

Oct. 8, 1940.

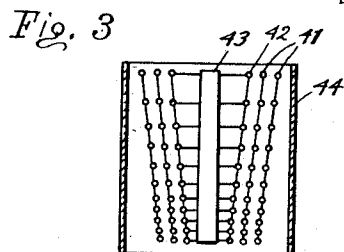
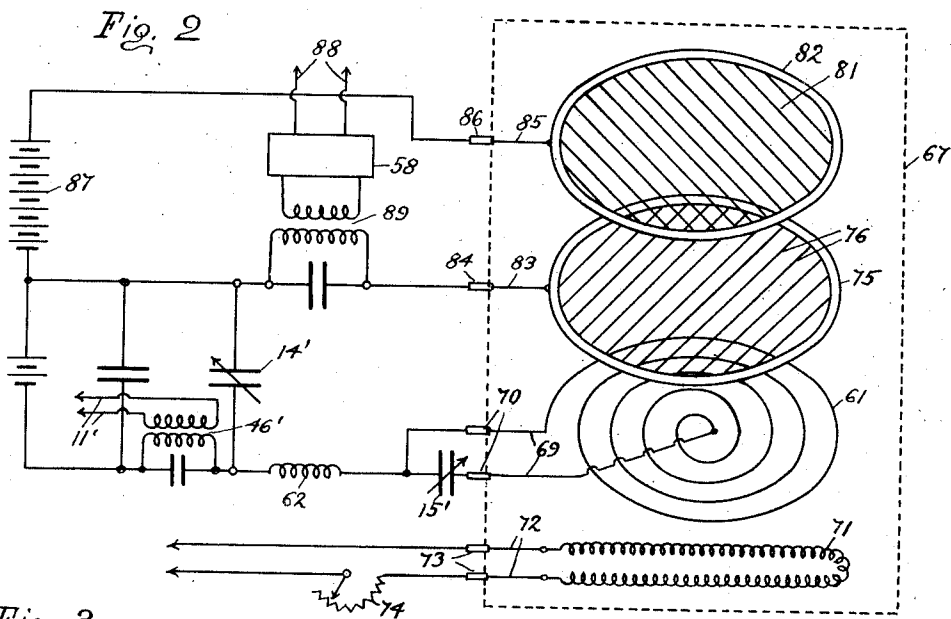
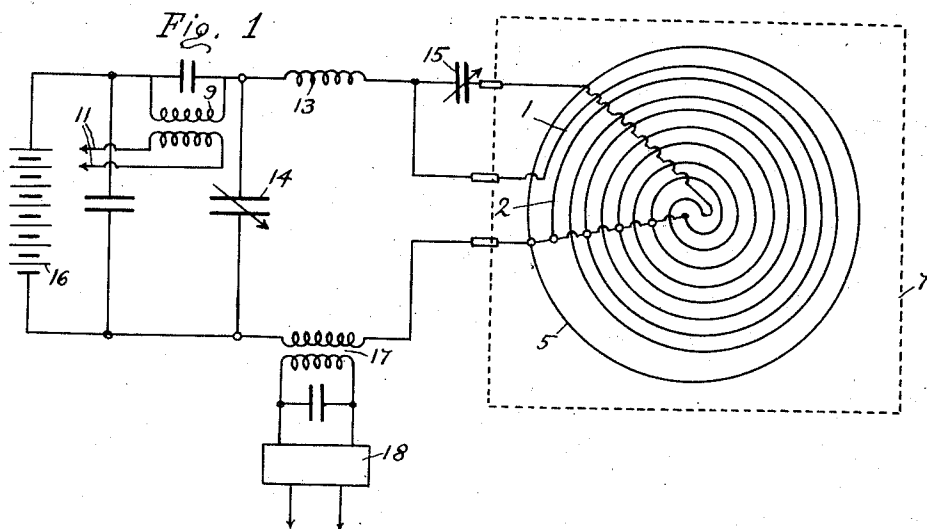
G. WALD

2,217,326

PICTURE TRANSMITTER

Filed March 15, 1937

3 Sheets-Sheet 1



GEORGE WALD

INVENTOR

BY *John P. Nironow*
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Oct. 8, 1940.

