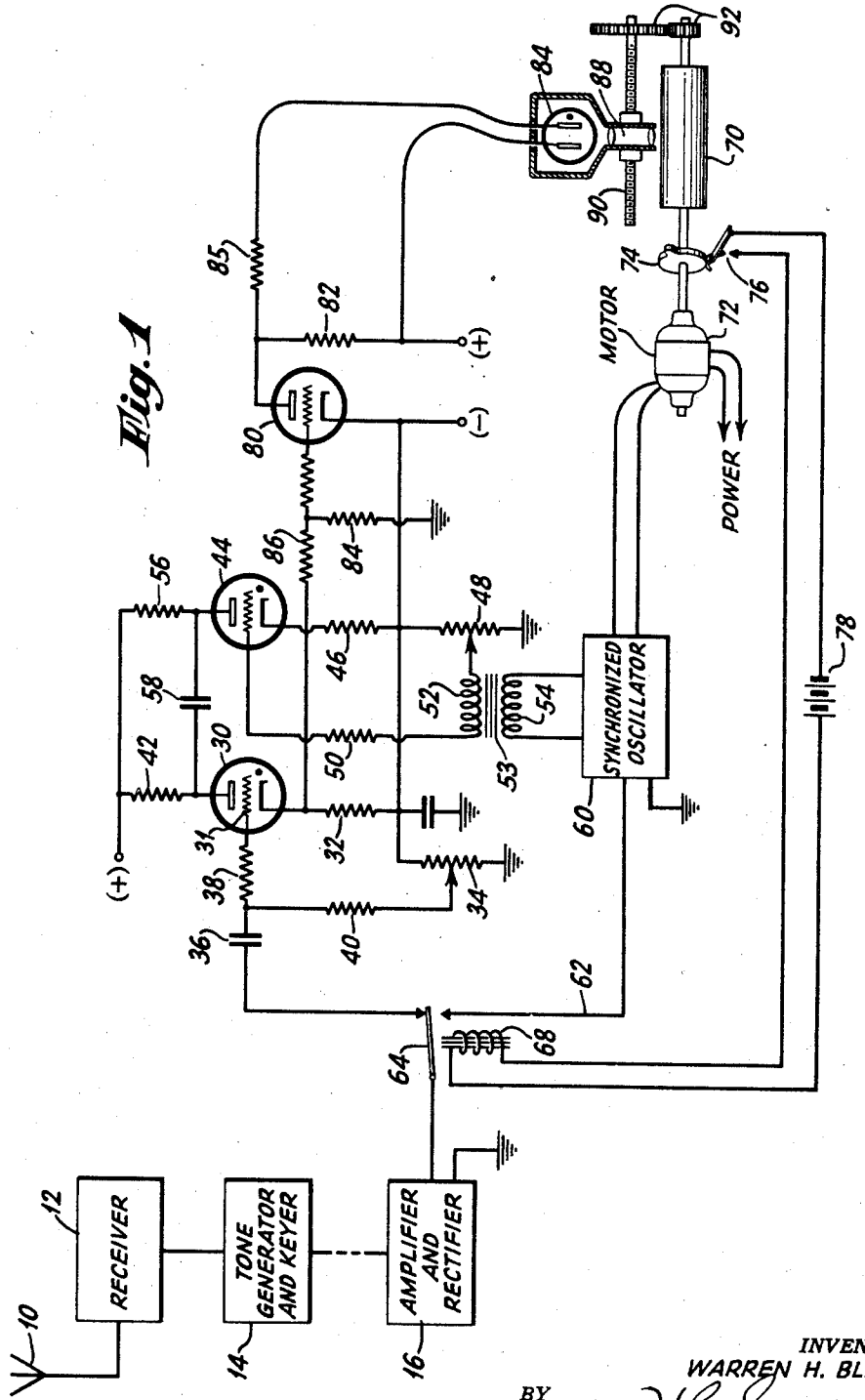
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FACSIMILE SYSTEM

