

Dec. 31, 1940.

H. O. ROOSENSTEIN

2,227,108

SIGNALING SYSTEM

Filed Feb. 19, 1937

3 Sheets-Sheet 1

Fig. 1

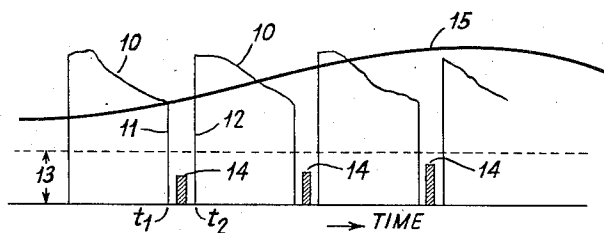


Fig. 2

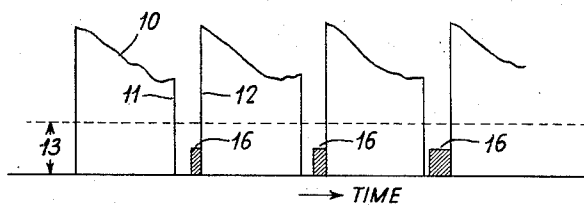


Fig. 3

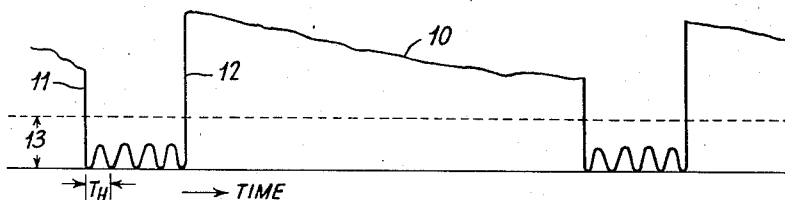
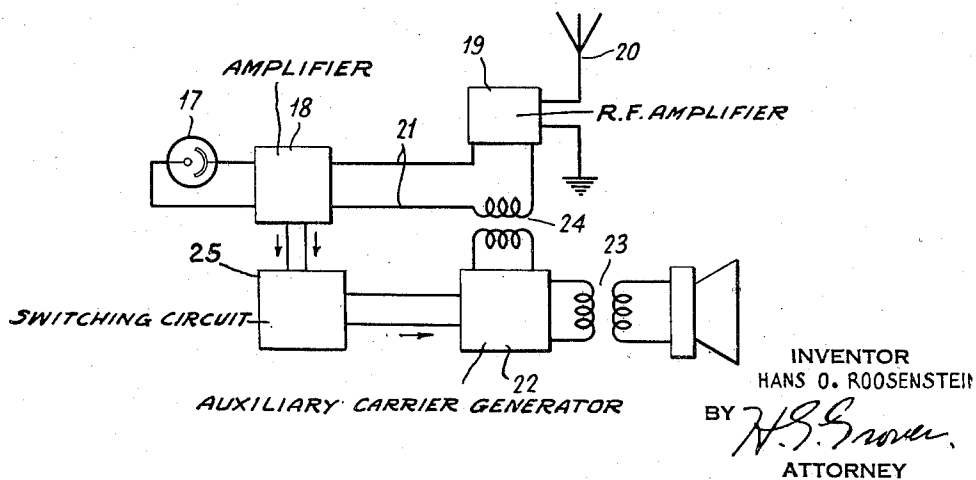