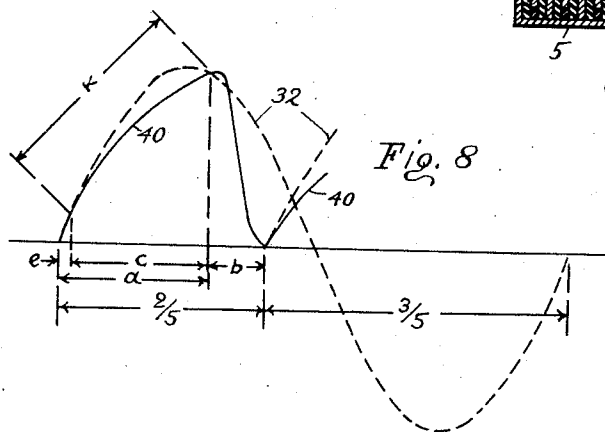
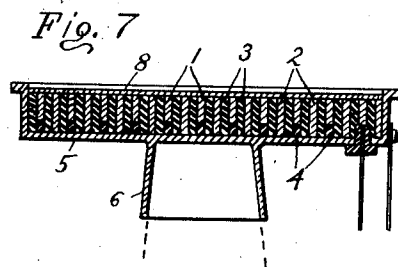
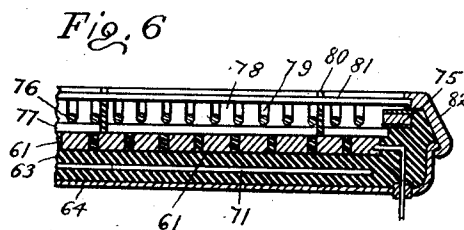
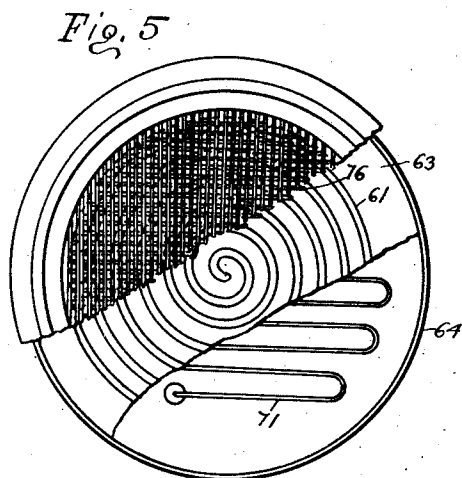
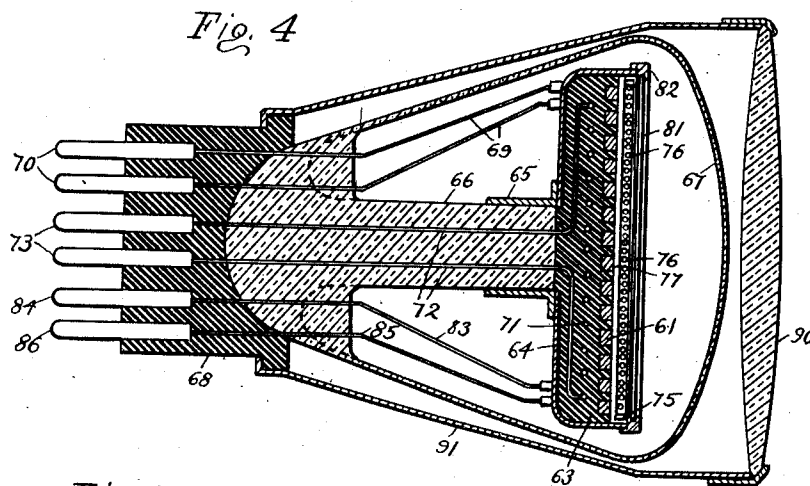
G. WALD