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Fig. 1



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FACSIMILE SYSTEM

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Fig. 2

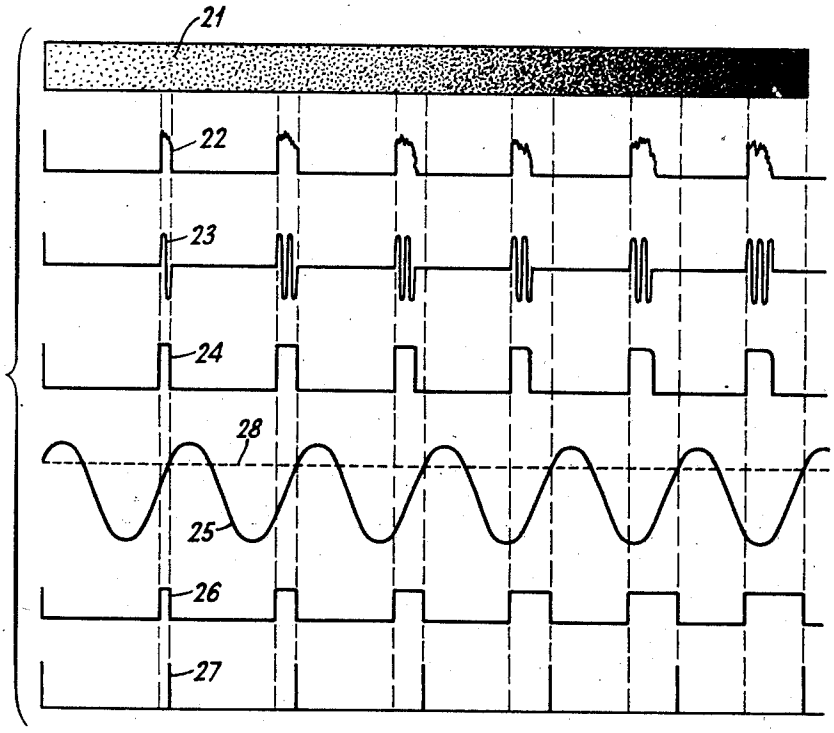
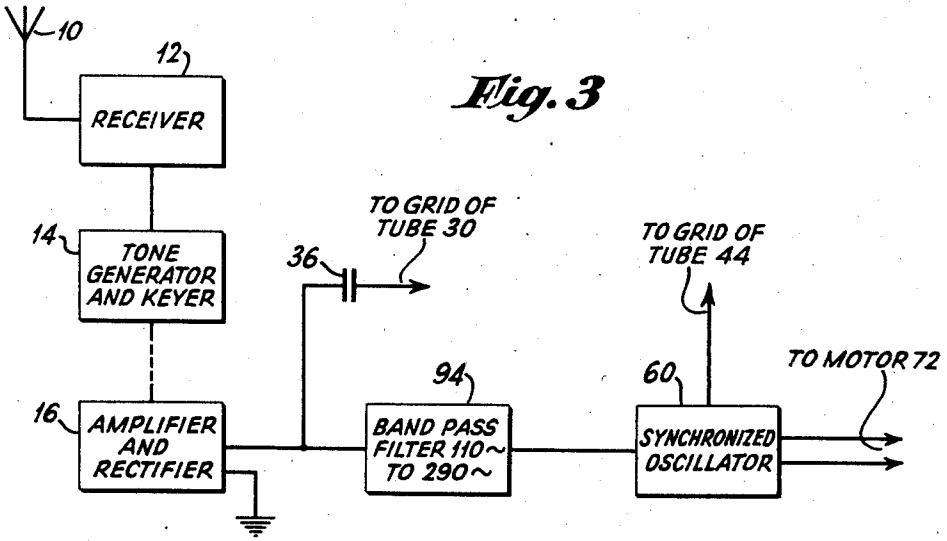


Fig. 3



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FACSIMILE SYSTEM

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Application August 30, 1940, Serial No. 354,829

11 Claims. (Cl. 178—6.7)

This invention relates to facsimile and photo-radio systems wherein signals are transmitted from one location to another, the signals being used to produce facsimile reproductions of the subject matter being scanned at the transmitter. More specifically, the present invention relates to a photo-radio receiver for receiving phase modulated or phase displaced impulses and converting the received impulses into voltage variations of a constant frequency but of a variable length.

In previously used facsimile and photo-radio systems, the commonly known constant frequency variable dot system has been used in which the picture signals as derived from the facsimile scanner are used to key a transmitter at a predetermined and constant frequency in order to send out signal impulses, the lengths of the individual impulses being controlled in accordance with the strength of the signals derived from the scanner. These voltage variations of a constant frequency and of a variable length are then used to key a transmission frequency in order that the keyed signals may be received at a remotely located receiver. The received signals, therefore, vary in length and occur at a predetermined fixed frequency, the length of the impulses being indicative of the light value of the subject being scanned, and these voltage variations are then used to control the amount of ink supplied to the printing drum or the amount of pressure applied on the printing bar of a facsimile receiver in order to reproduce the particular image being scanned at the transmitter.

