatus and to correct for the difference in speed between the two by stepping the distributor brushes backward or forward independently of the driving motor whenever the angular shift between the brush and the motor shafts exceeded a certain amount. Another practice has been to run the receiving apparatus at one of two speeds which are respectively slower and faster than that of the associated transmitting apparatus and to shift from one speed to the other to maintain approximate synchronism with the transmitter. The phase wander inherent with the above methods prohibits their use in high speed signaling systems when the signal impulse waves become very short and it then becomes desirable to hold the receiving distributor at substantially the same constant speed as the transmitting distributor.

An object of this invention is to overcome these difficulties and is attained, in one embodiment by employing a driven tuning fork embodied in a system to be disclosed hereinafter.

Briefly, the operation of the system embodied in the present invention is such, that a transmitting tuning fork driven by a thermionic tube arrangement is adapted to rotate a transmitting distributor which periodically transmits in addition to the character signal impulses, a synchronizing impulse which is identical in character to the character signal impulses. This fact adds to the simplicity of the circuit arrangement.

As mentioned previously, the printing telegraph system embodied in the present invention involves the shifting of the character impulse along the axis of a timed scale, the position of the impulse thereon determining the character to be selected. The position selected for the synchronizing impulse will not vary as the character impulses do, but it is obvious that the synchronizing impulse which is similar to the character impulses, will be identified by its timing with reference to an arbitrary time scale.

The transmitted character and synchronizing impulses are received and amplified by the same wave receptive apparatus. The receiving tuning fork vibrations are maintained by the transmitted synchronizing impulses which may be sent out by line or radio networks. The E. M. F. generated in the pick-up coils of the fork build up sufficient voltage by amplification sufficient to rotate the receiving distributor. When the receiving and transmitting stations are correctly phased which is accomplished automatically, a selector relay switches the system over to its printing position so as to separate the printing and synchronizing impulses.

Therefore, another object of this invention is to provide for positively driven tuning forks in contradistinction to the variable speed systems outlined.

Still another object is the provision of periodic synchronizing impulses adapted to drive the receiving rotary apparatus.

Still another object is the provision for automatically separating the character impulses from the synchronizing impulses when correct phasing is obtained.

Still another object of the invention is the provision of frequency multiplying means and of

distributor operating means responsive to the multiplied frequency of the transmitted impulses to operate the receiving and sending apparatus in phase.

Further and other objects of the present invention will be hereinafter set forth in the accompanying specification and claims and shown in the drawings which by way of illustration is what I now consider to be the best mode in which I have contemplated applying that principle. Other embodiments of the invention employing the same or equivalent principle may be used and structural changes made as desired by those skilled in the art without departing from the present invention and within the spirit of the appended claims.

In the drawings:

Fig. 1 shows a schematic diagram illustrating the embodiments in this invention.

Fig. 2 shows a circuit diagram of the tube driven tuning fork and amplifier of the transmitting station.

Fig. 3 is a circuit diagram of the impulse driven fork and amplifier at the receiving station.

Fig. 4 is a circuit diagram of the phasing system employed in this embodiment of the invention.

Referring now to the drawings in which similar parts are designated by the same numerals in the several views, it is believed that a clear understanding of the invention will be had therefrom when considered in conjunction with the following description.

For the sake of clarifying the following description, the operation and description of the printing telegraph system embodied herein will be given first, then followed by the description and operation of the transmitter, the receiver, and then the phasing system employed in the present invention.

General description

The particular form of communication system explained in conjunction with the embodied synchronizing and phasing system is a printing telegraph system operable by a line or radio network. This system to be disclosed is readily adaptable to facsimile or television transmission or other systems to be remotely controlled employing rotary mechanisms that need be operated in a synchronous relationship. From the following disclosure it will be obvious that this invention need not be limited to the specific structure preferred and presented for illustrative purposes. The above mentioned system involves the shifting of the character impulse along the axis of a timed scale, the position of the impulse thereon determining the character to be selected, and is of the type disclosed in the U. S. Patent 1,927,077 issued to G. W. Watson, September 19, 1933.

Referring now to Fig. 1, D represents a printing telegraph unit which may be of any well known type having a series of character pivoted key bars 10 and is adapted to initiate a character impulse when one of the character keys is depressed. A separate contact 11 is associated with each individual key bar 10 and connected to contacts or segments 12 corresponding to the character represented by each key bar.

