

Oct. 17, 1939.

C. O. BROWNE ET AL

2,176,663

TELEVISION AND THE LIKE SYSTEM

Filed Feb. 9, 1934

Fig. 1

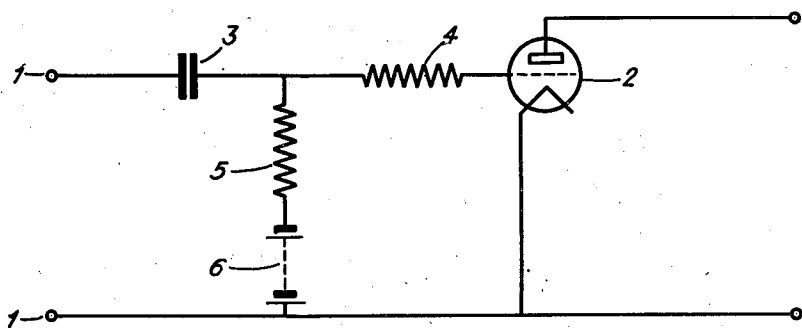
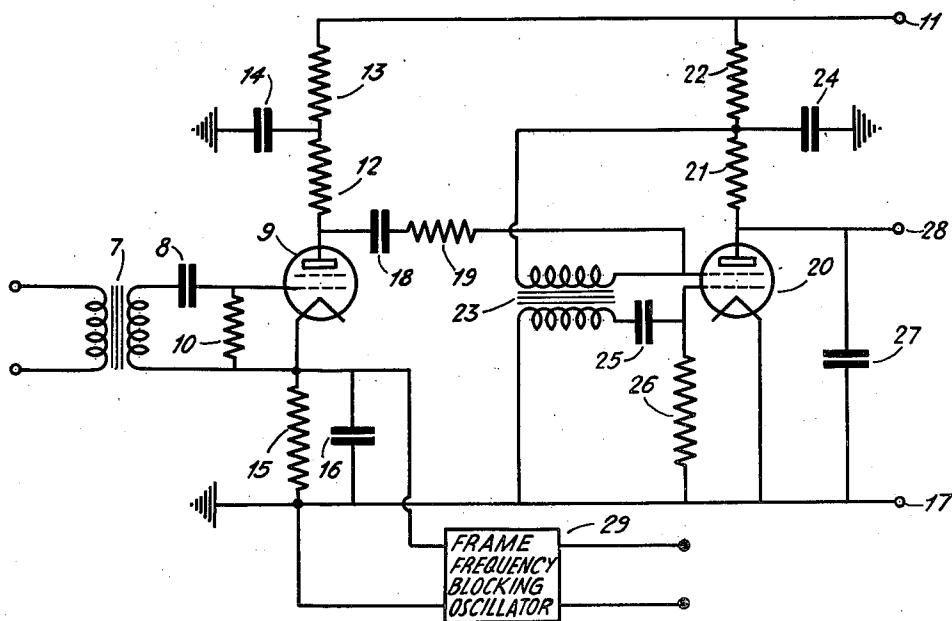


Fig. 2



INVENTORS
C. O. BROWNE
J. HARDWICK
BY *W. H. Brown*
ATTORNEY

UNITED STATES PATENT OFFICE

2,176,663

TELEVISION AND THE LIKE SYSTEM

Cecil Oswald Browne, West Acton, London, and
John Hardwick, West Drayton, England, as-
signors to Electrical and Musical Industries
Limited, Hayes, Middlesex, England, a company
of Great Britain

Application February 9, 1934, Serial No. 710,424
In Great Britain February 10, 1933

3 Claims. (Cl. 178—7.3)

The present invention relates to television and like systems.

In transmitting images electrically to a distance it is usually necessary to transmit synchronizing signals which serve, at the receiver, to maintain a scanning device in synchronism with the scanning device at the transmitter. For example, in many systems the image to be transmitted is scanned line by line and an impulse, known as a line impulse, is transmitted between the scanning of each line. Further, an impulse, known as a framing impulse and usually of a different character from the line impulse, is transmitted in the interval between successive scan-
nings of the same image or, in the case of film television for example, between the transmission of successive frames.