Systems in which constant frequency variable dot transmission is used, for certain inherent objections, frequently prevent the production of images with the desired clarity and fidelity. Normally, the carrier frequency chosen for such work is relatively high, and, if the signals arrive at the receiver over two or more paths which are different in length, then the received signals will not have the desired length and the image frequencies as received will cause considerable distortion at the receiver so that good high fidelity pictures cannot be reproduced. Furthermore, atmospheric disturbances frequently cause false indications at the receiver or cause the length of the key carrier to be shortened or increased so as to materially impair the fidelity of the reproduced picture.

For these reasons systems known in the art have been developed for sending out the key impulses in phase displacement, the degree of phase displacement being determined by the light intensity of the picture scanned. In the constant frequency variable dot system, the intelligence of the received signals resides in the length of the dot or the length of each successive impulse, whereas in the phase displacement system the impulses arrive at a predetermined fixed frequency, but their phase relationship of arrival as compared to the fixed frequency is varied in accordance with the light values of the picture, and accordingly, the intelligence of the received signals is contained in the degree of phase displacement.

Such systems are particularly desirable since the length of the various keyed impulses is not controlling at the receiver, and accordingly, if two or more paths are traversed by the transmitted wave, then the receiver is unaffected by impulses arriving after the first impulse, and furthermore, atmospheric disturbances do not affect the receiver since changes in the lengths of the keyed impulses have no effect on the receiver. The receiver responds only to the phase displacement of the impulses as compared to a fixed standard, and such phase displacement as determined by the light value of the scanned picture is unaffected by multiple path reception or atmospheric disturbances.

The present invention relates to a receiving system for receiving impulses which are phase displaced in accordance with the subject matter transmitted, and for converting the impulses as received into impulses of a constant frequency and variable length, or constant frequency variable dot. These converted constant frequency variable dot impulses are then used at the printer for reproducing the picture.

It is therefore one purpose of the present invention to provide a facsimile or photo-radio receiver for converting phase displaced impulses of a constant frequency into voltage variations of a constant frequency and variable length.

Another advantage of the present invention resides in the provision of means for synchronizing the receivers with the transmitter.

Still another advantage of the present invention resides in the production of a facsimile or photo-radio receiver which is maintained in synchronism with the transmitter through the use of a series of synchronizing impulses sent at a frequency of substantially double the frequency of the impulse transmission.

A further purpose of the present invention resides in the production of a facsimile or photo-radio receiver in which phase displaced impulses of a predetermined frequency may be converted into voltage variations of a predetermined fre-

quency and of a variable length, the system being responsive only to the phase displacement of the received impulses as compared to a standard and fixed frequency.

Various other advantages and purposes of the present invention will become more apparent to those skilled in the art from a reading of the specification and claims, particularly when considered with the drawings, wherein:

Figure 1 shows one form of the present invention;

Figure 2 shows a series of curves indicating wave form, phase displacement and impulse length at various points in the receiver system, and

Figure 3 shows a modified form of the present invention.

In Figure 1 is shown an antenna 10 for receiving the phase displaced impulses from a transmitting system. Attached to the antenna is a receiver 12 which may include one or more stages of amplification, and a demodulator. The type of receiver used is not important, since either a tuned radio frequency or superheterodyne circuit may be used. The output from the receiver is supplied to a tone generator and keyer 14 wherein a tone frequency of several thousand cycles per second is generated, the tone frequency being keyed in accordance with the demodulated signal output of the receiver 12. The output of the keyer 14 is supplied to an amplifier and rectifier 16 which again may be of any desired design. The amplifier at 16 is included in the figure inasmuch as the spacing between the tone generator and keyer 14 and the amplifier and rectifier 16 may be some considerable distance, since it is often desirable to actually receive the signals at one point and to produce the facsimile or photo-radio images at another point. If the keyer 14 and the rectifier 16 are located in relatively close proximity, then the addition of the amplifier after the keyer and before the rectifier is not necessary.