Fig. 4



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Fig. 5

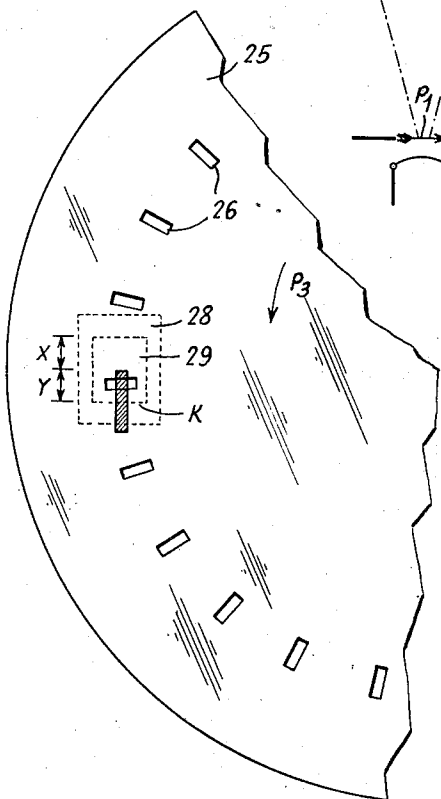
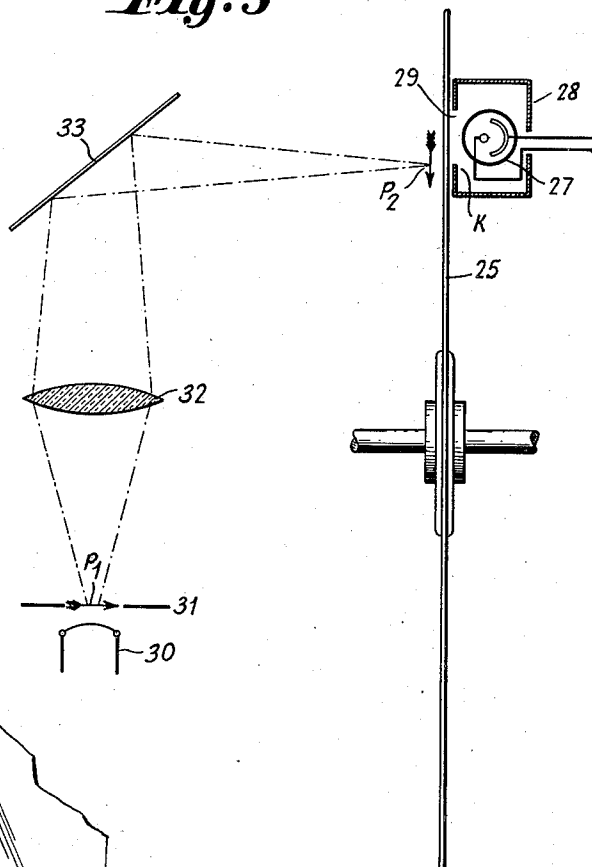


Fig. 6

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Fig. 7

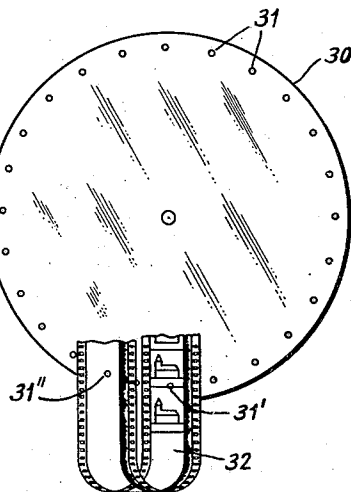
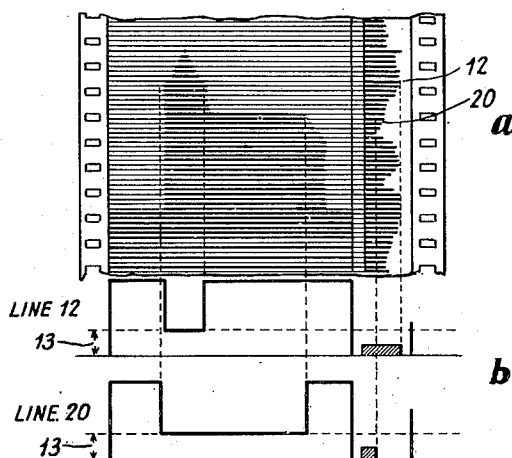


Fig. 8



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SIGNALING SYSTEM

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3 Claims. (Cl. 178—5.8)

This invention relates to a signaling system and, in particular, to a new and improved method and means for transmitting sound as well as simultaneously transmitting sound and accom-

panying television signals.
Simultaneous transmission of television pictures (video signals) and acoustic actions has usually been practiced in the prior art by modulating two distinct carrier waves with the video signals and the acoustic actions. Another method known in the earlier art is to modulate first with the acoustic signals at the sending station an auxiliary carrier wave and to thereupon superpose this sound-modulated auxiliary carrier upon the carrier wave which is modulated with the density (or light and dark contrast) values of the picture.

It has also been suggested in the art to insure the transmission of the acoustic signals during the intermissions or spaces between the constituent picture lines in such a manner that at the sending end during the duration of a line, the acoustic actions are first stored up, say, by the aid of a cathode-ray tube comprising a storage mosaic screen, while they are later transmitted during the line interval. What is then required at the receiving end is an apparatus which must also be furnished with means insuring a storage action, say, also a cathode-ray tube comprising a mosaic screen or plate by which the incoming acoustic actions are first accumulated, whereupon they are slowly picked up during the full duration of a line and thus rendered acoustically.