Rotary arm 13 driven by the motor as shown in the diagram is adapted to engage the contacts in rather rapid succession to initiate the character pulse by discharging the condenser 14 coacting with the transmitting commutator 15. An individual condenser is provided for each character key bar 10, and is charged by depressing the key 10 to close the charging circuit through contact 16 associated with the key bar 10, battery 17, condenser 14, and key bar 10. The condenser is discharged during a predetermined interval of time when the rotary arm engages the particular character segment 12 through the circuit closed by contact 11 and fully described in the aforesaid patent.

The character impulse as produced by the printer transmitter units D and TD in the manner just explained, is then conducted to the radio or line amplifier E and wave transmitter F to effect transmission of the signal impulse in a manner that is well known and need not be further explained, and is received in the usual manner by the wave receiver unit G and impulse amplifier H. The received impulse is then passed to the receiving commutator or distributor RD and the printing telegraph receiver unit in a manner similar and which is fully disclosed in the aforesaid patent to record the character corresponding to the character transmitted, with the exception of a few features included in the phasing system which will be described hereinafter, the principle of reception for recording the message is the same as described in the said mentioned patent.

It is to be understood that the rotary arm 19 of distributor 20 is rotated in synchronism with the rotating arm 13 of distributor 15 which will be explained presently. It will be shown how the synchronous rotating arms are used in the art and applied to this type of system to effect the correct selection of the key and type bar arrangement designated 21 which is operated by energization of the attached solenoid 22, and each character solenoid which in turn is connected to the distributor segments or contacts 23.

Description and operation of transmitting apparatus

It has been found that in order for the recording unit N to operate correctly in the system described above the rotary brush of the receiving distributor RD (Fig. 1) unit must not drift out of phase with the transmitting distributor brush 13 more than about one-quarter of a segment such as shown at 23. Let it be assumed that in a time unit this is equivalent to 1/8000 of a second. Hence if tuning forks with the highest degree of accuracy were used the synchronism of the rotary arms would not be maintained very long if the forks were driven independently. This difficulty is overcome by the present invention which will be obvious from the following disclosure.

In Figure 1 the circuit arrangement is shown schematically to embody a tube driven transmitter tuning fork A. This fork is adapted to have the driving coils thereof energized by a thermionic tube circuit arrangement. Other sets of associated coils which will be designated hereinafter as pick-up coils are adapted to generate electrical energy which upon amplification is fed back to the driving coils to vibrate the fork at a constant and predetermined rate.

The generated electrical oscillations are passed through an amplifier as shown at B and then to another stage of amplification designated C to supply the windings of the motor sufficient electrical power to rotate its connected arm 13 of the transmitting distributor TD.

Referring now to Fig. 2, the transmitting fork unit 25 is of the type having a low temperature

co-efficient and damping characteristics and well known to those familiar in the art and has associated therewith two independent energizing units to effect constant vibration of the tines of the fork and will be referred to hereinafter as the driving coils or units 26 and pick-up coils or units 27. Both the pick-up and driving units are provided with permanent magnets associating with the tines of the fork to effect the vibration thereof and which is a common expedient in the art.

The driving coils 26 are connected to one winding of a transformer 28, the other winding of which is included in the plate circuit of the thermionic tube 29. The pick-up coils 27 are connected to one winding of transformer 30, the other winding of which is adapted to energize the control grid of tube 29. The usual batteries are supplied for filament heating and plate voltages. It is seen that when the fork 25 starts to vibrate a small E. M. F. is generated in the pick-up coils 27 and passed on to the control grid of the drive tube 29. The amplified oscillations in the plate circuit of this tube are fed to the driving coils 26. Thus once the fork has started to vibrate it will be automatically maintained in operation.

On account of slight mechanical vibrations that always will reach the fork and also of the small irregularities in the tube circuits the fork will start itself when the voltages are applied to the tube circuits, although it may take a short interval of time before the fork reaches its final amplitude.