In order to clearly describe the operation of the present invention, various curves indicating voltage variations are shown in Figure 2. Referring to this figure, a light wedge 21 is shown, which varies in light value from white to black. The curves of the figure are associated with the light wedge and the variation in impulse phase displacement or length in the various parts of the system is indicated in the drawings so that these variations may be compared with the corresponding light value of the light wedge. The curve 22 shows a series of impulses of constant frequency which are displaced in phase relationship so far as their beginning is concerned with respect to a standard frequency shown at 27 in the figure. When the light value of the image is high, then the phase displacement, as indicated by Figure 2, is at a minimum, whereas when the light value of the picture is dark, or low, then the phase displacement of the transmitted impulses is at a maximum. Actually these impulses are keyed impulses of a high frequency carrier, the high frequency carrier not being shown in the figure. These impulses may not continue throughout their allotted time in accordance with the light values of the image by reason of atmospheric conditions, or, as a matter of fact, the impulses may be increased in length for the same reason. Because of the design of the present invention, the termination of the impulses shown at 22 is not indicative, and only the phase displacement between these impulses as compared to the fixed frequency 27 are controlling as will be shown later. The impulses 22 are, of course, received by the receiver 12, and, after demodulation, are used to key the tone generator 14 so that a series of impulses of tone frequency will be produced by the tone generator and keyer, this series of impulses being indicated at 23 in Figure 2. The tone frequency is materially less than the carrier frequency used in the actual transmission. In view of the design of the tone generator and keyer, the tone oscillations 23 are of constant frequency and amplitude but vary in phase displacement in accordance with the received signals and the length of the tone impulses 23, although not controlling in the receiver, are in fact determined by the length of time that the received impulses 22 persist due to multipath transmission.

These keyed tone impulses are then supplied to the amplifier and rectifier 16 to produce at the output thereof a series of impulses 24 which are also phase displaced with respect to the fixed frequency 27 and which vary in length in accordance with the length of the keyed tone impulses as supplied by the keyer 14. The displacement of the beginning of the impulses 24 from the fixed frequency 27 is an indication of the subject matter transmitted. The impulses 24 do not generally terminate in phase with the fixed frequency 27; however, this is not vital since the receiver responds to the phase displacement.

The rectified output of the amplifier and rectifier 16 of Figure 1 as shown by the curve 24 in Figure 2 is supplied to the control electrode 31 of a gas-filled discharge tube 30. The discharge tube may be of the type 885 tube and includes a cathode, a control electrode and an anode. This tube is rendered conductive by the application of a positive impulse to the control electrode, but in view of the fact that the tube is gas-filled, conduction will continue even though the control electrode is made negative and the tube can be rendered non-conductive by removal or suppression of the anode potential below a potential sufficient to maintain a discharge from the cathode to the anode. The cathode of the discharge tube 30 is connected to ground by way of cathode load resistances 32 and 34, the latter of which is preferably made in the form of a potentiometer. Coupling between the rectifier 16 and the gas-filled discharge tube 30 is by way of the coupling condenser 36, and a relatively large resistance 38 is included in series with the control electrode of tube 30 in order to limit the current in this electrode to a safe value. The control electrode 31 is connected to a point along the potentiometer 34 by resistance 40. The anode of the gas-filled tube 30 is maintained positive by a connection to a positive source of potential through the anode resistance 42.

Another gas-filled discharge tube 44 is also used which is similar to the tube 30 and which also includes a cathode, a control electrode and an anode. The cathode of tube 44 is connected to ground through cathode load resistances 46 and 48, the latter of which is preferably made in the form of a potentiometer. The control electrode of the gas-filled tube 44 is connected to a point along the potentiometer 48 by a grid resistance 50 and the primary winding 52 of the transformer 53. The anode is maintained positive with respect to the cathode by a source of positive potential, the source being connected to the anode through an anode resistor 56. The

two anodes of the gas-filled discharge tubes 30 and 44 are inter-connected by a condenser 58.

