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MEANS FOR TOUCHING UP RADIO PHOTOGRAPHS

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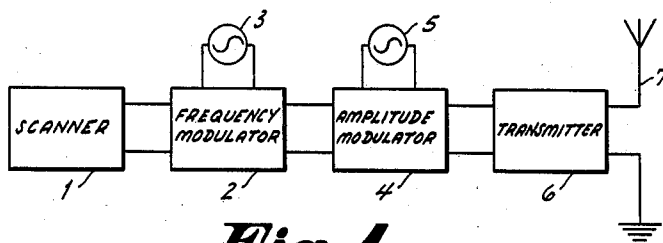


Fig. 1

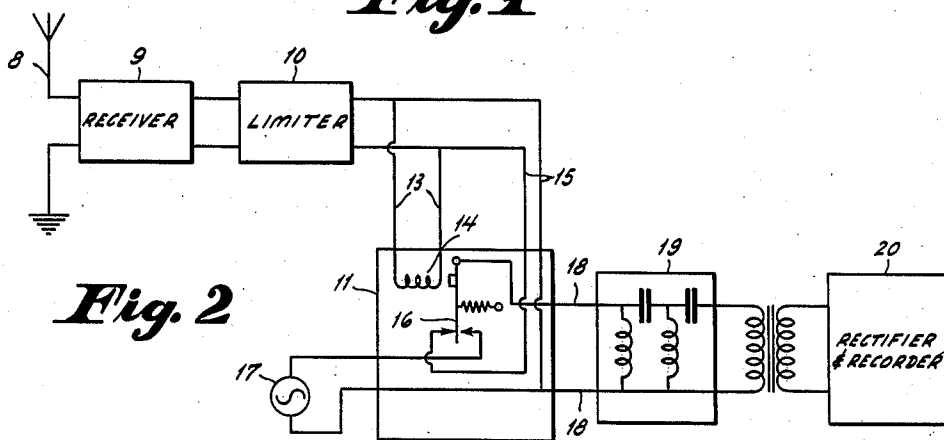


Fig. 2

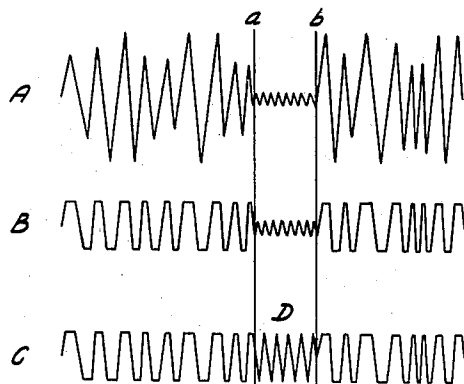


Fig. 3

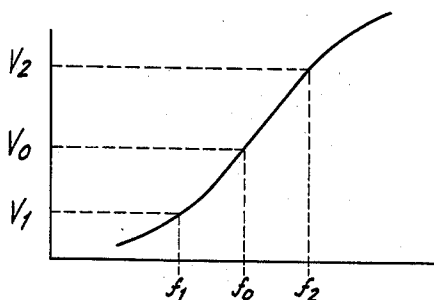


Fig. 4

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MEANS FOR TOUCHING UP RADIO
PHOTOGRAPHSJames Ernest Smith, Brooklyn, N. Y., assignor to
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2 Claims. (Cl. 178—6.7)

This invention relates to photo radio reception.

In facsimile and other photo radio transmitting systems the received signal often fades to, and below, the noise level during adverse multipath effects in the upper atmosphere. The effects appear as pronounced streaks in the received picture. These streaks are either white or black, depending upon the polarity of modulation.

It is an object of my invention to touch up the streaks in received pictures due to fading and other effects.

Another object of my invention is to add local indications that convert the white or black streaks in fading effects to gray so that they are not particularly noticeable.

Other objects will appear in the following description, reference being had to the drawing in which:

Fig. 1 is a block diagram illustrating a photo radio transmitter.

Fig. 2 is a block and diagrammatic illustration of a receiving system employing my invention.

Fig. 3 shows graphs illustrating principles of my invention.

Fig. 4 shows the voltage attenuation curve of the demodulator.

While my invention is useful with other forms of modulation I have illustrated it in connection with facsimile and other photo radio systems in which the modulations are produced by varying the frequency of the carrier.

Referring to Fig. 1, scanning device 1 has its varying output feeding into modulator 2 varying a sub-carrier frequency produced by low frequency generator 3. The varying frequency output containing the picture modulations pass into modulator 4 which varies the amplitude of radio frequency generator 5. The output of modulator 4 passes into transmitting apparatus 6 and the signal is radiated by antenna 7. The scanning apparatus 1, frequency modulator 2, generators 3 and 5, amplitude modulator 4, transmitting apparatus 6 and antenna 7 may be of any desired form and the details of these are no part of my invention. Consequently they are shown and described only generally for a clearer understanding of my improvement which resides particularly in the receiving system. At the receiver end of the system the modulated signal is received on antenna 8 and is amplified, detected and further amplified by the receiving apparatus 9. The output of receiver 9 therefore consists of the variable sub-carrier frequency which contains the frequency modulations imposed at the distant transmitter.

