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SIGNALING SYSTEM

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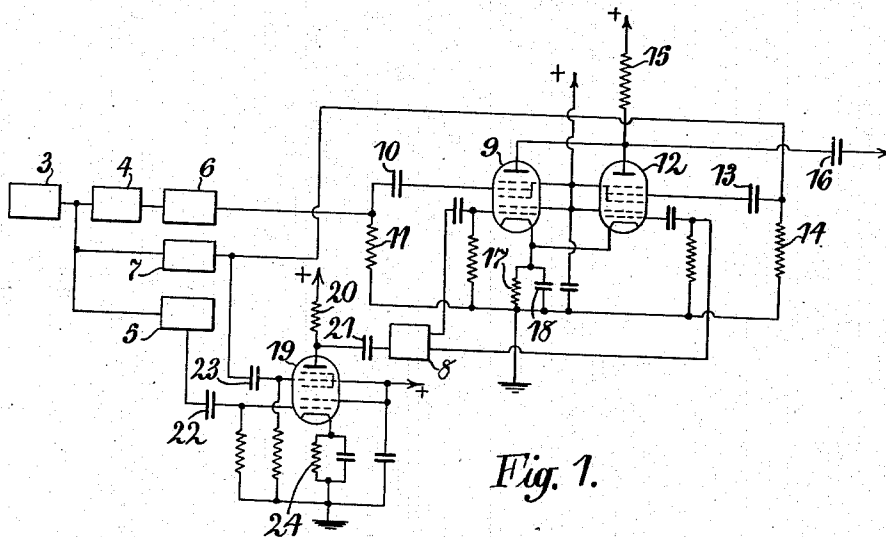


Fig. 1.

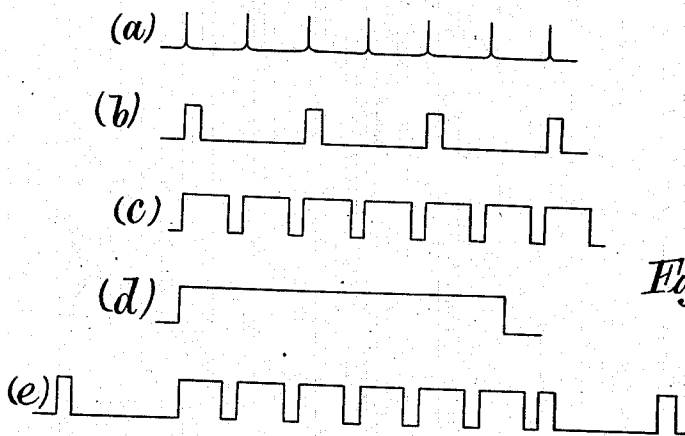


Fig. 2.

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2,212,558

SIGNALING SYSTEM

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10 Claims. (Cl. 178—69.5)

The present invention relates to the transmission of impulses of different kinds over a common channel, and is particularly but not exclusively concerned with television and like systems.

The invention is applicable, for example, to television systems of the kind in which synchronising impulses of different kinds are transmitted in the line and frame intervals respectively, that is to say, in the intervals between the scanning of successive lines and frames of an object of which an image is to be transmitted. A known system of this kind, in which the present invention may be employed with advantage, is that described in British specification No. 425,220, in which the synchronising signals transmitted are of unidirectional, impulsive character, leading edges at the line scanning frequency being arranged to persist throughout the framing intervals, in order to ensure that, at the receiver, the scanning oscillation generator which is held in step by the line impulses shall not fall out of step during the frame intervals.

The present invention accordingly provides apparatus for the transmission of spaced electrical impulses of different kinds, from either of two separate sources respectively, into a common output circuit, in which there are provided switching means arranged, when in one condition, to permit the transmission of impulses from one of said sources to said output circuit, and, when in another condition, to permit the transmission to said output circuit of impulses from the other of said sources, characterised in that means are provided for automatically preventing the change-over of said switching means from one of said conditions to the other from taking place except during the spacing periods between the impulses from at least one of said sources.

The invention further provides apparatus according to the preceding paragraph, particularly for television and like systems, wherein said two sources are arranged to generate respectively line frequency synchronising impulses of relatively short duration, and auxiliary synchronising impulses of a longer duration, said auxiliary impulses providing leading edges which recur in phase with and at the same frequency as said line frequency impulses, and wherein means are provided for generating switching impulses at frame frequency and for utilising said switching pulses to control the change-over of said switching means, the arrangement being such that auxiliary impulses are transmitted to said out-

put circuit during the framing intervals and that line frequency impulses are transmitted at other times.