A synchronous oscillator 60 is provided which generates voltage variations of substantially sinusoidal wave form and of a frequency equal to the frequency used in transmitting the phase displaced signal impulses. The oscillator 60 is synchronized by means of the impulses received from the transmitter, these impulses being supplied to the oscillator 60 by way of conductor 62 when the movable armature 64, which is associated with the electromagnet 68, is in its lower position. At the transmitting apparatus, the subject matter to be transmitted by facsimile or photo-radio is scanned in the usual manner employing a rotary drum and a scanning head, and between each scanned line impulses are transmitted corresponding to black or white, and these impulses between each scanned line are used for synchronizing purposes. At the receiving apparatus a rotating drum 70 is used to which is connected a motor 72 for rotating the drum. Mounted on the shaft of the drum is a cam wheel 74 cooperating with which are a pair of contacts 76. For each revolution of the drum the contacts are closed for a relatively short space of time, and through the energy supplied by the battery 78 the coil 66 of the electromagnet is energized to move the armature 64 from the upper to the lower position, thus directing the rectified impulses from the rectifier 16 to the oscillator 60.

The motor 72 may be supplied with energy from a power line and may also be supplied with the oscillations from the oscillator 60 in order to maintain the proper synchronous operation of the motor. Once the rotating drum 70 has been properly phased with respect to the transmitter, such synchronous operation of the proper phase relationship is maintained by reason of the connection of the motor 72 to the oscillator 60. Furthermore, the oscillator is maintained in proper synchronous operation with the transmitter by supplying to the oscillator a series of synchronizing impulses between each scanned line each time the relay winding 68 is energized. When the relay winding 68 is deenergized, the rectifying energy from the rectifier 16 is supplied to the control electrode 31 of the gas discharge tube 30.

As stated above, the synchronous oscillator 60 supplies voltage variations of substantially sinusoidal wave form as indicated in the curve 25 in Figure 2 and these voltage variations are applied to the primary winding 54 of the transformer 53. These voltage variations are accordingly impressed upon the control electrode of the gas discharge tube 44.

Associated with the curve 25 in Figure 2 is a dotted line 28 which indicates the potential at which the gas discharge tube 44 is rendered conducting. When the voltage variations exceed a voltage value represented by the dotted line 28, then the tube 44 is permitted to conduct and such conduction will continue until the difference of potential between the anode and the cathode of the tube is materially reduced even though the potential of the control electrode may actually subsequently be reduced due to the variation of the voltage as shown at 25 in Figure 2.

The voltage variation of sinusoidal wave form as indicated at 25 in Figure 2, as stated above, is produced by the oscillator 60 in response to the synchronizing signals received from the transmitter. These synchronizing signals bear a fixed phase relationship to the constant frequency impulses represented at 27, and may, in fact, correspond to white portions of a picture or to black portions or any other predetermined desired constant phase relationship. These synchronizing signals in controlling the oscillator 60, produce voltage variations of sinusoidal wave form bearing a phase relationship to the standard frequency 27 such that the change in voltage from negative to positive crosses the cut-off line 28 of tube 44 in phase with the fixed frequency 27 as indicated in Figure 2.

Normally, the discharge tube 44 is conducting and such conduction continues until a rectified impulse is supplied to the control electrode 31 of tube 30 from the rectifier 16. The front of this impulse from the rectifier 16 is phase displaced from the standard frequency 27 by an amount depending upon the light value of the picture being scanned at that particular instant. The leading edge of the impulse drives the control electrode 31 positive to cause the tube 30 to become conducting, and, in view of the accompanying potential drop at the anode of tube 30, causes a substantial and sudden decrease in the potential betwen the cathode and anode of gas discharge tube 44 because of the presence of condenser 58. Tube 44 is therefore rendered nonconductive and this non-conductive condition continues until the voltage applied to the control electrode of tube 44 reaches a value corresponding to the potential represented by the dotted line 28. At this time tube 44 is rendered conductive, and conversely, tube 30 is rendered nonconductive. The two tubes 30 and 44, therefore, operate alternately, and tube 30 is conductive for a time period represented by the phase displacement of the received impulses rectified by the rectifier 16 (as represented at 24 in Figure 2) as compared to the fixed frequency standard represented at 27 in Figure 2. Tube 30 will remain conductive until tube 44 is made conductive by the voltage variation 25 as supplied by the oscillator 60, even though the rectified impulse 24, as supplied to the control electrode of tube 30, ceases to be present.