The invention is concerned with a method in which the acoustic actions are also sent out during the intervals between the component lines of a frame, but in which storage means are provided neither at the sending nor at the receiving ends. As a matter of fact, what is to be transmitted during the said line intervals, according to the invention, is the instantaneous value of the sound.

A number of exemplified embodiments of the method here disclosed shall be described in more detail further below together with such means and ways as are required for the purpose of practicing the basic idea of this invention both at the sending and the receiving ends.

In the drawings, Figs. 1, 2 and 3 are graphical representations of television signals intermingled with signals representative of sound for explaining my invention;

Fig. 4 shows schematically in block diagram form, the circuit arrangement for transmitting

both video and sound signals simultaneously from one transmitter,

Fig. 5 shows diagrammatically apparatus for converting continuously electrical signals representative of sound into impulse signals,

Fig. 6 shows a portion of a Nipkow disk for use in the apparatus shown in Fig. 5,

Fig. 7 shows a modification of the apparatus shown in Fig. 5, and

Fig. 8 shows graphically the electrical signaling impulses resulting from a modification of the apparatus shown in Fig. 7.

Referring to Fig. 1, 10 shows the shape of the modulation potential of a television transmitter in the course of a strip or line of the frame or picture, while 11 and 12 illustrate conditions at the beginning and end of the line intervals. The assumption shall be made in this connection that the carrier amplitude 13 stands for the black value of the picture having a finite height or level so that greater brightness amplitudes than black are transmitted by a carrier value higher than 13. For the purpose of synchronization the carrier amplitude is lowered below value 13, as also known from the prior art, to be more precise, preferably to zero carrier value. During line intervals which extend from instant t_1 to instant t_2 , a supplemental impulse 14 is transmitted, and all of these supplemental impulses 14 shall be supposed to have, during each line interval, the same time position and the same duration, while the amplitude thereof is to correspond to the instantaneous value of the sound to be transmitted, and which is represented in Fig. 1 by the graph 15. If the line (scan) frequency and therefore the frequency of the impulses 14 is, for instance, twice as high as the maximum frequency occurring in the sound or note, satisfactory conditions of sound transmission are insurable. At the receiving end, for example, by the aid of means to be disclosed in more detail further below, the line impulses are filtered out so that by demodulation there results a shape of A. F. current which resembles the shape of curve 15, and this current, after suitable amplification, is fed to a loud-speaker. Transmission on carrier frequency and audibilizing of the sound is accomplishable by the aid of impulses resembling impulses 14 fundamentally speaking in exactly the same way as by tonal modulation of a sinuous continuous carrier wave. That this is so can be readily demonstrated if it is kept in mind that sound transmission by means of a sinuous carrier must operate even when the carrier wave is made to cover only one carrier period, while completely suppressing the same for

the time of the following carrier period by suitable means, while, in turn, sending it out again in modulated form during the carrier period next following. It should also be kept in mind that the non-sinusoidal shape of the impulses 14, will, fundamentally, also not disturb the process of modulation and demodulation seeing that it is optional to work at the receiving end, for instance, with the lower side-band.

It would be possible within the scope and spirit of this invention to lower the carrier value, at the beginning of a line interval, that is to say, at instant t_1 , to a value being a function of the tonal amplitude, and to change, upon the end of the line interval, that is to say, at instant t_2 , from the said sound-dependent carrier value to the carrier value which corresponds to the brightness value or density value of the first picture element of the new line. Thus, as it were, the impulse 14 would be extended or spread over the entire line interval. But this means that the line impulses themselves are subjected to amplitude modulation by the sound to be transmitted, that is, subjected to simple modulation as distinct from the double modulation to be discussed further below.

Another embodiment of the invention is illustrated in Fig. 2. Also in this case, inside each line interval, say, at the end of each such interval, a supplementary impulse 16 is transmitted being of a constant amplitude, though variable duration. The amplitude of these supplementary impulses is shown to fall below the so-called "black" level 13, and the length of the impulse is proportional to the prevailing instantaneous value of the sound.