In some systems, only one series of synchronizing impulses is transmitted, certain impulses or sets of successive impulses at regular intervals being of longer duration than the remainder; at the receiver, all of the impulses serve to control one scanning motion, while the impulses or sets of impulses of longer duration are separated and serve to control another scanning motion.

It has been found that variations in amplitude of the synchronizing impulses are undesirable for various reasons. For example, in systems in which the impulses do not serve directly to synchronize apparatus at the receiver with apparatus at the transmitter, but are employed to control the generation of local oscillations which in turn serve the function of synchronization, changes of amplitude of the synchronizing signals may lead to faulty synchronization. Systems in which a cathode ray tube is employed at the receiver to reconstitute the transmitted image are often of this type, the locally generated oscillations generally being of saw-tooth wave form and serving to control the scanning of the fluorescent screen of the tube by the cathode ray beam.

It has been found that with oscillation generators which are suitable for use in such systems, the constancy of the frequency of the generated oscillations is not only dependent upon the regularity with which the synchronizing impulses arrive, but is also disturbed by variations in the amplitude of the impulses.

It is an object of the present invention to provide a television or the like system in which the undesirable effects of variation of the amplitude of the synchronizing impulses are eliminated or reduced.

According to the present invention, in a television or the like system there are provided

equalising means adapted, when fed with synchronising impulses of different amplitudes, to reduce the differences in amplitude.

According to a feature of the invention, equalising means of the character mentioned above are provided in a transmitter for television or the like purposes of the type in which the synchronizing impulses are mixed with and transmitted over the same channel as the picture signals. Preferably, the equalisation of the amplitudes of the synchronising impulses is carried out before the impulses are mixed with the picture signals.

A further feature of the invention resides in the use of equalising means such as are mentioned above in a television or the like system in which the synchronizing impulses are employed at the receiver to control the generation of saw-tooth scanning oscillations by an oscillator which is susceptible to changes in the amplitude of the controlling pulses.

According to a further feature of the invention, in a television or the like system there are provided means comprising a thermionic valve and adapted, when fed with synchronizing impulses of different amplitudes, to reduce the differences in amplitude, the operating potentials applied to the electrodes of said valve being such that the difference between the control grid potential at which said valve ceases to pass anode current and the control grid potential at which grid current commences to flow is equal to or less than the minimum amplitude to which the synchronizing impulses fall in practice.

The synchronizing impulses are generally applied to thermionic amplifiers before being fed to the transmission channel and fortuitous electrical disturbances of the type known as "ground noises" may be introduced. These disturbances, which may be to a large extent in the same sense as the synchronizing impulses, occur in the intervals between the impulses and may disturb synchronization at the receiver.

A further feature of the invention accordingly resides in the provision in a television or the like system of means adapted substantially to eliminate fortuitous electrical disturbances such as ground noises occurring in the intervals between successive impulses in a train of synchronizing impulses.

Means for this purpose may be provided at the transmitter, or at a receiver, or at both.

The invention will be described by way of example with reference to the accompanying drawing, in which:

Fig. 1 shows diagrammatically equalising apparatus suitable for use in systems according to the invention, and

Fig. 2 is a circuit diagram of a part of a receiver of a further system according to the invention.

The apparatus shown in Fig. 1 is suitable for use in a film television system for the equalisation, at the transmitter, of the line of impulses for example.

In a transmitter of this type, which will be considered by way of example, a motion picture film is moved at a uniform speed past an illuminated slit disposed perpendicularly to the direction of motion of the film. A drum carrying plane mirrors equal in number to the number of lines into which each frame is to be divided for transmission purposes is mounted for rotation about an axis parallel to the direction of motion of the film, the mirrors all lying in planes parallel to this axis.