2,217,326

PICTURE TRANSMITTER

Filed March 15, 1937

3 Sheets-Sheet 2



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2,217,326

PICTURE TRANSMITTER

Filed March 15, 1937

3 Sheets-Sheet 3

Fig. 9

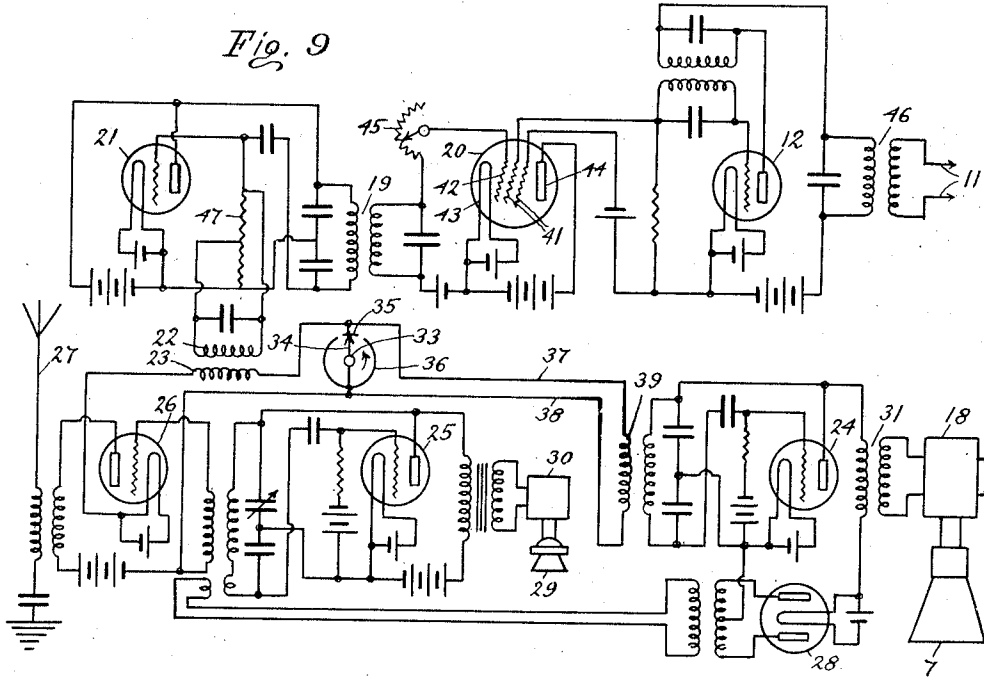
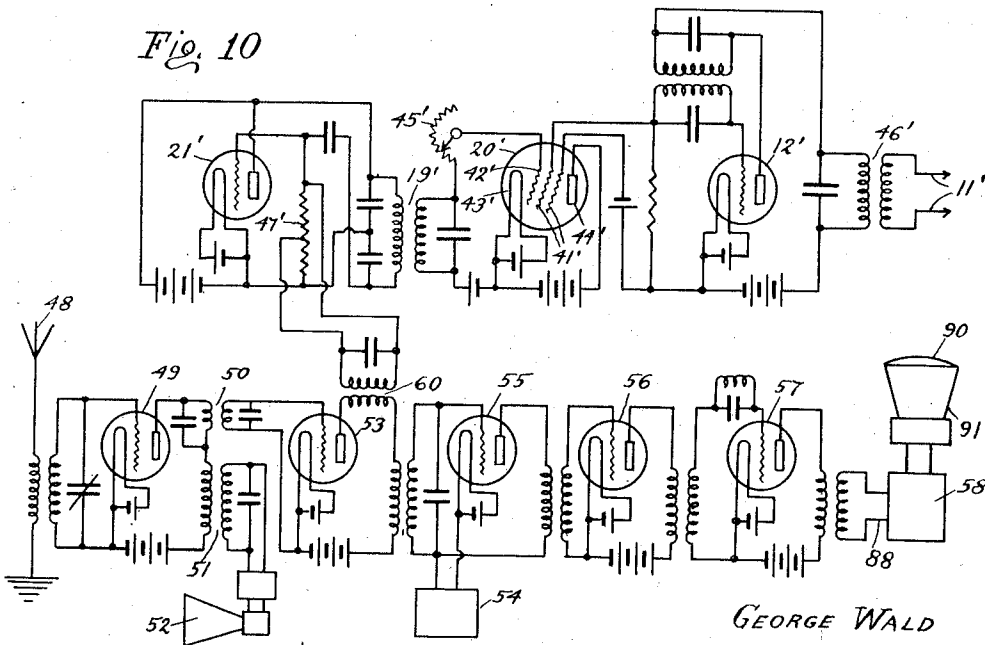


Fig. 10



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UNITED STATES PATENT OFFICE

2,217,326

PICTURE TRANSMITTER

George Wald, Fort Totten, N. Y.

Application March 15, 1937, Serial No. 130,925

8 Claims. (Cl. 178—5.8)

My invention relates to methods and apparatus for transmission and reception of television and has particular reference to image, sound and scanning signal transmission by radio waves or similar carriers.

One of the objects of my invention is to provide an improved means for scanning an image in the transmitter. For this purpose I preferably provide a special transmitter consisting of a flat inductive coil forming a cathode, with a non-inductive anode supported in parallel alignment with the cathode and separated by a small gap filled by a photoelectric composition. I also provide means to impress a periodically varying frequency on the cathode, the latter being tuned so as to be in resonance with the impressed variable waves at different points of its length so that the peak of the impressed voltage will travel from one end of the cathode to the other during each cycle of the frequency variation thereby producing a television current of varying strength when the cathode is illuminated by the image. This transmitter is similar to my transmitter described in my U. S. Patents Nos. 1,754,491 and 1,790,736. However, instead of using a non-inductive cathode and anode and connecting them with external coils by numerous taps, I provide an inductive cathode, thereby greatly simplifying and cheapening the construction and providing better operation, as the scanning is accomplished by a continuous movement instead of steps or jumps as with tapped coils described in the foregoing patents.

Another object of my invention is to provide a variable frequency scanning circuit for the transmitter, operating in one direction only in order to avoid the hysteresis effect in the oscillating tubes and circuits. For this purpose I provide a low frequency oscillating circuit of, for example, twelve cycles per second. I do not let the circuit complete each cycle, however, but interrupt the excitation of the circuit at the peak of the ascending current wave, thereby producing a rapidly descending wave of current decay, by means of a rotary switch making, for instance, thirty revolutions per second. The excitation circuit of an oscillator tube is again energized by the switch when the decay current reaches zero value, so that a new rising current wave is generated, there being thirty such rising waves per second. I use only the ascending current wave for scanning, and no image or television current is produced during the flow of the decay current. Thus, a television signal is produced which can be used in any ordinary television system, such

as employing a Braun tube in any of its modifications, using this signal for deflecting the electronic beam by magnets or condensers. This signal can be also used with my television system as described in my U. S. Patent No. 1,810,692, or, preferably, with my new system forming a subject matter of this invention, employing the foregoing photoelectric receiving screen for an image with a spirally wound inductive cathode. I use the variable current wave for generating variable frequency in a special oscillating circuit applied to the cathode of the screen. The cathode is tuned so that the peak of the voltage wave travels from one end of the cathode to the other when frequency varies within predetermined limits, thereby scanning the image and producing a television current wave during the ascending current wave of the low frequency oscillator.