In accordance with the invention, therefore, there is provided an oscillator whose frequency is twice the desired line frequency and from this energy there is derived square pulses of three different frequencies. The first of these derived impulses has a frequency equal to the desired line frequency and the pulse duration is of the order of 10% of the duration of one complete cycle for the line frequency. The second set of derived pulses has a frequency equal to that of the master oscillator, i. e., twice the line frequency, but the pulses have a duration equal to approximately 40% of the line duration, while the third set of impulses has a frequency equal to that of the desired frame frequency and has a duration of the order of two or more cycles of the line frequency. The line and frame frequencies are fed to a switching device which, in one operative position, passes only the line frequency impulses, while in the other operative position passes the frame frequency impulses. Since the arrangement is to be used for interlaced television systems, a non-integer ratio of line frequency to frame frequency is provided, and in order to insure that alternate framing impulses occur between the line impulses, the impulses whose frequency is twice that of the line impulses are combined in a triggering device which serves to actuate the switching device. The effects of combining the frame impulses and the impulses of twice the line frequency is such to cause the frame pulse to be delayed for substantially one half the line period so that with respect to the line impulses, the leading edge i. e. point of initiation of the frame impulse for the first frame impulse, coincides with the leading edge of the line pulse, while for the second or following frame impulse, the leading edge of the frame impulse occurs halfway between two successive line pulses. By choosing the non-integer ratio to be an odd number of halves, it will be apparent that the line scanning starts at the edge of the picture at one frame and in the middle of the picture for the succeeding frames, and this action is cyclically repeated. One of the very important advantages arising from the provisions of the invention is the fact that the pulses of twice the line frequency insure that the frame impulses alternately coincide in their initiation with the leading edge of the line impulse while the intermediate frame impulses are ini-

tiated halfway between two successive line impulses.

The invention will now be described by way of example with reference to the accompanying diagrammatic drawing, which illustrates the application of the invention to a television transmission system. In the drawing,

Fig. 1 shows a part of a television transmitter, and

Fig. 2 is an explanatory diagram to which reference will be made in the course of the description of Fig. 1.

The television transmitter to be described by way of example is one employing interlaced scanning in which the object of which an image is to be transmitted is completely scanned in two traversals thereof, the path followed by the scanning in one traversal interlacing with that followed in the next traversal. The pictures scanned in each traversal may be either the same picture or successive frames of a motion picture film. For convenience, the frequency at which traversals of the object take place will be referred to as the frame frequency.

Referring to Fig. 1, master oscillations of a frequency equal to twice the line frequency are generated by means of a master oscillator 3; assuming, for example, that 405 lines are scanned in each of two successive frame scans, and that 50 frames are scanned per second, the frequency of the oscillations generated by the master generator is arranged to be 20,250 cycles per second. The master oscillations may take the form shown in Fig. 2a, for example, and may be generated in any known or suitable manner as shown in Fig. 2 of United States Patent No. 1,802,745, issued April 28, 1931 to James N. Whitaker for "Dot multiplex." Master oscillations from generator 3 are fed to frequency-dividers 4 and 5, the outputs of which comprise respectively oscillations at line frequency and impulses of approximately rectangular form recurring at the frame frequency. The frequency-dividers 4 and 5 conveniently take the form of multi-vibrators of any known or suitable kind, such as described in the paper entitled "A Convenient Method for Referring Secondary Frequency Standards to a Standard Time Interval" by Hull and Clapp, in the Proceedings of the Institute of Radio Engineers for February 1929, beginning at page 252 et seq., and in particular, at page 258 et seq., or in the paper entitled "Universal Frequency of Standardization From a Single Frequency Standard" by J. K. Clapp, which appeared in the Journal of the Optical Society of America, volume 15, 1927, at page 25, and the impulses produced by frequency-divider 5 are preferably arranged to have a duration of the order of a line period.

Line frequency oscillations from frequency-divider 4 are fed to a multivibrator 6, which is preferably of the kind described in British Patent No. 425,220, and is arranged to generate line synchronising impulses of substantially rectangular wave form, and of a duration equal to about $\frac{1}{10}$ of a line period; the impulses generated by multivibrator 6 are illustrated in Fig. 2b.