During the time when tube 30 is rendered conductive, a predetermined voltage drop is present across the cathode resistor 32. This voltage variation is represented at 26 in Figure 2, and it will be noticed that the frequency of occurrence of these voltage variations is constant and corresponds to the transmission frequency, but that the impulses are of varying length, depending upon the phase displacement of the transmitted impulses. Therefore, the voltage variations which are derived from the resistance 32, are in fact voltage variations of constant frequency and of a variable length, depending upon the light intensity of the transmitted subject matter. The portion of the invention as thus far described operates to convert constant frequency phase displaced impulses into constant frequency variable dot impulses.

The voltage variations appearing across the resistance 32 are applied to the control electrode of an amplifier tube 80 having a cathode, a control electrode and an anode. The cathode is connected to the negative terminal of a source of potential, and the anode is connected to the positive terminal of a source of potential through a load resistance 82. Furthermore, the control electrode is connected to ground by way of resistance 84, and the cathode end of resistance 32 is connected to the control electrode of tube 80 by way of resistance 86. Across the resistance

82 appears a voltage variation similar in wave form to the voltage variations shown at 26 in Figure 2 but of increased amplitude and of an amplitude sufficient to cause the operation of the glow discharge tube 84. The glow discharge tube 84 is connected across the resistance 82 in series with a resistance 85. The glow discharge tube 84 as well as its associated optical system 86 are moved axially along the recording frame by means of a worm drive mechanism 90 which is mechanically connected to the recording drum 70 by way of gears 92. The gear ratio of the gears 92 as well as the pitch of the worm drive 90 depend upon the number of lines scanned per inch of subject matter.

From the above, therefore, it may be seen that there has been provided a very simple arrangement for converting phase displaced voltage variations into voltage variations of a constant frequency variable length, the latter voltage variations being used as the recording means for reproducing the scanned image. The disadvantages of using constant frequency phase displaced impulses in the transmission from the transmitter to the receiver have been outlined above, and from the above explanation of the applicant's receiver system, it may be readily appreciated that transmission over multiple paths or in atmospheric disturbances will not affect the fidelity of the picture reproduced at the receiver, since the length of the converted impulses depends solely upon the phase displacement of the received impulses and the receiving system is not responsive to any trailing or suppressing of the transmitted impulses or to any atmospheric disturbances but only to the degree of phase displacement of the transmitted signals.

A modification of the present invention is shown in Figure 3, in which a different type of synchronizing apparatus is used. If the device disclosed in Figure 1 is to be operated at a relatively rapid rate, then some difficulty may be experienced in producing a relay which will respond at a sufficiently rapid rate to transfer the rectified synchronizing and picture impulses from the rectifier 16 to the synchronized oscillator 60 and to the control electrode of gas discharge tube 30. In Figure 3 this element has been omitted, and the apparatus shown in Figure 3 is intended to be used with a transmitter wherein the synchronizing impulses are sent to the receiver at a rate double the frequency used in transmitting the phase displaced impulses. If the phase displaced impulses are sent at a frequency of 100 cycles per second, for example, then the synchronizing impulses between each scanned line would be transmitted at a constant phase relationship and at a frequency of 200 cycles per second. In this case, the rectified output from the rectifier 16 is supplied directly to the control electrode 31 of gas discharge tube 30 and the rectified output is also supplied to a band pass filter 94 which is designed to pass all frequencies between substantially 110 cycles and 290 cycles per second. It is not desired that the band pass filter pass frequencies of the order of 100 cycles per second if this is the frequency used for transmission of the picture signals, and furthermore, it is not desired that the band pass filter pass 300 cycles per second since the third harmonic of the picture frequency would then be transmitted to the synchronized oscillator. Since the synchronizing impulses of a frequency of 200 cycles per second, for example, are transmitted only between successive line scannings, then, during the transmission of such synchronizing signals the band pass filter will supply the synchronizing signals to the oscillator 60 which in turn supplies the controlling impulses to the motor 72 in order to maintain proper synchronous operation of the motor and also supply voltage variations to the control electrode of tube 44.

As stated above, these voltage variations for controlling the tube 44 may be of sinusoidal wave form as shown at 25 in Figure 2, but as a matter of fact any desired wave form may be used so long as its phase relationship with respect to the fixed standard frequency 27 is such that the tube 44 is caused to become conductive in phase with the standard frequency 27.

The gas discharge tubes 30 and 44, as well as the remainder of the system and the recording drum are not shown in Figure 3, since they are identical to the elements shown in Figure 1. By using the circuits shown in Figure 3 it is possible to eliminate the use of the relay winding 68 and the vibrating armature 64 so that relatively high frequencies and transmission rates may be used.