The time period of scanning is different, however, for the inner and outer portions of the cathode, because of difference in the inductance of inner and outer convolutions, so that it is necessary to provide means to compensate this effect.

For this purpose I introduce a variable resistance element in the grid circuit of the variable frequency oscillator, the resistance element representing supplementary grids in the path of electronic current in a variable mu tube, so called "type 35". This tube has a grid of variably spaced wires and at varying distance from the anode. My resistance elements or supplementary grids are arranged substantially parallel to the grid, but connected to another circuit, i. e. the variable frequency circuit. For accurate adjustment of the time period at the beginning and end of the variable frequency period I employ a rheostatic control in the circuit of the supplementary grids.

Still another object of my invention is to provide a convenient carrier wave for transmitting the television and sound currents together with the scanning signal. For this purpose I use an arrangement similar to the one described in my U. S. Patent No. 2,026,005, by providing a carrier wave of a relatively low frequency and high power and impressing on it a wave band of a relatively high frequency and low power, modulated by the television current. The low frequency band can be selected in the radio frequency range so as to use it for radio broadcasting simultaneously with the television transmission, so that with my system it is possible to introduce the television transmission gradually, as a supplement to the radio broadcasting and without any interference with the same. My system also

makes it possible to use but a single radio channel for image scanning or television current, signal current and sound. My arrangement simplifies the control by reducing the number of dials. Thus I may use only five or six controlling devices or dials: three for radio sound and two or three for television, instead of about fifteen as required for ordinary television systems.

Still another object of my invention is to provide a television receiver especially adapted for use with my transmission system. For this purpose I employ a tube having a cathode in the form of a flat spiral similar to the transmission cathode. The anode is represented by a series of fine parallel wires. A grid is supported between the anode and cathode and may also consist of a series of parallel wires at an angle to the anode wires. The whole assembly is preferably enclosed in a tube containing neon or similar gas or gases. I provide a local circuit of periodically varying frequency of the same periodicity as the transmitting variable frequency, and this circuit is applied to the cathode together with a local current for producing discharges in the gaps between the cathode and anode. The discharges vary in brightness in accordance with the variations of the received television current impulses and thereby reproduce the image.

My receiver is very simple in construction and operates in synchronism with the transmitter without the necessity of adjusting the synchronism for every reception. The scanning signal serves to interrupt the excitation of the local oscillator in the receiving circuit in the same manner as the rotary switch operates in the transmitting circuit, so that the scanning of the receiving screen becomes automatically synchronised with the scanning of the image in the transmitter. The image is reproduced by bright luminous discharges which can be projected on a large screen. The receiving tube can be built very cheaply, at a fraction of the cost of television cathode tubes with the controlled electronic beam, and it can be made of any desired or convenient size, in conjunction with a large projection screen, if so desired. No new channels are needed when installing my receivers as they conveniently operate on radio broadcasting channels.

My invention is more fully described in the accompanying specification and drawings in which—

Fig. 1 is a diagrammatic view of my television transmitting tube.

Fig. 2 is a diagrammatic view of my television receiving tube.

Fig. 3 is a diagrammatic sectional view of my variable mu tube.

Fig. 4 is a longitudinal sectional view of my television receiving tube.

Fig. 5 is an end view of the same partly in section.

Fig. 6 is a fractional sectional detail view of my receiving tube.

Fig. 7 is a similar detail view of my transmitting tube.

Figure 8 shows diagrammatically the wave action as occurring in connection with the apparatus and incident to the variable frequency of the circuits.

Fig. 9 is a diagram of connections for my telephonovision transmitter.

Fig. 10 is a diagram of connections for my telephonovision receiver.

As explained in my U. S. Patents 1,754,491;

1,790,736, and 1,810,692, a variable frequency applied across an inductive coil with a plurality of successive taps produces a maximum voltage point which travels along the induction coil from one tap to the other. In the present invention I employ a cathode in the form of an induction coil so constructed that every point along the edge of the coil is facing the anode and at the same time every point of the cathode is at the same distance from the anode, as can be accomplished for instance, by using flat parallel anode 1 and cathode 2. This construction produces a unit which is equivalent to an induction coil having an infinite number of taps. Otherwise the principle applied is the same as in my foregoing U. S. patents.