Each mirror, in turn, reflects an image of the strip of the film, which is at any instant opposite the slit, on to an apertured photo-electric cell in which picture impulses are generated in known manner. The arrangement is such that there is a short interval between the sweeping of an image over the above mentioned aperture, which may be called the picture aperture, by one mirror and the sweeping of an image thereover by the next mirror. During this interval the mirror which has just ceased its scanning operation serves to throw an image of a second illuminated slit or aperture over a second photo-electric cell also provided with an aperture. In this second cell there is thus generated a unidirectional impulse, known as a line impulse. Since all the mirrors act in turn to produce a line impulse, the successive line impulses may vary in amplitude. The impulses are therefore fed, after suitable amplification if desired, to a device such as is illustrated in Fig. 1, which serves to reduce the differences in amplitude.

Referring to Fig. 1, the impulses, which will be considered to be in the positive sense, are applied to a pair of input terminals 1 and are established between the control grid and cathode of a thermionic valve 2, the grid-cathode path of this valve being in series, with respect to the input terminals, with a condenser 3 and a resistance 4 in series with each other. The junction point of the condenser 3 and the resistance 4 is connected to the cathode of the valve through a resistance 5 and a source of grid bias such as the battery 6, the grid being biased so that its normal operating point is below the lower bend of the anode current-grid voltage characteristic curve of the valve. Any voltage in a negative sense which may be associated with the positive impulse is thus prevented from producing an effect upon the anode current. Further the potentials applied to the electrodes of the valve are so chosen that the difference between the grid voltage at which grid current flows and the voltage to which the grid is biased is such that the smallest amplitude to which the impulses fall in practice is sufficient to cause grid current to flow. The series resistance 4, in series with the resistance of the grid-cathode path of the valve, constitutes a potential divider; when grid current flows, the latter resistance falls to a less value, and only a small fraction of the applied voltage is set up between the control grid and cathode. Thus the series resistance 4 serves to prevent any appreciable change in grid voltage when grid current is flowing and the change of

grid voltage is limited substantially to the difference between the voltage at which grid current flows and the normal operating voltage of the grid, irrespective of the amplitude of the impulses. The anode current can therefore only vary between zero and a fixed maximum and is arranged to carry out this variation in response to all the impulses applied to the grid. The output from the anode circuit of this valve therefore yields impulses of substantially uniform amplitude.

Further, by giving the grid of the valve 2 sufficient negative bias, it may be arranged that parasitic "ground noises" occurring in the intervals between synchronizing impulses and of less than a predetermined amplitude produce negligible changes in anode current, whilst synchronizing impulses even of smallest amplitude are sufficiently large to produce the full change in anode current. The elimination so obtained of ground noises, which are characteristic of all thermionic amplifiers, is of particular importance in systems in which the synchronizing impulses serve to control the generation of saw-tooth oscillations. Further reference is made to this point in the description of the apparatus illustrated in Fig. 2.

In a similar arrangement in which the impulses are of negative sign, these may be applied to a grid-leak rectifier at such amplitude that their peaks are equalised on the bottom bend of the anode current-grid voltage characteristic curve. Any voltages in a positive sense associated with the negative impulses are arranged to occur within the range of grid current and so produce substantially no change in anode current.

The equalised line impulses may be mixed with the picture impulses and caused to modulate a carrier.

Referring now to Fig. 2, it will be assumed that the apparatus illustrated is to be fed with a series of impulses at the line scanning frequency of which certain impulses, or sets of successive impulses, at the frame frequency, are of longer duration than the remainder. It will also be assumed that the impulses are mixed with picture signals, the latter being in the opposite sense with respect to the datum line of the impulses.

The impulses are applied to the primary winding of an iron cored transformer 7, one end of the secondary winding of which is connected through a condenser 8 to the control grid of a screened grid valve 9, while the other end is connected directly to the indirectly heated cathode thereof. The control grid is also connected to the cathode through a leak resistance 10. The anode of the valve is connected to the positive terminal 11 of a suitable source of current (not shown) through an anode resistance 12 and a decoupling resistance 13 in series, the junction point of the two resistances being earthed through a condenser 14. The cathode of the valve is connected through a coupling circuit comprising a resistance 15 and a condenser 16 in parallel to the negative terminal 17 of the anode current source, and this point is earthed.