In another exemplified embodiment illustrated in Fig. 3 in which the time axis is plotted on a scale four times larger than in Figs. 1 and 2, the video carrier wave is modulated, during the line intervals, by a sinusoidal auxiliary carrier wave the period of which is indicated by T_H . This auxiliary carrier whose half-period must be at any rate less than, or equal to, the duration of the line intervals, is in turn subjected to amplitude or frequency modulation in accordance with the instantaneous value of the sound. In other words, what is involved in the method illustrated in Fig. 3 is a double modulation of the video carrier by tonal amplitudes. It will be readily seen that what is concerned in the embodiment Fig. 1 is an amplitude modulation of a rectangular auxiliary carrier in the sense of Fig. 3, though the half-period of the said auxiliary carrier in the case of Fig. 1 is greater than in the case of Fig. 3. It will also be understood quite readily that Fig. 2 represents the case of frequency modulation of an auxiliary carrier in the sense of what has been explained by reference to Fig. 3. Also Figs. 1 and 2 refer to double modulation of the video signal carrier (picture carrier wave).

In the picture or frame interval, or, if television transmission by the interlace method is concerned, in the interval between two series or sequences of line (partial scans), the sound may be sent in the same way as before explained for the line intervals, i. e., at times corresponding to the line intervals.

Fig. 4 shows the embodiment of a transmitter adapted to practice the method and as applied to a so-called person or subject television (as distinct from a film television apparatus). 17 denotes a photo-electric cell, while 18 is the picture current amplifier. An R. F. amplifier 19 including the modulation stage feeds the aerial 20. The picture modulation potentials are transmitted to

the transmitter over line 21. 22 is the generator of the auxiliary carrier wave having, for instance, a period T_H as indicated in Fig. 3. This auxiliary carrier is modulated by way of a transformer 23 from a microphone, while, in turn, it modulates by way of transformer 24 the main carrier generator 19. The rectangle 25 schematically denotes a means whereby the auxiliary carrier generator 22 is blocked for the length of a line. It will thus be noted that in an arrangement as shown in Fig. 4, the line impulses are voice-modulated or doubly so by purely electrical means.

Figs. 5 and 6 illustrate a transmitter equipment in which the line impulses, by "photo-optical" means and ways are modulated by sound. Referring to Figs. 5 and 6, 25 denotes a Nipkow disk in which are illustrated, however, only the openings 26 which serve to transmit the sound accompaniment and to produce the line impulses, while the picture scanning holes have been omitted for the sake of simplicity. 27 denotes a photo-electric cell which is located inside a casing 28 which has an aperture 29 to admit the light. The equipment moreover comprises a source of light 30 and a diaphragm 31, an objective 32 which serves to image the slit of diaphragm 31 by way of a mirror 33 upon the Nipkow disk 25. The mirror 33 may either be directly secured upon a microphone diaphragm or else may be actuated and controlled by a light valve device of the kind employed in sound film recorder equipment, and which is traversed by the microphonic currents. The aperture 31 is imaged from the objective by way of the mirror 33 upon the surface of disk 25 in such a way that in the plane of the said disk an image of the aperture appears as indicated by the arrows P_1 and P_2 . When the mirror 33 oscillates the image P_2 of the aperture experiences a shift tangentially to the sense of rotation of the disk. The image of the diaphragm aperture which is shown shaded in Fig. 6, as will be noted, moves in the plane of Fig. 6 in vertical direction. The disk 25 shall be assumed to rotate in the direction indicated by arrow P_3 , Fig. 6, so that each of the openings 26, as soon as they come to register or coincide with opening 29 will expose the photo-electric cell 27. However, as long as an opening 26 moves inside the distance marked x in Fig. 6, the photocell 27 will not be illuminated. But as soon as a given opening 26 enters into the path of the pencil of rays which produces image P_2 of slit 31, a constant light flux will be caused to strike the said photocell; the length of such exposure corresponds to the distance marked y , and the same is a function of the position of the image P_2 upon the disk 25 in dependence upon the instantaneous value of the sound. It is only when the opening 26 reaches edge K that the flux or pencil of light will be intercepted again. Hence, during the line intervals which last the same length of time as an opening 26 requires to cover the distance $x + y$, there is produced in this device a supplemental impulse of the kind schematically illustrated at 16 in Fig. 2.

