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TELEVISION

Original Filed Nov. 9, 1928

Fig. 1

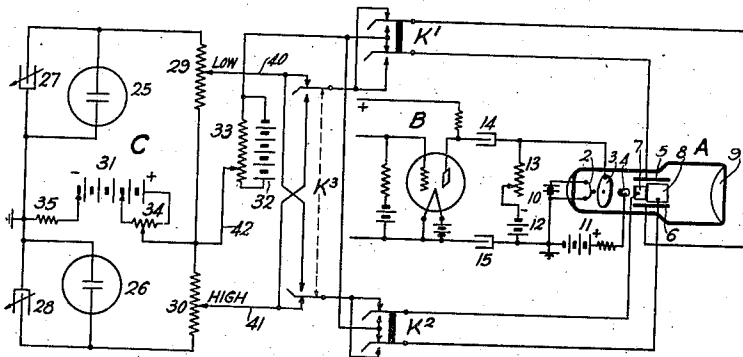


Fig. 2

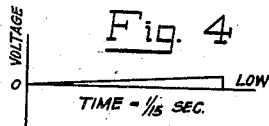
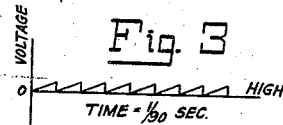
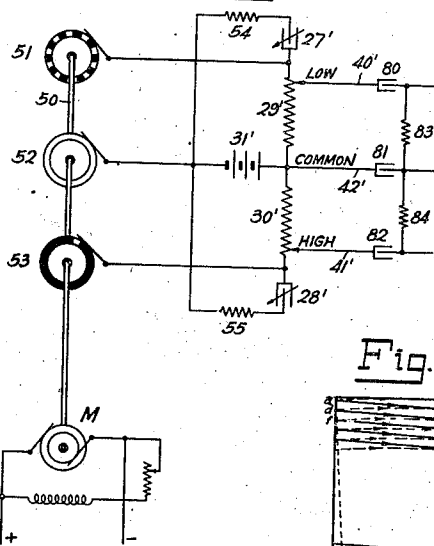
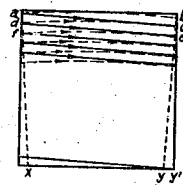


Fig. 5



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TELEVISION

Original application filed November 9, 1928, Serial No. 318,262. Divided and this application filed December 18, 1930. Serial No. 503,150.

The present invention relates in general to television and the object of the invention, broadly stated, is to provide a new and improved television receiver.

5 A special object of the invention is to provide a television receiver of the type which employs a cathode ray tube and which can be used to pick up television programs which are broadcasted by transmitting stations
10 using the so-called disc transmitter.

Other objects of the invention relate to various improvements in television receivers of the general character pointed out above and will be discussed hereinafter.

15 This application is a division of my prior application Serial No. 318,262, filed November 9, 1928.

Referring to the drawings accompanying this specification, Fig. 1 shows a cathode ray
20 television receiver using a neon tube oscillator for producing the scanning potentials; Fig. 2 shows a modified type of oscillator employing a motor-driven interrupting
25 mechanism; Figs. 3 and 4 show the wave forms of the scanning potentials which are produced by the oscillators shown in Figs. 1 and 2; while Fig. 5 is a diagrammatic representation showing how the television frame
30 in the cathode ray receiver of the instant case compares with the television frame in a disc type of receiver or transmitter.

Referring now to Fig. 1, the reference letter A refers generally to a cathode ray tube of the general type which is in common use
35 and known as a cathode ray oscillograph tube. It comprises an evacuated glass vessel or tube within which is a filament or cathode 2, a perforated disc or shield 3, an anode 4, and two pairs of plates 5—6 and 7—8. The
40 end of the tube opposite the filament is preferably flattened out somewhat and is coated on the inside with some fluorescent material, such as willemite. The "A" battery 10 is provided for the purpose of lighting the fila-
45 ment 2, while the so-called "B" battery 11 serves to place a positive potential on the anode 4. A "C" battery 12 is also provided for the purpose of maintaining a negative potential upon the shield 3. In series with
50 the battery 12 is a high resistance grid leak 13.

The reference letter B indicates generally the last stage of a resistance coupled amplifier. This amplifier may be any good type of radio receiver such as is used to pick up ordinary radio broadcasts. The amplifier
55 is coupled to the cathode ray receiver by means of condensers 14 and 15.