The plate circuit of the drive tube 29 is coupled to the control grid of another amplifier tube 31. This tube drives a pair of tubes indicated at 32 connected in a standard manner to be used as class B amplifiers which are well known and need no further explanation. The desired output power level may be obtained by adjustment of the resistor 33 across the grids of tubes 32. The output circuit of this last stage of amplification which is represented by B on the diagram in Figure 1 is connected to the power amplifier shown in the figure which is a standard amplifier arrangement employing two parallel groups of tubes 34 as class B amplifiers. The output of the power amplifier is connected to the windings 35 of motor 36 adapted to rotate brush 13 attached to the shaft 37 of the motor. The transmitting distributor 15 consists of a solid conducting ring 38 adapted to be in constant engagement with a brush 39 located on the rotary arm 13. Conductor 41 connects this ring to an input terminal of the impulse amplifier E. It was previously mentioned that the segments 12 were positioned on distributor so that brush 40 of rotary arm 13 engaged the segments in rapid succession. It is obvious that there is an individual segment 12 for each character to be transmitted from the unit D.

Another contact 42 is provided on the distributor TD and positioned so that its brush 43 engages it once each revolution to send out an impulse at uniform time intervals. The character segments 12 and contact 42 are so disposed that they are not engaged at the same time by their respective brushes, that is, the impulse from contact 42 is sent out between the successive character impulses. The impulse sent out from contact 42 at uniform intervals is the synchronizing impulse which has the same characteristics as the impulse for each character and is obtained by the discharge of condenser 44 when the brush 43 engages the contact 42 which then by means of brush 39 and the solid conducting ring 38 is conducted to the impulse amplifier by conductors 41 and 45. During the intervals the contact is not engaged by its corresponding brush condenser 44 is charged by battery 17. Thus it is seen how the tuning fork vibrations generate a current corresponding to the frequency of the fork to drive the rotary distributor motor 36 which in turn causes the character and synchronizing impulses to be conducted to the impulse amplifier E and transmitter F to be transmitted to the remote receiving station by a suitable line or radio network circuit.

Description and operation of receiving apparatus

At the receiving station the transmitted character and synchronizing impulses are received in the usual manner by the radio or line receiver unit G and impulse amplifier H (Fig. 1). The synchronizing impulses sent out by contact 42 of the distributor 15 are employed to drive the tuning fork J at the receiving station.

The current then generated by the said fork is conducted to amplifiers K and L to supply the motor windings with sufficient energy to rotate the connected distributor arm 19 in synchronism and in phase with rotary arm 13.

Referring to Figs 1 and 4, the receiver distributor is provided with a solid conducting ring 50 with its corresponding brush 51 on rotary arm 19 in constant engagement therewith. The receiving segments 23 are allocated on the distributor RD similarly to the segments 12 on distributor TD and adapted to be engaged by the brush 52. Additional contacts 53 and 54 are positioned on the distributor 90 degrees apart. The position of the synchronizing contact 54 corresponds similarly to the position of synchronizing contact 42 on distributor 15.

The three contacts 53, which are connected together will be termed phasing contacts and the synchronizing contacts 54 are adapted to be engaged by the brush 55 on the rotary arm 19. It is understood that the brushes 51, 52 and 55 are joined electrically similar to the brushes 39, 40 and 43 on the rotary arm of distributor 15.

The secondary winding of the output transformer 56 of the impulse amplifier H, which may be of any well known type, includes in its circuit the solid conducting ring 50 and the primary winding of the fork drive transformer 57 which in turn is connected to armature 59 of selector relay 60 by conductor 58.

The normally closed contact 61 of relay 60 is connected to the solid ring conductor so that when the relay 60 is de-energized all impulses received by the transformer 56 are impressed on the primary winding of transformer 57. The synchronizing contact 54 and the normally open contact 63 of relay 60 are electrically connected to conduct the synchronizing impulses to the transformer 57 when relay 60 is energized. The coil of relay 60 bridged by condenser 65 is included in the plate circuit of thermionic tube 66, the control grid of which is adapted to be energized by the synchronizing impulse from contact 54 through resistor R. The armature 67 of relay 60 is extended to a point intermediate the secondary of transformer 56 and primary of transformer 57 by conductor 68. The normally closed contact 70 associated with armature 67 is adapted to conduct impulses from the three phasing contacts 53 through coil of phasing relay 71 when the relay is deenergized, and upon its energization through its normally open contact 69

the solenoids 22 of the recording unit each associated with its respective contact 23 is electrically connected to the impulse amplifier transformer 56 through the relay armature 67. The normally closed contacts 72 of relay 71 are included in the circuit of the distributor motor windings 73 so as to be effective in controlling the motor phasing upon energization of relay 71 which will be described later.