Although in describing Figure 3 a transmission frequency of 100 cycles per second is suggested, it is to be understood that other frequencies above or below 100 cycles per second could as well be used.

Either the circuit shown in Figure 1 or the circuit shown in Figure 3 may be used with the oscillator where the signal impulses are transmitted in phase displacement with respect to a fixed standard frequency, the degree of displacement being determined in accordance with the light values of the subject matter being scanned. Furthermore, both systems will convert the constant frequency variable phase impulses into constant frequency variable length impulses which may be used on a recording drum and both systems will maintain the recording drum in proper synchronous operation with the transmitter. It is possible to design oscillators which are sufficiently stable in operation to maintain the desired synchronous operation during the time required for the scanning of one line, and it has been found that synchronizing the oscillator during the interval between each line scanned is entirely sufficient.

Various alterations and modifications may be made in the present invention without departing from the spirit and scope thereof, and it is desired that any and all such modifications be considered within the purview of the present invention except as limited by the hereinafter appended claims.

I claim:

1. A receiving system wherein is received a carrier modulated by signalling impulses at a predetermined frequency, said impulses being displaced in phase relationship with respect to their frequency of occurrence in accordance with the intelligence to be transmitted, including means to demodulate the received carrier to produce a series of impulses of the predetermined frequency, the beginning of each impulse being phase displaced with respect to a fixed reference frequency in accordance with the phase displacement of the received impulses, means for generating a fixed reference frequency, and means responsive to the phase displacement of the produced impulses with respect to the generated fixed reference frequency for producing control impulses of a constant frequency and of a variable length,

the length of the control impulses being determined by the degree of phase displacement.

2. A facsimile recording receiving system wherein is received a carrier modulated by signalling impulses at a predetermined frequency, said impulses being displaced in phase relationship with respect to a fixed reference frequency in accordance with the intelligence to be transmitted, including means to demodulate the received carrier to produce a series of control impulses occurring at the predetermined frequency, the beginning of each impulse being phase displaced with respect to a fixed reference frequency in accordance with the phase displacement of the received impulses, means for generating a fixed reference frequency, means responsive to the phase displacement of the control impu'ses with respect to the generated fixed frequency for producing recording impulses of a substantially constant frequency and amplitude but of a variable length, the length of the recording impulses being determined by the degree of phase displacement, and means responsive to the constant frequency variable length recording impulses to produce a recording.

3. A receiving system wherein is received a carrier modulated by signalling impulses occurring at a predetermined frequency, said impulses being phase displaced with respect to their frequency of occurrence in accordance with the intelligence to be transmitted, including means to demodulate the received carrier to produce a series of impulses of the predetermined frequency, the beginning of each impulse being phase displaced with respect to a fixed reference frequency in accordance with the phase displacement of the received impulses, means for generating a fixed reference frequency, and means responsive to the phase displacement of the beginning of each produced impulse with respect to the fixed reference frequency for producing control impulses of a substantially constant frequency and amplitude but of a variable time duration, the time duration of the control impulses being determined by the degree of phase displacement with respect to the fixed reference frequency.

4. A facsimile receiving system wherein a carrier is received, the carrier being modulated at intervals of a constant frequency and at a substantially constant amplitude, the phase displacement of the modulation intervals being variable in accordance with the subject matter transmitted with respect to a fixed reference frequency, including means to demodulate the carrier to produce a series of impulses of substantially uniform intensity and of substantially constant frequency but having a phase displacement with respect to a fixed reference frequency in accordance with the received modulation intervals and the subject matter transmitted, means at the receiver to generate a fixed reference frequency, and means to compare the phase relationship of the produced series of impulses and the generated fixed reference frequency to produce control impulses of constant frequency and amplitude but of a length depending upon the phase disp'acement of the produced series of impulses with respect to the fixed reference frequency.

5. A receiving system wherein a carrier is received, the carrier being modulated at intervals of a constant frequency and at a substantially constant amplitude, the phase displacement of the beginning of each of the modulation intervals being variable with respect to a fixed reference frequency in accordance with the subject matter transmitted, including means to demodulate the carrier to produce a series of signal impulses of substantially uniform intensity and of substantially constant frequency with the beginning of each signal impulse phase displaced with respect to a fixed reference frequency in accordance with the received modulation intervals, means at the receiver to generate a fixed reference frequency, and means responsive to the phase displacement of the produced signal impulses with respect to the generated fixed reference frequency to produce impulses of constant frequency and amplitude but of a time duration depending upon the degree of phase displacement.