The reference letter C indicates a double neon tube oscillator which is provided for the purpose of impressing the necessary
60 scanning potentials upon the plates 5 to 8, inclusive, of the cathode ray receiver. The low frequency oscillator comprises essentially the neon tube 25 shunted by variable condenser 27 and connected in series with the
65 battery 31 through the high resistance 29. The high frequency oscillator is similar and comprises the neon tube 26 shunted by variable condenser 28 and connected in series with the same battery 31 through the high resistance 30. The voltage of the battery 31
70 is variable so that the frequency of the oscillators can be adjusted. One end of the battery may be tapped for rough adjustment, one cell at a time, while at the other end of
75 the battery a potentiometer is provided shunted around one or two of the cells to provide for a finer adjustment. The positive pole of the battery is connected to common lead 42 which is connected to plates 5 and 8 of
80 the cathode ray receiver. The low frequency conductor 40 is connected to scanning plate 6 of the receiver, while the high frequency conductor 41 is connected to the scanning plate 7. The common lead 42 includes the
85 potentiometer 33 which is shunted around the battery 32. This battery is connected in opposition to the battery 31 and is provided so that the cathode ray beam can be centered on the fluorescent screen 9 of the receiver.
90 Battery 32, being connected in the common lead, provides only for a diagonal adjustment across the screen, which, however, is ordinarily all that is required. Separate vertical and horizontal adjustments can be
95 provided for by inserting a potentiometer and battery in each of the leads 40 and 41, omitting the potentiometer and battery in the common lead 42.

The leads 40, 41, and 42 are connected to 100

the receiver through keys K1, K2, and K3. Key K1 reverses the connections to the low frequency scanning plates 5 and 6, while key K2 reverses the connections to the high frequency scanning plates 7 and 8. Key K3 reverses the high and low frequency conductors 40 and 41 with respect to their connections in the receiver. These keys are provided so that any desired direction of scanning may be secured.

Assuming that the receiver is set up and connected as shown in the drawings, the filament 2 will be heated by the battery 10 and is thus caused to emit electrons. In the ordinary operation of a cathode ray tube of this type the potential on the anode 4 is sufficient to pull a stream of electrons through the central opening in the shield 3, thus forming the well-known cathode ray or beam which passes through the cylindrical anode 4 and between the pairs of plates 5—6 and 7—8 and impinges on the screen 9 at the end of the tube. The "C" battery 12 should have such a value that the negative potential on the shield 3 will very nearly prevent the passage of any electrons when there is no incoming light signal; that is, with no incoming signal the cathode beam should be very nearly, if not quite, extinguished.

The purpose of the two pairs of scanning plates 5—6 and 7—8 is, of course, to cause the cathode beam to scan or trace a path over the fluorescent screen 9 so as to display the picture being received. This operation is described in my co-pending application, Serial No. 705,413, filed April 10, 1924, which describes the use of approximately sine wave generators for producing the scanning potentials. When potentials having such a wave form are used, however, the beam will trace a zig-zag or lissajous figure on the fluorescent screen, and since this does not correspond to the method of scanning used in the disc transmitter, potentials having a different wave form must be used. The foregoing may be understood better by reference to Fig. 5. The dotted semi-rectangular frame *abxy* represents the area scanned by a disc transmitter, horizontal clockwise scanning being assumed. The first hole in the disc will trace a path across the frame as represented by the dotted line *ab*, the second hole will trace a path represented by the dotted line *dc*, etc. It will be understood from this that the frame is scanned from top to bottom and from left to right, or the same as one reads a page of English print. The problem is to cause the cathode ray beam to scan the frame in the cathode ray receiver in the same manner. This can be done by arranging for generation of scanning potentials having a wave form such as is illustrated in Figs. 3 and 4, Fig. 3 showing the wave form of the high frequency scanning potential, while Fig. 4 shows the wave form of the low frequency scanning

potential. It will be seen that in each case the voltage rises with approximately straight-line characteristics to a maximum and then suddenly, practically instantaneously, falls to zero. It will be understood that when the voltage across condenser 28, for instance, is rising the voltage across the resistance 30 will be falling and vice versa, so that assuming positive values above the base line the curve, Fig. 3, represents the wave form of the potential across the condenser, while if negative values are assumed above the base line the curve shows the wave form of the potentials across the resistance 30.

The effect of these scanning potentials on the movement of the cathode beam will readily be perceived. Considering the rectangular frame shown by the solid lines in Fig. 5, we will assume that the scanning potentials both have a value of zero at a given instant and that at this particular instant the beam impinges at the point *a* in the upper left-hand corner of the frame, which will be true with the reversing switches K1, K2, and K3 in a particular position. As the voltage of the high frequency source rises, the beam will be pulled across the frame toward the point *b*, but at the same time the voltage of the low frequency source is rising also, with the result that the beam will gradually be deflected downward so that it actually traces a path as indicated by the line *ac*. When the point *c* is reached the voltage of the high frequency source drops suddenly to zero with the result that the beam instantly assumes a position at point *d* on the left of the screen, there being no visible path on the screen to denote the transition of the beam from *c* to *d*. The voltage of the high frequency source now rises gradually again with the result that the beam sweeps across the screen again from left to right following the path indicated by the line *de* until when *e* is reached the voltage again drops to zero and the beam instantly assumes its position at the left of the screen at point *f*. Thus, it will be seen that the beam traces lines from left to right across the screen, each line being a little lower down on the screen than its predecessor, until finally on the last movement across the frame the beam arrives at the point *y'*. At this point the voltage of the low frequency source drops to zero simultaneously with the voltage of the high frequency source and the beam thereupon instantly resumes its position at *a* in the upper left-hand corner of the frame. Thus, the beam has transversed the entire frame in a series of horizontal lines. It will be understood that the lines are much closer together in practice than are shown in Fig. 5, as this drawing is merely for the purpose of explaining the principle, and the displacement of the lines *ac*, *de*, etc., from the horizontal will be much less than appears on the drawing. While these lines do not coincide