Fig. 7 illustrates an embodiment of a transmitter equipment which is adapted to transmit sound films and in which the means adapted to scan the picture picks up the sound track accompanying the pictorial part during the line intervals. The Nipkow disk 30 has a series of holes 31, and all of these may be disposed at equal distance from the center of the disk so that they are suited to scan a film traveling at a constant rate of speed. The visual portion of the sound film 32, as shown in Fig. 7 is just being scanned

by the hole 31', while the sound track, after transmission of the respective picture line, is picked up by the hole 31'' being two holes removed from hole 31'. The point where the picture scanning occurs, and the point where the sound track is being picked up are so shifted in relation to each other in the direction of the tangent to disk 30 that the pick-up of the sound track (effected, for example, by the aid of a sound pickup device of the kind used in sound film reproduction) will just take place at the instant when the line scan has been completed. It will be preferable to use with a scanning device of the kind shown in Fig. 7 a sound and picture film in which corresponding pictorial and acoustic track portions are displaced in reference to one another a definite distance, say the length of a film loop comprising, for instance, 19 frames as customary in the sound-film art.

The equipment shown in Fig. 7 could, however, also be modified in this manner that one and the same opening of the Nipkow disk which has just finished scanning a picture line picks up also the portion of the sound track which pertains to a given frame and which is directly adjacent the frame. This is illustrated in Figs. 8a and 8b.

Fig. 8a shows the scanning of a black-and-white contrast picture film together with the portion of the sound track pertaining thereto. Fig. 8b shows the modulation curve for lines 12 and 20 with the corresponding sound track portions; and it will be noted that this mode of sound track pickup is predicated upon frequency modulation of supplemental impulses during the line intervals.

Receiver equipment adapted to practice the method here disclosed has this salient characteristic feature that the part designed to receive the acoustic signals is blocked for the duration of the lines. This may be insured by providing in the receiver a tube in which the A. F. potential resulting from the demodulation of the incoming carrier wave occasions a shift of potential at the control grid in the negative sense. The circuit organization must be then chosen so that, in the presence of the black value 13 of the A. F. voltage, the tube is just operated in its lower band, while when the A. F. potential has a higher value, the tube is operated at a point of its characteristic below the bottom knee so that it furnishes no plate current. Hence, the voltage arising in the plate circuit contains no pictorial components, in fact, the only modulation it contains is the modulation of the line and optionally the framing impulses. The tonal current is then obtained by standard demodulator means.

In this scheme the receiver may preferably be so designed that the R. F. amplifier stages and optionally also intermediate-frequency amplifier stages are common to the picture and the sound parts.

The sound head may also conveniently comprise a stopper circuit for the framing impulses

frequency which lies inside the audible range and which amounts, for instance, to 25 cycles (or 50 cycles usually in the interlaced method) in order that interfering noise in the sound reproduction may be suppressed.

Having described my invention, what I claim is:

1. In an electrical signaling system, the method of transmitting television signals and sound signals sequentially, which comprises the steps of producing television image signals, generating a main carrier frequency, modulating the carrier by the television signals, producing an auxiliary carrier frequency, translating sound energy into electrical energy, modulating the produced auxiliary carrier wave energy by the electrical energy developed from the sound energy, interrupting the production of the television signals at equally spaced intervals and for a predetermined constant time duration, modulating the main carrier frequency by the sound modulated auxiliary carrier frequency, transmitting the carrier frequency as modulated by the television signals and by the modulated auxiliary carrier frequency over a transmission channel and limiting the transmission of sound signal energy and the modulation of the main carrier by the modulated auxiliary carrier wave energy to only the intervals of interruption of the produced television signals.

2. A television system comprising a transparent film having optical representations thereon and an accompanying track of sound indicia related to the optical representation, said sound track indicia being longitudinally displaced on the film by a fixed predetermined distance from its related optical representation, a single scanning element, and means including the scanning element for translating a light image of the two longitudinally spaced and two different portions of the film as representing the picture image and the sound indicia into electrical signal energy in which the picture signals and sound signals alternately occur and related picture and sound portion recorded on the film are sequentially transmitted.

3. Apparatus for producing constant frequency impulses of constant amplitude and varying time duration, comprising a source of light, a light valve, means to actuate the light valve by electrical signals representative of sound energy, means to project light from the source upon the light valve, an apertured housing, a photoelectric cell mounted within the housing and positioned in register with the aperture thereof, a Nipkow disk positioned in front of said housing, said Nipkow disk and housing being positioned with respect to the light valve to receive light from the light source only during predetermined time intervals under the control of the electrical signals representative of the sound energy.

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