In general this also will contain modulations and fade-outs produced by static and other atmospheric causes. This low frequency output from receiving apparatus 9 passes into limiter 10 which cuts off portions of the negative and positive halves of the waves and thus eliminates the amplitude modulations produced by fading. Complete fade-outs, or fade-outs that descend into the noise level, are not eliminated by limiter 10 and it is here that my improvement enters. The output of limiter 10 is fed into a switching device 11 which preferably is of the electron type described in my joint application, Serial No. 270,332, filed April 27, 1939. The particular type of switch forms no part of my invention claimed herein and therefore to simplify the disclosure and aid in its understanding I have illustrated the switch 11 diagrammatically only, but it would be understood that the details of this switch will not be of the simple type actually disclosed. As I have thus illustrated it, the output of the limiter 10 has control lines 13 feeding into control coil 14 and output lines 15, the continuity of which is controlled by switching device 16 under control of coil 14. The switching device 16 also controls the continuity of local generator 17 which produces the "touching up" energy that eliminates the white or black streaks caused by fading, as previously referred to. The output lines 18 from the switch 11 are connected to a frequency demodulator converter 19 which may be of any sort but for simplicity of disclosure I have shown it as a high pass filter containing series capacity and shunt inductance. The output of the converter passes into appropriate rectifying and recording apparatus generally indicated at 20. The receiving, detecting and amplifying apparatus 9 and the rectifying and recording apparatus 20 may be of any sort as these devices are old and well known. The limiting apparatus 10 may also be of any desired type but preferably it would be that shown in my joint application above referred to.

The operation of the system will be as follows:

The scanning apparatus will modulate the sub-carrier frequency of generator 3 and 6 and the varying frequency output will amplitude-modulate the radio frequency carrier 5. The sub-carrier may be of any desired low frequency but a band within the range of 800 cycles to 2000 cycles mentioned in my joint application above referred to will be found satisfactory.

The output of modulator 4 passes into the transmitting apparatus 6 at the transmitting station and is radiated by antenna 7. The antenna

8 of the distant receiver in Fig. 2 will receive the modulated radio frequency carrier and this will be appropriately amplified at radio frequency, detected and amplified at audio frequency by the receiving apparatus 9. The output of this receiving apparatus is illustrated by graph A in Fig. 3, where the varying frequency of the modulated sub-carrier is clearly indicated. The fading effects are also indicated in this graph and between the points *a* and *b* it will be noted that substantially a complete fade-out has occurred. When the wave is passed through the limiter 10 the output will be as indicated by graph B of Fig. 3. This of course has the variable frequency present in graph A but the peaks have been eliminated by passage through this device, but the wave is substantially completely blocked out between the lines *a* and *b*, as in graph A. When this portion of the wave reaches the switch 11 the control device typified by 14, 16, will switch out the control lines 15 from limiter 10 and will switch in the local oscillator 17. This local oscillator will therefore fill in the graph at *d* with energy of the same amplitude and constant frequency as indicated. Obviously limiter 10 or another limiter can be placed after the switch 11 if desired so that the output will have the same amplitude for the local energy as well as that coming from the receiver.

If the upper limit of the modulation band F_2 (Fig. 4) is 2000 cycles, and the lower limit F_1 is 1000, then the frequency of local oscillator 17 will be adjusted to have a frequency of F_0 substantially half way between these two values. This means that when the fade-out occurs as between the lines *a*, *b*, in graph A instead of having a white streak or a black streak, as the case may be, there will be a gray portion which is neutral and will be substantially unnoticeable.

As soon as the point B is reached, the voltage in coil 4 will be such as to throw the switch 16 to pass the energy in lines 15 to the frequency demodulator 19 and interrupt the source.

In this way as the signal fades out or into the noise level instead of the black or white streak in any particular type of recorder, a gray portion will be produced that has a less harsh or pleasing appearance. In other words, my improvement

automatically touches up the defects of the recorded picture somewhat analogous to the touching up of a picture by a photographer, but of course it is done at high speed by the electron type of switch and it is entirely automatic. Instead of using my improvement with frequency modulated signals which are converted into varying amplitude signal voltages V_1 , V_0 , V_2 , by the varying frequencies, as indicated in Fig. 4, it will be quite apparent that the same effect can be produced when variable amplitude modulation is produced by the scanning apparatus, as the constant output and constant frequency of local generator 17 would still produce a medium amplitude that would produce gray in the picture.

In disclosing my improvement I have necessarily referred to particular apparatus but this has been by way of example only and various modifications may be used without departing from the spirit of the invention.

Having described my invention, what I claim is:

1. In signalling apparatus, a source of frequency modulated signal waves, a local source of oscillations having constant frequency intermediate the upper and lower limits of the frequency modulation of the signal waves, means for limiting the amplitude of the frequency modulated waves to eliminate spurious amplitude increase, and means to demodulate the frequency modulation of the signal waves when the signal strength is above a predetermined value and to demodulate the constant frequency modulation of the local source when the signal is therebelow.

2. In signalling apparatus, a source of frequency modulated signal waves, a demodulator for converting the frequency modulation into amplitude modulation, a local source of oscillations having a constant frequency intermediate the upper and lower limits of the frequency modulation of the signal waves, means for limiting the amplitude of the frequency modulated waves to eliminate spurious amplitude increase, and means for connecting the demodulator to the limiter to receive the signal wave when it is above a predetermined amplitude and to the local source when it is therebelow.

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