My telephonovision system includes a transmitter shown in Figs. 1 and 7. It consists of a cathode 1 in the form of a flat spiral wound together with a metal ribbon 2 forming an anode and separated from the cathode by a strip of insulation 3. The anode ribbon is wider than the cathode so that it projects at one side of the spiral as shown in Fig. 7, the space below the cathode ribbon being filled with insulation 4. The assembled electrodes are placed in a tray-shaped holder 5 and the edges of the anode are soldered to the bottom of the holder. The latter has a tubular extension or ferrule 6 for mounting it on a suitable support in an enclosing tube 7 shown with dotted lines in Fig. 1. The front surface of the receiver is finished smooth and covered by a thin layer 8 of a suitable photoelectric substance, such as sulphur, selenium or similar materials, which are then annealed to enhance the photoelectric properties.

The convolutions or turns of the anode are all short circuited so that it is non inductive while the cathode represents an induction coil. The non-inductive anode 1 and the inductive cathode 2 are connected across a source of direct current 16 in series with a secondary 9 of a transformer, the primary of which is connected by leads 11 to a source of a variable frequency current, produced by a circuit of an oscillator 12 (Fig. 9). The voltage of the battery 16 is slightly higher than the variable frequency voltage applied across the leads 11, and inasmuch as the variable frequency voltage is superimposed on the battery voltage, the anode remains at all times positive. Consequently, the potential of the anode fluctuates to correspond to the variable frequency current but remains always positive in relation to the cathode. Now since every point of the inductive cathode 1 is in parallel with an adjacent point of the non-inductive anode 2 electrically connected by the high resistance photoelectric material 8, all the points of the cathode 1 will emit electrons from its entire surface and these electrons will be simultaneously picked up by the anode 2 and will produce a total current of a value X. Assuming that at a given moment the image to be transmitted remains stationary, then the resistance at all points between the cathode 1 and the anode 2 will retain their set values and the current X will remain constant at a fixed value, i. e. the current X represents in value the sum of all currents flowing from every point of the cathode to every point of the anode. This current X will fluctuate rhythmically at a value corresponding to the variable frequency voltage, each instantaneous current at a certain cycle of the variable frequency being the same. The current X is, therefore, a constant variable frequency current of, say, 160 to 180 k. c. On and

above the X current in the cathode-anode circuit there is also another current which is produced by the maximum voltage traversing the resonance points of the cathode impedance. This current shifts along the cathode 1 in series with a corresponding point of the anode 2 corresponding to the change in frequency applied to leads 11. This current exists at only one point of the cathode at a time, viz. the maximum voltage point and the instantaneous value of this current depends upon the resistance value at that point. As this maximum voltage point traverses the entire cathode 1, forming the disc on which the image is focused, the entire image is thus scanned and produces a television current of a frequency, for instance, up to 100 k. c. which is the natural television current. The circuit 9, 13, 1, 2 and the primary 17 is tuned to, for instance, 160 to 180 k. c. and will permit the X current to flow therein, while the television amplifier 18 is tuned to a current, for instance, up to 100 k. c., therefore it will permit the television current to flow therein but the X current will be excluded therefrom. Hence circuit 18 will detect and amplify the television current. As the image is scanned, for instance, thirty times a second, the mechanical movement of the image in one thirtieth of a second is hardly perceptible in that time to affect the X current, the image may be assumed for all practical purposes to be stationary during the time consumed by scanning one frame, and therefore the image is properly scanned even when the image is moving with normal mechanical motion. An additional inductance 13 is included in the circuit of the cathode in order to tune the cathode so as to be in resonance with the frequencies supplied by the oscillator and to retain the peak of the voltage wave within limits of the screen formed by the cathode. Thus if the frequencies vary, for instance, between 160 and 180 kilocycles, and the cathode has 500 turns, the coil 13 may be in resonance with the frequency of 180 k. c. but with the cathode will respond to the frequency of 160 k. c. The peak of the voltage wave under these conditions will travel from one end of the cathode to the other when the frequency changes between the limits indicated. The resonance may be further adjusted by condensers 14 and 15. A battery 16, or a similar source of current, may be connected across the terminals of the electrodes 1 and 2 in order to provide sufficient current for passing across the photoelectric material at the points of maximum voltage. The current varies in accordance with the degree of illumination by an image projected on the screen and forms a television current. The television and variable frequency currents are separated from the battery current by the transformer 17 and are passed through a detector and amplifier 18 where the television current is detected for transmission.