The driving coils 74 associated with tuning fork 75 and similar to the driving coils 26 of transmitter fork 27 are energized by the secondary winding of the fork drive transformer 57 (see Figures 3 and 4).

The pick-up coils 76 of this impulse driven fork are adapted to energize the primary of transformer 77, the secondary of which controls the control grid of tube 78. The plate of tube 78 is coupled to the control grid of amplifier tube 79, the plate circuit of which is inductively coupled to tubes 80 arranged in a manner standard for class B amplifiers and similar to the amplifier circuit mentioned hereinbefore in reference to transmitting apparatus.

From the output of the amplifier tubes 80 the amplified fork oscillations are conducted to the power amplifier L which is a similar arrangement as described for the power amplifier C. From the output of the said amplifier L connection is made to the windings 73 of the synchronous motor adapted to rotate the connected distributor arm 19.

The tuning fork 75 is operated in the following manner: Let it be assumed that the frequency of the fork is 60 cycles and that the rotary brush 13 at the transmitter is rotated 1800 revolutions per minute, that is, 30 synchronizing impulses similar to the character impulses are generated and transmitted per second. The transmitted synchronizing impulses are received and amplified at the receiver in the usual manner, and let us assume that the rotary arm 19 is at rest on the synchronizing contact 54 so that the impulses are conducted from the impulse amplifier H output transformer 56 to the synchronizing contact 54. From the contact 54 the said impulses are conducted to the control grid of tube 66 thru the resistor R connected between grid and cathode of said tube which is normally biased near cut-off so that current then will pass to the coil of relay 60 in the plate circuit of the tube.

Energization of relay 60 closes the contact 63 to conduct the synchronizing impulses from contact 63 and armature 59 to the winding of transformer 57 to energize the driving coils 74 of tuning fork 75.

The fork starts to vibrate and causes an E. M. F. to be generated in its pick-up coils 76 and conducted thru transformer 77 to tubes 78, 79 and 80 to be amplified similarly as explained hereinbefore. It must be understood that the synchronizing impulses transmitted and received control the vibration and frequency of the fork at the receiver. The operation of the fork at such a frequency then generates a current of like frequency by means of the pick-up coils. These oscillations in the pick-up coils are amplified by the fork amplifier K and then are impressed on the input circuit of the power amplifier L, later to be conducted to the motor windings 73 to operate the motor in exact synchronism with the motor at the transmitting station.

Phasing system

In the following description the term "in phase" means that in the course of rotation the receiver brushes maintain such a position in respect to the transmitter brushes that perfect transmission of the character impulses is effected so that proper recording of the transmitted characters is obtained, that is, when the transmitter brushes and receiver brushes pass the corresponding commutator segments simultaneously. On account of possible phase lags in the system the brushes may be rotated synchronously, however, they may not always be in the proper phase relationship.

For example, the synchronous motors embodied in the invention may be 1800 R. P. M., four pole synchronous motors. Thus, when running at synchronous speed, the receiver brushes must maintain one of four angular positions in respect to the transmitter brushes, so that the brushes may be rotated in phase, on 90, 180, or 270 degrees out of phase. The method preferred for establishing the proper phase relationship between the brushes will be explained in connection with Figure 4.

The synchronizing impulses from the transmitter are received and amplified and conducted to output transformer 56. The receiving motor is at rest and the selector relay 60 and phasing relay 71 are in the normal position shown in the figure. The synchronizing impulses from the winding of transformer 56 then pass through the normally closed contacts 61 of selector relay 60 through the primary of transformer 57. The driving coils 74 are energized and cause the fork to start to vibrate and an E. M. F. to be generated in the pick-up coils 76. The oscillations in the pick-up coils are amplified by the fork amplifier and then impressed on the input circuit of the power amplifier as explained before. When the fork attains such an amplitude that the output voltage from the power amplifier is sufficient, the motor starts and pulls into synchronism. If the motor attains such a phase that the brushes pass one of the phasing studs 53 at the moment the synchronizing impulse arrives current will pass through the coil of the phasing relay 71, energizing it and momentarily open its contacts 72 in the motor circuit, causing the motor to slip one or more poles until it attains such a phase that the brush passes the synchronizing contact at the moments the synchronizing signals are received.