The functions of the valve 9 are three in number; the first is to limit the amplitude of the synchronizing impulses to a substantially constant value, the second is to separate the synchronizing impulses from the picture signals, and the third is to separate one series of impulses from the other. The valve will be referred to in this description as the equalising valve. The synchronizing impulses and the picture signals

are applied to the primary winding of the transformer 7 in such a sense that the synchronizing impulses tend to charge the grid side of the grid condenser 8 positively; each synchronizing signal accordingly tends to cause grid current to flow, and the grid consequently assumes a negative charge which leaks away slowly through the grid leak 10. This cycle of operation is repeated for each successive impulse. The value of the leak resistance 10 and the capacity of the grid condenser 8 are made such that the grid eventually acquires a mean negative bias which is more negative than that corresponding to zero anode current; the magnitude of this bias voltage varies in accordance with the peak amplitude of the synchronizing impulses, the variation being such that each impulse in turn just causes grid current to flow. Furthermore, the potentials applied to the anode and screening grid of the valve 9 are so chosen that synchronizing impulses of the smallest amplitude which is likely to occur in practice are able to cause grid current to flow. The picture signals, since they are in negative sense with respect to the synchronizing impulses, cannot cause current to flow in the anode circuit of the equalising valve 9, and the synchronising impulses are thus substantially freed from them. Moreover, the change of grid voltage due to any synchronizing impulse is always limited to the difference between the voltage corresponding to anode current cut-off, and the voltage at which grid current commences to flow, and the amplitude of the impulses set up in the anode circuit is consequently substantially constant.

It is also preferably arranged that the negative potential attained by the control grid of the valve 9 is greater than that corresponding to anode current cut-off by an amount such that ground noises accompanying the synchronizing impulses produce no change in anode current, and are thus eliminated. The possibility of ground noise disturbances affecting the generators of saw-tooth oscillations is thus avoided or reduced.

Each synchronizing impulse produces a pulse of current in the anode circuit of the equalising valve 9, and, on account of the anode resistance 12, there is a sudden fall in the potential of the anode each time a synchronizing impulse reaches the grid. There is thus set up, at the anode, and in relation to the negative terminal 17 of the anode current source, a series of impulses at the line scanning frequency, the impulses being in the negative sense with respect to the mean anode potential. The anode of the valve 9 is connected through a condenser 18 and a resistance 19 in series to the screening grid of a screened grid valve 20 which forms part of a blocking oscillator; the cathode of the latter valve is earthed.

The anode of the blocking oscillator valve 20 is connected through an anode resistance 21 and a decoupling resistance 22 in series to the positive terminal 11 of the source of anode current, and the screening grid is connected through the secondary winding of an iron-cored reaction transformer 23 to the junction of the two resistances 21, 22. The junction point is also earthed through a decoupling condenser 24. The control grid of the valve 20 is connected to the cathode through a grid condenser 25 and the primary winding of the transformer 23 in series, and a grid leak 26 is also connected between the control grid and the cathode. A reservoir condenser 27 of suitable capacity is connected between the anode and cathode of the valve 20.

A synchronising impulse appearing on the anode of the valve 9 causes a pulse of current to flow in the decoupling condenser 24 and the secondary winding of the reaction transformer 23, and the latter is connected in such a sense that the effect induced in the control grid/circuit of the valve 20 by this pulse of current is such as to drive the control grid potential in the positive direction. Current eventually flows between the control grid and the cathode, and the grid condenser 25 consequently assumes a negative charge. The capacity of the grid condenser 25 is made such that the negative charge is effective in biasing the control grid to a point well below the point corresponding to zero anode current, and the anode-cathode path of the valve becomes substantially insulating.

While no current flows between the anode and cathode of the blocking oscillator valve, the reservoir condenser 27 charges through the anode resistance 21. The negative charge on the grid condenser 25 is arranged to be dissipated gradually through the leak resistance 26, and the latter is given such a value that a further synchronizing impulse arrives before the grid potential has fallen sufficiently to allow the valve to become conducting. It should be pointed out here that, in the absence of the synchronizing impulses, the blocking oscillator valve 20 would oscillate at a frequency slightly lower than that of the impulses. The latter are effective in holding the blocking oscillator in synchronism, and the constancy of the frequency of the generated oscillations is not only dependent upon the regularity with which the impulses arrive, but is also disturbed by variations in the amplitude of the impulses.