The oscillator 12 is connected through a transformer 19 and an amplifier 20 with an oscillator 21 which is tuned for a low frequency such as 12 cycles per second. It receives its excitation from a secondary 22 of a transformer through the primary 23 of which passes a high frequency current from an oscillator 24. The oscillator 24 belongs to a circuit represented in the lower part of Fig. 9 and comprising also a low frequency high power oscillator 25, these two oscillators being connected with a mixer tube 26 for transmitting the combined wave from an antenna 27. The low frequency current, being of a relatively high power, serves as a carrier for the other

waves, as explained in my Patent No. 2,026,005. This circuit, with the exception of the transformer 22—23, is the same as described in the foregoing patent, including the back feed and the full wave rectifier 28. The oscillator 24 may be tuned for a short wave, such as 5 meters, while the oscillator 25 is preferably tuned for a radio broadcasting frequency of an available band, and it can be used directly for transmitting sound from a microphone 29 with its amplifiers 30. The circuit of the oscillator 24 is coupled by a transformer 31 with the detector 18 of the television camera 7.

The oscillator 12 is tuned to generate a wave 32 as shown in Fig. 8. Its excitation current from the transformer 22—23 is interrupted 30 times a second, however, so that the wave 32 is not completed. For this purpose a rotary commutator 33 is employed, consisting of an arm 34 mounted directly on the shaft of a motor (not shown) making 1800 revolutions per minute. The arm has a contact brush on the end sliding over portions 35 and 36 of a contact ring insulated from each other, but connected with wires 37 and 38 extending from a secondary 39 of a transformer, coupling the high frequency oscillating circuit with the mixing circuit. The commutator short circuits the wires 37 and 38 once during each revolution, when the brush of the arm 34 contacts with the portion 35. The result is that the wave 32 is started 30 times a second in the form of a rising wave 40 (Fig. 8), its starting shape being slightly different from the continuous wave form as shown.

The short circuiting arc 35 is shorter than the arc 36, their lengths being proportioned so that the time during which the arm 34 moves over the arc 36 corresponds to the time *a* of the rising voltage 40, and the time of movement over the short circuiting arc 35 corresponds to the time *b* of the decay current when the excitation of the grid of the oscillator 21 is stopped. It should be noted that the numerical values of frequencies are set forth only in the way of an example, and other values may be used in practical applications. It should be also noted that the output of the transformer 22—23, instead of being applied to the grid of the tube 21 through a grid leak 47, may be first rectified by a full cycle rectifier and then applied to the grid circuit of the tube 21.

The tube 21 is coupled by the transformer 19 with the oscillator 12 through the amplifier 20. The circuits are tuned so that the rising voltage curve 40 is used to generate a variable frequency through the self-exciting oscillator 12 within certain definite limits depending on the resistance in the grid circuit. These limits are slightly larger than the limits of resonance frequency for the cathode 1. Thus if the latter responds to frequencies from 160 to 180 k. c., then the tube 21 must generate frequencies, for instance, from 158 to 182 k. c. These additional frequencies, being outside of the range of the cathode, have no effect on the television current and they correspond to portions *b* and *e* of the wave 40, during which time no television current is transmitted by the antenna.

While any variable resistance in the grid or other component circuits will produce variable frequency in the tube 12, it is preferable to use a variable resistance specially modulated so as to have a variable time period at the beginning and end of the scanning in order to compensate for the difference in the time period of different convolutions of the cathode 1.

This difference in the scanning time period is caused by the different inductance of the small inner and large outer evolutions of the spiral. In order to compensate for this effect and to equalize the time period for different portions of the cathode, I introduce variable resistance elements 41 in the grid circuit of the tube 12, it being easier to swing in this manner the grid bias voltage of the tube 12. The elements 41 form a part of a specially constructed variable mu tube 20, of the so-called "35" type. This tube is characterized by a grid 42, having more wires per unit of length at one end than at the other, and being farther away from the anode at one end than at the other as shown in Fig. 3. The resulting difference in the emission of electrons causes difference in the degree of ionization and different resistance between the elements 41. With this arrangement the increase in the electronic stream is more rapid when the oscillator 21 begins to generate the current wave 40 and becomes slower as the wave progresses toward its peak. When there is no electronic stream between the cathode 43 and anode 44, the tube 12 is not oscillating, and it begins to function only when the space between the electrodes in the tube 20 becomes ionized and therefore conducting. Normally the space is slightly ionized, so that when the tube 21 is not generating, the tube 12 oscillates at a frequency around 158 k. c. and increases up to 182 k. c. when the voltage generated by the tube 21 increases along the curve 40. In this manner it is possible to compensate not only difference in the inductance of the inner and outer evolutions, but also difference in their respective lengths, by shortening the time period of the scanning for the inner turns or evolutions. The proper adjustment can be obtained by means of a variable resistance 45 in the circuit of the grid 42.

The receiving circuit, shown in the lower portion of Fig. 10, is essentially the same as described in my Patent No. 2,023,005 and comprises an antenna 48, detector 49, filtering transformer 50—51, sound reproducing apparatus 52, an amplifier 53, local oscillator 54, mixing tube 55, another amplifier 56, television detector 57, television amplifier 58, and television receiver 59. The circuit of the high frequency amplifier 53, however, includes a transformer 60 for coupling that circuit with the circuit of a low frequency oscillator 21' through a grid leak 47' exactly corresponding to the similar elements in the transmitting circuit. The rest of the elements in the variable frequency circuit, also correspond to the elements in the transmitter variable frequency circuit and are denoted by corresponding numerals with the mark prime. No rotary switch like 33 is used, however: current for the excitation of the tube 21' is supplied by the high frequency current and amplifier 53, and as this signal is interrupted at the transmitter by the switch 33, no high frequency power is received at the time of the interruption.