exactly with the lines *ab*, *dc*, etc., the method of scanning is the same; that is, the cathode ray scans in a clockwise direction and from top to bottom, and the departure of the lines produced by the cathode ray beam from the paths followed by the holes in the disc is very small. It is so small as to produce merely a very slight distortion of the picture which is practically unnoticeable.

The neon tube oscillator C is so designed as to produce scanning currents having the requisite wave form, as pointed out in the foregoing. The frequencies of the two oscillators must, of course, correspond to the picture frequencies employed at the transmitting station whose broadcasted pictures it is desired to receive. Broadcasting stations are now in operation which transmit at the rate of fifteen pictures per second using a disc having forty-eight holes. To receive these programs the low frequency oscillator including the neon tube 25 must have a frequency of fifteen cycles per second, while the high frequency oscillator including the neon tube 26 must have a frequency of forty-eight times this or seven hundred twenty cycles per second. The desired frequencies can be obtained by using the proper values for the resistances 29 and 30 and for the condensers 27 and 28. It is desirable, however, that the resistances 29 and 30 both be comparatively high, on the order of 10 megohms, and it is preferable, therefore, to take care of the difference in frequencies largely by means of a difference in the capacities of the two condensers 27 and 28. It follows from this that the condenser 27 of the low frequency oscillator will have a very much higher capacity than the condenser 28. The approximate values can readily be calculated from the formula

$$f = \frac{E}{eRC},$$

in which

f = frequency in cycles per second;
E = charging potential in volts (battery 31);
e = breakdown voltage of neon tube;
R = resistance in ohms (resistance 29); and
C = capacity in farads (condenser 27).

In the operation of the oscillator, and considering the low frequency side, the condenser 27 will be charged by the battery 31 through the resistance 29 until the potential across the terminals of the condenser reaches the value at which the neon tube 25 flashes over. When this occurs, the condenser is short-circuited through the neon tube and is instantly discharged. The neon tube then becomes open-circuited and the condenser is again charged, the operation continuing in this manner at the rate of fifteen cycles per second. The exact frequency can be adjusted by adjusting the condenser 27. The breakdown potential of the neon tube may be in the neighborhood of 100 volts and the battery 31 should have a

voltage somewhat higher than this so that the condenser 27 will be worked on the lower portion of its charging curve which has nearly a straight-line characteristic.

The high frequency oscillator including the neon tube 26, of course, operates the same as the low frequency oscillator except that the condenser 28 charges and discharges exactly forty-eight times as fast as the condenser 27. The exact frequency is adjusted by adjusting the capacity of the variable condenser. When the two oscillators are separately adjusted to substantially the proper frequencies they tend to keep in step with each other, due to the inclusion of the resistance 35 in the negative lead from the battery 31, and can then be adjusted simultaneously by regulating the voltage of battery 31.

The high and low voltage leads 40 and 41 could be taken directly from the terminals of the condensers, if desired, common lead 42 being connected to the other terminal of the battery in this case, but it is better to connect these leads around the resistances 29 and 30 so that the oscillators will be independent of any extraneous circuits which might introduce variable capacity effects which would have a tendency to make it difficult to maintain adjustment of the frequencies. The resistances 29 and 30 are preferably constructed in the form of potentiometers so that the impressed voltages on conductors 40 and 41 can be varied for the purpose of varying the amplitude of movement of the cathode ray beam as it traverses the fluorescent screen in the receiver. By adjusting the potentiometers toward the outside terminals of the resistances the voltages on the conductors 40 and 41 will, of course, be increased and the amplitude of the beam will be increased also. Thus the beam can be made to cover as large or small a frame as is desired within the limits of the apparatus.