The synchronizing impulse is in such a sense that its arrival causes the control grid to be driven beyond the anode current cut-off point in the positive direction, and current consequently flows in the anode circuit. The reaction transformer 23 is so connected that the sudden change of current in the screening grid circuit causes the control grid to become still less negative, and the flow of anode current is further increased, the action being cumulative. The reservoir condenser 27 is thus very rapidly discharged through the anode-cathode path of the valve.

The control grid eventually reaches a potential at which grid current can flow, and the grid is again made very negative. The change thus occasioned in the current in the screening grid circuit is again reflected in the grid circuit, the sense of the reaction coupling being such that the grid rapidly becomes more negative than the anode current cut-off point, and the reservoir condenser 27 again commences to charge up. This cycle of operation is repeated for each successive synchronizing impulse, and there is accordingly set up across the reservoir condenser a saw-tooth voltage oscillation at the line scanning frequency which may be derived from the terminals 28 and 17.

Now it will be seen that the anode current pulses in the valve 9 due to the synchronizing impulses pass through the resistance 15. The capacity of the condenser 16 in shunt therewith is made such that its impedance to the impulses of short duration is low compared to its impedance to the impulses of longer duration, and each successive set of impulses of longer duration tends to be integrated by the condenser 16 to form a single impulse. Thus there is set up across this condenser a series of impulses at the frame scan-

ning frequency. These impulses are applied, preferably through a filter circuit, not shown, to the frame frequency blocking oscillator 29. This may be similar in construction and manner of working to the line frequency blocking oscillator (except that it is found preferable in the case of the frame frequency oscillator to employ an air-cored reaction transformer) but since, as will be apparent, the frame frequency impulses are in the positive sense with respect to the mean cathode potential, they may be applied to the control grid of the blocking oscillator valve; it will be remembered that in the case of the line frequency blocking oscillator, the line frequency impulses are in the negative sense, and it is accordingly necessary to apply them to the screening grid of the line frequency blocking oscillator valve.

The output of both blocking oscillators may be applied to suitable thermionic amplifiers. Preferably, such amplifiers incorporate means for providing anti-regenerative feed-back, such feed-back having been found to improve the wave form of the saw-tooth oscillations.

As has been explained, the anode cathode path of the equalizing valve 9 is substantially insulating during the period between synchronizing impulses. The synchronizing impulses are all of durations which are short compared to the intervals between them, and it will thus be seen that, over the major portion of each cycle of oscillation thereof, the input circuits of both the line and frame frequency blocking oscillators are substantially completely insulated from one another. Interaction between the blocking oscillators, which may manifest itself as a triggering-off of the frame frequency oscillator by the impulses which control the line frequency oscillator, is thus reduced.

While the invention has been described in only certain of its preferred forms, other modifications are possible and such will readily suggest them-

selves to those skilled in the art to which the invention is directed.

We claim:

1. In a television system wherein synchronizing and video signals are transmitted over a common transmission channel, thermionic means for reducing the effect of both increasing and decreasing changes in amplitude from a predetermined value in the synchronizing signals, and means for restricting the operation of the thermionic means only to time periods during which the synchronizing signals are transmitted.

2. In television apparatus, means for receiving video and synchronizing signals transmitted over a common transmission channel, an oscillator for controlling the position in space at which the electro-optical representations due to the video signals result, means for reducing the effect of both increasing and decreasing amplitude changes from a predetermined value in the synchronizing signals to produce preestablished signal levels therefrom, and means for utilizing the signals resulting from the received synchronizing signals to control the said oscillator.

3. In television receiving apparatus, means for receiving synchronizing and video signals transmitted over a common transmission channel, a blocking oscillator tube for controlling the position in space at which electro-optical representations due to video signals result, an equalizing tube responsive to the received synchronizing signals for limiting the amplitude of the synchronizing signals to a predetermined value thereby controlling the blocking oscillator, and means for separating the video and synchronizing signals and separating frame and line synchronizing signals, and means for utilizing the separated frame and line synchronizing signals.

CECIL OSWALD BROWNE.
JOHN HARDWICK.