The impulses will then pass through the resistor R connected between the grid and cathode of tube 66 and which, as previously mentioned is biased near cut off, and then will pass current through the coil of selector relay 60 included in the plate circuit of said tube. Operation of relay 60 causes contacts 61 and 70 to open and contacts 63 and 69 to be closed. By opening contact 61 the direct connection from the output of the impulse amplifier to the fork drive transformer 57 is opened and connection is made to the synchronizing contact 54 through the closed contact 63 through conductor 58 to energize the driving coils 74 of the fork. In this manner it is seen that the synchronizing impulses transmitted control the frequency of the fork directly to maintain the inphase relationship of the rotary arms. Opening the direct connection from the output transformer 56 through contact 61 to the fork drive transformer 57 is necessary in order to separate the character impulses from the synchronizing impulses when the transmission begins. The circuit through the coil of the phasing relay 71 is also opened by the contact 70 of relay 60 and by closure of contact 69 the common lead

from the character solenoids 22 is connected to the negative side of the output transformer 56 of the impulse amplifier.

The condenser 65 bridged across the coil of relay 60 is charged by each synchronizing impulse and stores the charge so that a current flows continuously through the relay coil so long as synchronizing impulses are received, namely, so long as the brush arms are in phase. To indicate the inphase condition a contact 81 similar to contacts 23 can be positioned similar to the contact 54 so that the synchronizing impulse is also conducted through the neon lamp 82 or any similar indicating device.

The phasing system just explained can obviously be used when the motors are operated directly from an A. C. line and for other forms of systems than the one illustrated so that it is not limited by the specific structure shown for its explanation.

Summary

A brief summary of operation of the system will now be given, the tuning fork controlled by the vacuum tube 29 will start to vibrate when the correct voltage requirements are impressed on the tube, to generate a constant frequency alternating current for driving the transmitter motor. A synchronizing impulse, the characteristics of which are similar to the character impulses to be transmitted, is transmitted every revolution of the rotary brush arm. This impulse transmitted by line or radio upon its reception is amplified by the character impulse amplifier to energize the driving coils of the receiving station tuning fork causing this fork to start vibrating. The associated pick-up coils generate an alternating current the frequency of which is the same as the fork frequency, which is amplified and causes the receiving distributor motor to be driven in exact synchronism with the transmitting distributor motor.

If the rotation of the receiver motor is not in phase, the phasing relay 71 is operated to cause the motor to slip a pole or more until the brush arm rotates in exact phase with the transmitter brush arm. When this condition is attained selector relay 60 causes the fork to be operated directly from the synchronizing impulses as received from the synchronizing contact 54.

When a 60 cycle tuning fork is employed to be driven by the synchronizing impulses to operate the synchronous motor, the transmission of 30 impulses per second mentioned herein must not be maintained, the number of impulses may be varied according to the operating conditions since the fork as operated is an inherent frequency convertor.

When the inphase rotation is attained the operation of the selector relay also is effective to permit the solenoids 22 of the recorder to be connected for operation. Upon establishing this condition the character impulses transmitted become effective to operate the solenoids to record the transmitted characters since the operated selector relay now separates the character and synchronizing impulses.

It must be understood that the synchronizing or control impulses are identical in their characteristics to the character impulses transmitted in the system explained above, and that the character signals are single impulses for each character, in contradistinction to combinational code signals, and that these character signals are transmitting during predetermined timed intervals, the time of transmission therein representing the particular characters, and that the synchronizing control impulses are transmitted at predetermined periods during the said timed intervals.

While there has been shown and described and pointed out the fundamental novel features of the invention as applied to a single modification, it will be understood that various omissions and substitutions and changes in the form and details of the device illustrated and its operation may be made by those skilled in the art without departing from the spirit of the invention. It is the intention therefore to be limited only as indicated by the scope of the following claims.

What is claimed is:

1. In a communication system, means comprising printing telegraph transmitting and rotary distributor units adapted to transmit character signals comprising impulses of equal amplitude and duration, means to transmit single synchronizing impulses, the amplitude and duration of which are equal to that of the character impulses, the transmission of the last mentioned impulses occurring at predetermined intervals in each cycle, rotary receiving distributor means, means associated with last mentioned rotary means to be controlled directly by said synchronizing signals to generate a constant frequency alternating current, means energized by said generated current to rotate said rotary receiving means in synchronism with said transmitting means to properly receive said character impulses.