It will be understood now that with the oscillator in operation and connected up as shown the cathode ray beam in the receiver A will be caused to traverse a path across an imaginary picture frame such as is shown in Fig. 5 on the fluorescent screen 9 at the end of the tube, viewing the tube from the outside, or from the right of the drawing. With no incoming signal this frame will be practically invisible. When light signals are received, however, the potential of the shield 3 will be made more positive so that more electrons are permitted to pass through, and the intensity of the beam is thus greatly increased, the amount of increase, of course, depending on the strength of the received signal at any given instant. It follows, therefore, that as the beam traverses the frame its intensity will change in accordance with the change in the incoming light currents so that certain portions of the frame will be more or less brightly illuminated while other portions

of the frame will be left dark, all in accordance with the illumination of the picture which is being transmitted.

The modified form of oscillator shown in Fig. 2 may be used in place of the neon tube oscillator in circumstances where a motor is available and where the use of moving parts is not objectionable. The motor-driven oscillator is somewhat simpler to operate than the neon tube oscillator, as there are less adjustments, but ordinarily it will not be as desirable as the latter in which all moving or rotating parts of the ordinary kind are eliminated.

Referring to the drawings, the reference letter M indicates the driving motor which may be a synchronous motor running in step with the motor at the transmitting station or it may be an ordinary shunt field motor arranged to be adjusted by hand to the required speed, for instance 900 R. P. M. On the shaft of the motor is mounted an interrupting mechanism which comprises the slip ring 52 and the short-circuiting commutators 51 and 53. The slip ring 52 serves to connect the negative pole of the battery 31' with the active segments of the two commutators. The brush of commutator 51 is connected to the far side of condenser 27' while the brush of commutator 53 is connected to the far side of condenser 28'. The commutator 53 has one active segment while the commutator 51 has forty-eight active segments. Assuming a motor speed of 900 R. P. M., commutator 53 will short-circuit the condenser 28' fifteen times per second, while commutator 51 will short-circuit the condenser 27' seven hundred twenty times per second. This produces the proper scanning frequencies for receiving programs transmitted at the rate of fifteen pictures per second with a forty-eight-hole scanning disc. The apparatus can, of course, be adjusted for other rates of transmission, although if the ratio between the number of pictures per second and the number of holes in the scanning disc is different from that assumed, then one or both of the commutators will have to be changed. The neon tube oscillator possesses an advantage in this respect in that the frequency of the oscillators can be independently adjusted and thus the same physical apparatus can be used on a number of different systems of transmission. The rest of the apparatus in Fig. 2 is similar to the corresponding apparatus shown in Fig. 1, except that the conductors 40', 41', and 42' are connected to the receiver through condensers, which prevents displacement of the ray by the battery 31', and renders it unnecessary to provide a compensating battery such as 32, Fig. 1. The condensers are indicated by reference characters 80, 81, and 82, and should be of large capacity, on the order of 2 M. F. High resistance leaks 83 and 84

should also be used, connected from leads 40' and 41' to the common lead 42'. It will be understood that the condenser method of coupling can also be used with the oscillator shown in Fig. 1.

Having described my invention, what I consider to be new and desire to have protected by Letters Patent will be pointed out in the appended claims.

What is claimed is:

1. In combination, two neon tube oscillators, means for adjusting the frequency of each oscillator separately, means causing said oscillators to tend to keep in step when adjusted, and means for adjusting both oscillators simultaneously.

2. In combination, two neon tube oscillators for producing impulses of frequencies which bear a multiple relationship, each oscillator comprising a neon tube shunted by a variable condenser and a resistance through which the condenser is charged, a common source of current for charging the condensers of both oscillators, and a resistance in series with said source and said condensers for producing a drop in potential which causes said oscillators to tend to keep in step with each other.

3. In combination, two neon tube oscillators each comprising a neon tube shunted by a variable condenser, a common branch coupling said oscillators, said branch including a source of current for charging said condensers and a resistance for causing the oscillators to tend to keep in step when adjusted, and means in said common branch for adjusting both oscillators simultaneously.

4. In combination, an oscillator comprising two neon tube oscillating circuits having a common branch, each circuit consisting of a neon tube shunted by a variable condenser and a resistance connected in series with said common branch, a source of current in said common branch for charging said condensers, and a resistance in said common branch for synchronizing said two oscillating circuits.

5. In combination, two neon tube oscillators each comprising a neon tube shunted by a condenser and a resistance through which the condenser is charged, means for adjusting the frequency of each oscillator, means for supplying current for charging the condensers of both oscillators, a connection common to the charging circuits of both condensers, and a resistance included in said common connection for producing a drop in potential which causes said oscillators to tend to keep in step with each other.

6. In combination, an oscillator comprising two neon tube oscillating circuits having a common branch, each circuit including a neon tube shunted by a condenser and a resistance connected in series with said com-

mon branch, means for charging the condensers of both oscillating circuits, and a resistance in said common branch for synchronizing said two oscillating circuits.

⁵ In witness whereof, I hereunto subscribe my name this 13th day of December, A. D. 1930.

HAROLD J. McCREARY.

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