The receiver operates on a similar principle to that of the transmitter heretofore explained, and consists of a spirally wound cathode 61 similar to the cathode 1 and also provided with an external inductance 62 for tuning the cathode to the specific frequencies, together with the condensers 14' and 15'. The cathode is embedded in an insulation 63 in a holder 64 supported by its tubular extension 65 on a post 66 in a tube 67 provided with a base 68. Leads 69 extend from the cathode to prongs 70 in the base. An elec-

tric heater 71 is supported in the holder 64 under the cathode and is connected by leads 72 with prongs 73. Its circuit includes a regulating resistor 74. Current for the heater may be supplied by a lighting circuit. A grid 75 is supported above the cathode and consists of fine wires 76 preferably arranged so that at least two wires pass over a single thickness of the cathode coil as shown in Fig. 6. The wires are stretched in the frame of the grid and are supported on thin insulation strips 77, forming separators between the convolutions of the cathode.

At certain intervals higher strips 78 are placed with slots 79 for the wires, these strips serving as separators to keep the wires at proper distances apart. Other still higher strips 90 provide support for anode wires 81. These wires are similar to the grid wires but extend at right angles thereto and are held in a ring 82 clamped over the holder 64. The grid is connected by a wire 83 to a prong 84, and the anode is connected by a wire 85 to a prong 86. The tube 67 is preferably filled with neon or similar gas or gases which will glow when there is current discharge in the space between the anode and cathode, the grid controlling the flow of electrons. A battery 87 provides initial charge under which the gas is just beginning to become ionized. There being at least two wires over the single thickness of the cathode ribbon 61, the four crossing wires form a small rectangular aperture over the cathode ribbon. A luminous discharge or glow takes place in such apertures, giving the effect of a more or less bright illumination according to the strength of the television current. The television current is received through wires 38 and an amplifier 58 and impressed on the grid through a transformer 89. A variable frequency scanning current is received through wires 11' and transformer 46' on the cathode circuit, so that the discharges in the tube are produced by the combination of these three currents: battery, television and scanning variable frequency. The grid and anode wires may be made very fine, .001 of an inch in diameter, for instance, with distances between the wires equal to their diameters. The grid wires may be placed at a distance of about 0.002 of an inch from the surface of the cathode. With the anode having 6 inches in diameter, fine details of the image can be reproduced. The image can be projected on a larger screen through a lens 90 supported in an outer metal casing 91 for the tube 67.

It should be noted that the variable resistances 45 and 45' need be used only occasionally to adjust the circuits when, for instance, the tubes change their characteristics in time. If an A. C. rectifier is used for all the circuits, then the circuit of the oscillator 12' may be connected to the rectifier through a one hundred thousand ohm resistance in order to separate it from the circuit of the oscillator 20'.

As it was already mentioned, my telephonovision system does not require any special channels, and the antennas 27 and 48 are of the ordinary type used for radio broadcasting and reception. The television current and signal can be transmitted on any commercial radio frequency band, and the television receivers can be connected with any ordinary radio receivers, using the same antennas.

With my arrangement of separate variable frequency generators at the transmitting and receiving stations operated by a single television signal from the rotary switch 33, it is only nec-

5 necessary to transmit the television signal on the carrier wave, and this signal sets up simultaneously the rising wave 40 at both stations so that no additional or special synchronization is necessary. There is a blank interval between the end of one rising wave and the beginning of the next, corresponding to the time of the decay current, which is not transmitted. The image is reproduced, therefore, by scanning in one direction only, always exactly in synchronism with the scanning of the image at the transmitting station. This rising wave can be used, of course, with any other television receivers, such as electronic tubes, for operating magnets or condensers 10 deflecting the electronic beam. My system of using the rising wave for producing a variable frequency wave for scanning the tuned resonant cathode greatly simplifies the construction and operation of the receivers, eliminating the necessity of using high priced and delicate electronic tubes.

My receiver is rugged and simple in construction, does not require an exact degree of rarefaction or vacuum in the tube, and can be built for a small fraction of the cost of the electronic beam tubes.

The receiver tube of my construction can be also used as a transmitting camera with but small changes: by using, for instance, photoelectric substances on the electrodes, or employing a cold free electron-emitting cathode.

It is understood that my telephonovision system can be modified without departing from the spirit of my invention as set forth in the accompanying claims.