2. In a communication system, means adapted to transmit intelligence by impulses of equal amplitude and duration during a predetermined timed interval, the time of transmission therein representing the particular intelligence characters, means to transmit single synchronizing impulses at predetermined intervals during said timed intervals, the amplitude and duration of said impulses being equal to said intelligence impulses, means receptive to both mentioned impulses, rotary receiving means associated with the said receptive means and adapted to be operated directly by the synchronizing impulses to rotate said rotary means in accordance with the transmission of said synchronizing impulses thereby effecting proper reception of said intelligence impulses.

3. In a communication system, means adapted to transmit character impulses of equal amplitude and duration during predetermined timed intervals, the time of transmission therein representing the particular characters, means to transmit single control impulses at predetermined periods during said timed intervals, the amplitude and duration of said impulses being equal to said character impulses, means to receive and amplify said transmitted impulses, character recording means responsive to said character impulses, and rotary means driven directly by said control impulses to control the effect of said character impulses on said recording means.

4. In a communication system, means adapted to transmit character impulses of equal amplitude and duration during predetermined timed intervals, the time of transmission therein representing the particular characters, means to transmit single control impulses at predetermined periods during said timed intervals, the amplitude and duration of said impulses being equal to said character impulses, means to receive and amplify said transmitted impulses, character recording means responsive to said character impulses, means responsive at predetermined pe-

riods to separate said character impulses from said control impulses, and rotary means driven directly by said control impulses to control the effect of said character impulses on said recording means.

5. In a communication system, means for transmitting character impulses of equal amplitude and duration during predetermined timed intervals, the time of transmission therein representing the particular characters, means to transmit single control impulses, the amplitude and duration of which being equal to said character impulses, means including rotary means adapted to receive said impulses, means to operate said rotary means, said means adapted to be driven directly by said control impulses to control the effect of said character impulses received.

6. In a communicating system, means including rotary distributing means to transmit character impulses of equal amplitude and duration during predetermined intervals, the time of transmission therein representing the particular characters, means to rotate said distributing means, means to transmit single control impulses at predetermined periods during said timed intervals, the amplitude and duration of which being equal to said character impulses, means responsive to said character impulses, means responsive to said control impulses, rotary receiving distributor means to control said transmitted impulses, and means to drive the last mentioned rotary means directly by the control impulses to control the means responsive to said character impulses.

7. In a communication system, means including rotary distributing means to transmit character impulses of equal amplitude and duration during predetermined timed intervals, the time of transmission therein representing the particular characters, means to transmit single control impulses at predetermined periods during said timed intervals, the amplitude and duration of which being equal to said character impulses, a predetermined number of said control impulses transmitted during a predetermined period of time, means responsive to said character impulses, means responsive to said control impulses, rotary distributing means adapted to control the effects of said impulses on the respective impulse responsive means, means to operate the last named rotary means and adapted to operate at a predetermined frequency, said frequency greater than the number of control impulses transmitted during said period of time, and means included in said means responsive to said control impulses adapted to drive the said rotary operating means to operate in phase with the first mentioned rotary means to effect correct operation of said means responsive to the character impulses.

8. In a communication system, means including rotary means to transmit timed aperiodic character signals comprising impulses of equal amplitude and duration and periodic and single control impulses, the amplitude and duration of which are equal to that of the character impulses; receive said impulses, said rotary means adapted to be maintained in substantial synchronism with the transmitting rotary means by the control impulses, character recording means associated with said receiving means responsive to the aperiodic character impulses, and means to render the recording means unresponsive to either the character or control impulses when the said rotary means operate non-synchronously.

9. In a communication system, rotary means to transmit single control signals during a predetermined timed interval, means including rotary operating means to receive said control signals, the said rotary means adapted to be driven synchronously by said signals but at a predetermined phase angular displacement with respect to each other, and means whereby the control signals are received at any particular time during the said timed interval to effect proper phasing of the second mentioned rotary means so that the phase angle displacement is nil.

10. In a communication system, means including rotary operating means to transmit timed aperiodic character signals and single periodic control signals the amplitude and duration of which are all equal, means including rotary operating means to receive the said signals, means to automatically separate the character signals and control signals, recording means associated with said receiving means operated by the character signals, and means to drive the said receiving rotary means directly by the control signals to maintain substantial synchronous operation of the said rotary means.

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