Oscillations from master generator 3 are fed directly to a further multivibrator 7, also preferably of the kind described in the above-identified British Patent No. 425,220, which is arranged to generate synchronising impulses at twice the line frequency, as illustrated in Fig. 2c, each of these impulses having a duration substantially equal to 40% of a line period.

Frame frequency impulses are fed from frequency-divider 5 to another multivibrator 8 which may also be of the type described in British Patent No. 425,220, through a heptode valve 19, the function of which will be described later and which will at this stage be assumed, for purposes of explanation, to be replaced by a direct connection; multivibrator 8 is arranged to generate a set of frame impulses, of the form shown in Fig. 2d, the frame impulses recurring at the rate of 50 per second, in the example under consideration, and each having a duration between 2 and 3 line periods. The frame pulses serve, in a manner which will be more fully described hereinafter, as switching pulses.

Line frequency synchronising impulses from multivibrator 6 are fed to the fourth grid (proceeding from the cathode) of a heptode valve 9 through a condenser 10 associated with a leak resistance 11, and broader pulses from multivibrator 7 are fed to the corresponding grid of a second similar heptode 12 through a condenser 13 having associated therewith a leak resistance 14. The anodes of heptodes 9 and 12 are connected together, and through a resistance 15 to the positive terminal of a source (not shown) of anode current, the negative terminal of which is earthed. The output of the apparatus is taken from the anodes of the heptodes through a condenser 16. The second, third and fifth grids of each of the two heptodes are connected together and to a point at a suitable positive potential in the anode current source, and the two valves are suitably biased by means of a resistance 17, associated with a by-pass condenser 18, connected in their common cathode circuit.

It will be appreciated that by feeding switching impulses of frame frequency (such as those generated by multivibrator 8) to the first grids of heptodes 9 and 12 in opposite polarity and at suitable amplitudes, it can be arranged that the heptode 9 is operative to feed line impulses to the output circuit, through condenser 16, at all times except during the framing intervals, while heptode 12 is operative to feed broader pulses to the output circuit only during the framing intervals. Such an arrangement is found to have the following disadvantage: it is difficult to arrange in practice that the heptode 12, which is that which passes the broader pulses to the output circuit, is always switched on during an interval between successive broader pulses, so that there may appear in the output circuit mutilated broader pulses which have less than their normal duration. As will be clear to those versed in the art, if such a mutilation is permitted to take place, the scanning operation taking place at the receiver may be upset, and correct interlacing may be lost.

The frame-frequency impulses from frequency-divider 5 are accordingly not fed directly to the multivibrator 8, but are fed in the positive sense, through condenser 22, to the first grid of the heptode 19, the anode of which is connected through resistance 20 to the positive terminal of the anode current source and through condenser 21 to the input of multivibrator 8. The broader pulses from multivibrator 7 are fed in the negative sense to the fourth grid of heptode 19 through condenser 23, and heptode 19 is so biased, by means of biasing resistance 24, that no anode current flows therein except in the intervals between the pulses applied to its fourth grid. That is to say, the broader pulses from multivibrator 7 bias heptode 19 to cut off,

and if a frame-frequency impulse from frequency-divider 5 arrives at the first grid of heptode 19 while a broader pulse from multi-vibrator 7 is operative upon the fourth grid thereof, the frame-frequency impulse does not become operative until the broad pulse disappears. The pulse set up at the anode of heptode 19 due to the frame-frequency impulse is then sufficient to trigger off multivibrator 8. The operation of heptodes 9 and 12 at other times than during intervals between broader synchronising impulses is thus avoided.

Fig. 2c illustrates the synchronising signal set up in the output circuit in the neighbourhood of a framing interval.

It will be appreciated that since 405 lines are scanned per two frames, and since the frame frequency impulse from frequency-divider 5 recur regularly at the rate of 50 per second, successive frame synchronising signals, constituted by groups of the broader pulses of Fig. 2c, will commence in different phases with respect to the line synchronising signals. Thus the first broad pulse of the frame signal following that shown in Fig. 2c will commence half a line period after the leading edge of the preceding line pulse.