I claim as my invention:

1. A television transmitter comprising a photoelectric screen for an image, consisting of a cathode and anode having an inherent inductance, the inductance varying progressively from the middle portion of the screen to the outer portions, a low frequency oscillating circuit, means to periodically interrupt the excitation of the oscillating circuit thereby producing a periodically rising current wave followed by a decay current wave, a second oscillating circuit adapted to convert the rising current into a periodically varying frequency applied to the cathode and anode, means to tune the anode and cathode so as to be in resonance by different portions of their screen surface with the peak of the voltage wave of the varying frequency circuit thereby causing scanning of the screen by the voltage wave and producing television current when the screen is illuminated by an image, and means to transmit the television current together with the scanning signal caused by the interruption of the excitation of the oscillating circuit.

2. A method of television transmission and reception consisting in producing a sawtooth style signal current, impressing the signal current on a controlling circuit including a thermionic pentode tube for varying progressively the quantity of electrons flowing between the controlling elements, influencing an oscillating circuit adapted to oscillate at a variable frequency by the said progressively varying current to produce a variable frequency signal current, scanning the image screen having a different inductance at its different points by the variable frequency current thereby producing an image signal current, transmitting and receiving the image signal current, and translating and reproducing the image.

3. A television apparatus comprising means

for producing a sawtooth style signal current, a controlling circuit including a thermionic pentode tube adjusted by an adjustable resistance, means for impressing the sawtooth style current on the controlling circuit to vary progressively the quantity of electrons flowing between the controlling elements, an oscillating circuit adapted to oscillate at a variable frequency, means for influencing the oscillating circuit at the controlling circuit to produce a variable frequency current, means for scanning an image screen by the variable frequency current, the said image screen having a different induction at its different points, means for framing the image on the screen by adjusting the variable resistance thereby producing an image signal current, and means for transmitting and receiving the image signal current and means for translating and reproducing the image.

4. A television transmitter comprising a screen for an image, consisting of flat spiral electrodes having a spiral gap between them extending from the central to the outer portion of the screen, a photoelectric substance in the gap, the electrodes being formed so as to provide a different inductance at different portions of the gap, means to produce a variable frequency to scan the electrodes, means to tune the electrodes to cause the peak of the voltage wave to scan the photoelectric substance between the electrodes thereby producing a television current when the screen is illuminated by an image, and means to transmit the television current.

5. A television transmitter comprising a screen for an image, consisting of a spirally wound inductive cathode, a spirally wound non-inductive anode having all points of its turns parallel to and interleaved with all corresponding points of the turns of the cathode, means to impress a voltage of periodically varying frequency on the cathode, the said cathode being adapted to be resonant to the impressed variable frequency current within predetermined limits thereby causing the peak of the voltage to scan the screen, a photoelectric substance between the cathode and anode adapted to pass a television current when the screen is illuminated by an image and scanned by a variable frequency current and means to transmit the television current.

6. A television transmitter comprising a screen for an image, consisting of electrodes wound in the form of flat spirals with the convolutions of the cathode interposed between the convolutions of the anode and insulated from each other, a photoelectric substance between the electrodes at the surface of the screen, the electrodes being connected across a source of direct current, means to develop a variable frequency voltage, means to impress the said voltage on said direct current at the electrodes, an external inductance in the circuit of the electrodes, means to scan the electrodes by the peak of the voltage of the variable frequency wave thereby producing a television current when the screen is illuminated by an image, and means to transmit the television current.

7. A television receiver comprising a cathode in the form of a flat inductive spiral, an anode in the form of a plurality of parallel conductors at a small distance from the cathode, a grid between the cathode and anode consisting of a plurality of parallel conductors at an angle to the anode conductors, means to develop a variable frequency current, means to scan the cathode by the variable frequency current and by a televi-

sion current, and means to produce luminous discharges at the points of scanning thereby reproducing an image corresponding to the image impressed on the transmitter.

- 5 8. A television system including in combination a transmitter comprising an inductive cathode, means providing for a continuous scanning ac-
10 tion of an object, said means including a low frequency oscillating circuit, means for inter-
rupting the excitation at the peak of the ascend-
15 ing circuit wave whereby only such ascending wave portion is used for scanning, means for producing a relatively low frequency high power wave band, means for producing a relatively high
20 frequency low power wave band, means for receiving audible impressions and modulating said first named wave band in accordance with the same, means for connecting said second means with said scanning means whereby said high frequency low power wave band is modulated by the television current, means whereby both of

said wave bands are transmitted in the form of a complex wave and with a signal impulse incorporated therein, a receiver including a local circuit of periodical varying frequency and having the same periodicity as is embodied in the
5 variable frequency circuit of said transmitter, a tube including a cathode, said local oscillation being impressed upon said cathode, a local oscillator forming a part of said receiver, said
10 scanning signal serving to interrupt the excitation of said local oscillator, a screen for visual images and forming a part of said receiver, means for scanning said screen in synchronism with the interruptions of the local oscillator and thereby
15 in synchronism with the scanning as occurring in said transmitter, and means forming a part of said receiver for translating into audible sounds the audible impressions emanating from said transmitter.

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