6. A facsimile receiving system wherein a carrier is received, the carrier being modulated at intervals of a constant frequency and at a substantially constant amplitude, the phase displacement of the modulation intervals being variable in accordance with the subject matter transmitted including means to demodulate the carrier to produce a series of signal impulses of substantially uniform intensity and of substantially constant frequency, said produced series of impulses having a phase displacement with respect to a fixed reference frequency in accordance with the subject matter transmitted as determined by the received modulation intervals, means at the receiver to generate a fixed reference frequency, means to compare the phase relationship of the produced series of signal impulses and the generated fixed reference frequency to produce control impulses of constant frequency and amplitude but having a length depending upon the degree of phase displacement of the signal impulses with respect to the fixed reference frequency, and means responsive to the produced control impulses.

7. A facsimile receiver wherein phase modulated impulses of a predetermined substantially constant frequency are received including means for generating a fixed reference frequency corresponding to the frequency of the received impulses, and means including an electronic discharge device responsive to the phase displacement of the received impulses with respect to the generated fixed reference frequency for producing a series of impulses of substantially constant amplitude and of the same frequency as the received impulses but of a duration depending upon the phase displacement of the received impulses.

8. A facsimile receiver wherein phase modulated impulses of a predetermined frequency are received including means for generating a fixed reference frequency corresponding to the frequency of the received impulses, means responsive to the phase displacement of the received impulses with respect to the generated fixed reference frequency for producing a series of impulses of substantially constant amplitude and of the same frequency but of a duration depending upon the phase displacement of the phase modulated received impulses, said means including a pair of electronic discharge tubes, and means for rendering the tubes alternately conductive, one of said discharge tubes responding to the received phase modulated impulses and the other of said discharge tubes responding to the generated fixed reference frequency.

9. A facsimile receiver wherein are received phase displaced impulses of a predetermined frequency in accordance with the intelligence to be

transmitted including means for generating a fixed reference frequency corresponding to a multiple of the frequency of the received impulses, and means responsive to the phase displacement of the received impulses with respect to the fixed reference frequency for producing a series of impulses of substantially constant amplitude and of the same frequency but of a length depending upon the degree of phase displacement of the received impulses, said means including a pair of alternately conducting discharge paths, one of said discharge paths responding to the beginning received phase displaced impulses and the other of said discharge paths responding to the generated fixed reference frequency.

10. A facsimile receiving system wherein a modulated carrier is received, the carrier being modulated by a series of impulses occurring at a predetermined frequency, the modulating impulses being phase displaced with respect to a fixed reference frequency by an amount depending upon the subject matter to be transmitted, means to demodulate the carrier frequency to produce a series of signal impulses of the predetermined frequency, the beginning of each impulse being phase displaced with respect to a fixed reference frequency in accordance with the received phase displaced impulses, means to generate a fixed reference frequency corresponding to the frequency of the produced signal impulses, and means responsive to the phase displacement of the produced signal impulses with respect to the generated fixed reference frequency for producing a series of impulses of similar frequency and of substantially constant amplitude but of a duration depending upon the degree of phase displacement.

11. A facsimile receiving system wherein a modulated carrier is received, the carrier being modulated by a series of impulses occurring at a predetermined frequency, the modulating impulses being phase displaced with respect to a fixed reference frequency by an amount depending upon the subject matter to be transmitted, means to demodulate the carrier frequency to produce a series of signal impulses of the predetermined frequency, the beginning of each impulse being phase displaced with respect to a fixed reference frequency in accordance with the phase displacement of the received impulses, means to generate a fixed reference frequency corresponding to the frequency of the produced signal impulses, means responsive to the phase displacement of the produced signal impulses with respect to the generated fixed reference frequency for producing a series of impulses of similar frequency and of substantially constant amplitude but of a length depending upon the degree of phase displacement, said means including a pair of electronic discharge paths which are rendered alternately conductive, one of said discharge paths responding to the beginning of each produced impulse and the other of said discharge paths responding to the generated fixed reference frequency, and means responsive to the produced constant frequency variable length impulses for producing a facsimile recording.

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