The provision of broad pulses at twice line frequency during the frame intervals not only enables the line scanning generator at the receiver to be maintained in synchronism during those intervals, but also provides frame signals which are capable of producing very accurate interlacing.

The invention is not limited to television systems, and many modifications thereof within the scope of the appended claims will occur to those versed in the art.

I claim:

1. In a signaling system, the combination of a first pulse generator, a second pulse generator, a third pulse generator, all of said generators bearing a predetermined frequency relation among themselves, selective transmission means for alternately transmitting pulses from said first and said second generators, switching means for making said alternate selections, further switching means controlled by pulses from said second and said third generators, and coupling means between said further switching means to said first named switching means for restricting the selection making to time periods between pulses from said second generator.

2. In a signaling system, the combination of a first pulse generator, a second pulse generator, a third pulse generator, a source of control frequency, means to control the frequency of all of said generators from said source, selective transmission means for alternately transmitting pulses from said first and said second generators, switching means for making said alternate selections, further switching means controlled by pulses from said second and said third generators, and coupling means between said further switching means to said first named switching means for restricting the selection making to time periods between pulses from said second generator.

3. In a signaling system, the combination of a first pulse generator, a second pulse generator, a third pulse generator, a source of oscillations for controlling the frequency of all of said generators, a frequency divider between said source and said first generator, selective transmission means for alternately transmitting pulses from said first and said second generators, switching

means for making said alternate selections, further switching means controlled by pulses from said second and said third generators, and coupling means between said further switching means to said first named switching means for restricting the selection making to time periods between pulses from said second generator.

4. In a signaling system, the combination of a first pulse generator, a second pulse generator, a third pulse generator, frequency control means for maintaining predetermined frequency relationship among all of said generators, selective transmission means for alternately transmitting pulses from said first and said second generators, switching means for making said alternate selections, further switching means controlled by pulses from said second and said third generators, and coupling means between said further switching means to said first named switching means for restricting the selection making to time periods between pulses from said second generator.

5. In a signaling system, the combination of a first pulse generator, a second pulse generator, a third pulse generator, all of said generators bearing a predetermined frequency relation among themselves, selective transmission means for alternately transmitting pulses from said first and said second generators, thermionic switching means for making said alternate selections, further switching means controlled by pulses from said second and said third generators, and coupling means between said further switching means to said first named switching means for restricting the selection making to time periods between pulses from said second generator.

6. In a signaling system, the combination of a first pulse generator, a second pulse generator, a third pulse generator, all of said generators bearing a predetermined frequency relation among themselves, selective transmission means for alternately transmitting pulses from said first and said second generators, multi-vibrator switching means for making said alternate selections, further switching means controlled by pulses from said second and said third generators, and coupling means between said further switching means to said first named switching means for restricting the selection making to time periods between pulses from said second generator.

7. In a signaling system, the combination of a first wave energy generator, a second energy wave generator, a third wave energy generator, means for alternately transmitting waves from said first and said second generators, switching means actuated in accordance with energy from said third generator for determining the time period of said alternate transmission, and means under the control of energy from said second generator for actuating said switching means only during intervals between waves from said second generator.

8. In a signaling system, the combination of a first wave energy generator, a second energy wave generator, a third wave energy generator, means for alternately transmitting waves from said first and said second generators, switching means actuated in accordance with energy from said third generator for determining the time period of said alternate transmission, actuating means for controlling said switching means, and coupling means between said second generator and said control means for restricting the actuation of said switching means to time intervals

occurring only between waves from said second generator.

9. In a signaling system, the combination of a first wave energy generator, a second energy wave generator, a third wave energy generator, frequency control means for maintaining predetermined frequency relationship among all of said generators, means for alternately transmitting waves from said first and said second generators, thermionic switching means actuated in accordance with energy from said third generator for determining the time period of said alternate transmission, and means under the control of energy from said second generator for actuating said switching means only during intervals between waves from said second generator.

10. The method of transmitting synchronizing signals in an interlaced television transmission system, which comprises the steps of generating pulse energy of a predetermined frequency and wave shape, generating pulse energy of a second predetermined frequency and wave shape, generating pulse energy of a third predetermined frequency and wave shape, alternately selecting pulse energy from said first generated frequency and said second generated frequency in accordance with the generated pulse energy of said third frequency, and restricting the commencement of said alternate transmission to time intervals between pulses of said second frequency.

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