SEARCH ROOM

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CIRCUIT FOR DETERMINING CARRIER FREQUENCIES OF FREQUENCY MODULATED SIGNALS

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FIG. 1

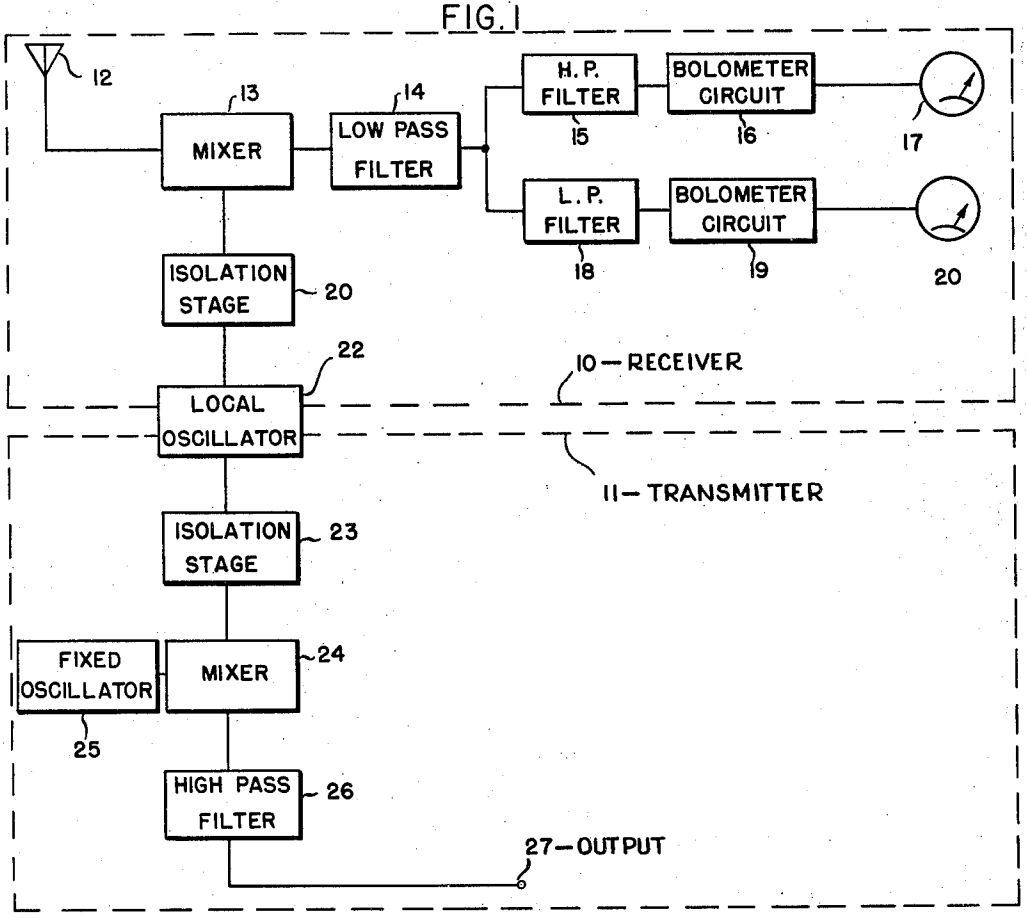
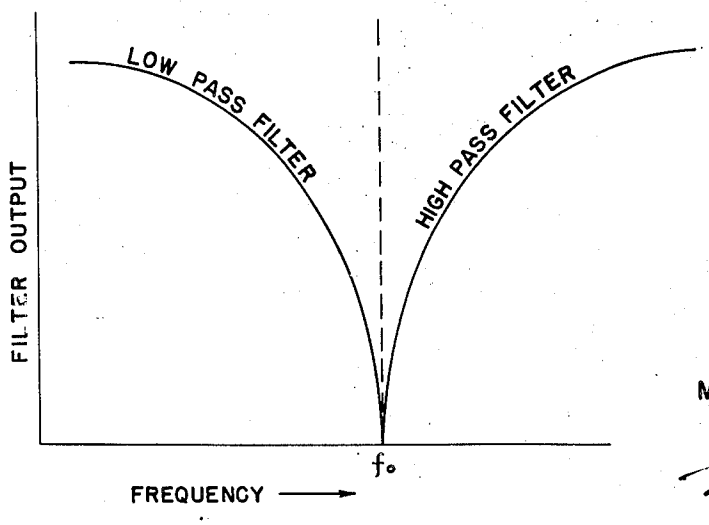


FIG. 2



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CIRCUIT FOR DETERMINING CARRIER FREQUENCIES OF FREQUENCY MODULATED SIGNALS

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2 Claims. (Cl. 250—17)

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This invention relates generally to electrical apparatus and more particularly to apparatus for producing interference upon (jamming) a communication channel.

A method of jamming a frequency modulated signal is to repeatedly sweep the jamming signal through a frequency spectrum which includes the carrier frequency of the frequency modulated signal. This sometimes proves unsatisfactory, since there may be other communication channels in the same frequency spectrum which should not be interfered with.

Another method of jamming a frequency modulated signal channel is to generate a signal of the same carrier frequency as that of the channel to be jammed. This minimizes interference to other channels and improves the effectiveness of the jamming apparatus. This method, however, poses difficulties in determining and reproducing the carrier frequency.

It is, therefore, an object of this invention to provide means for determining the carrier frequency of a received frequency modulated signal.

Another object is to provide means for generating a jamming signal at the carrier frequency of a selected frequency modulated signal.

Other objects, features, and advantages of the invention will suggest themselves to those skilled in the art and will be apparent from the following description of the invention taken in connection with the accompanying drawing in which:

Fig. 1 is a block diagram of the frequency determining and generating circuits; and

Fig. 2 is a graph of the transmission curves of the matched filters shown in the frequency determining circuit of Fig. 1.

Referring now more particularly to Fig. 1, the circuit components are for purposes of description divided into two groups which are shown enclosed by dotted line blocks. That group enclosed by the dotted line block 10 comprises the circuit in which the carrier frequency of the signal to be jammed is determined, hereinafter termed the frequency determining circuit; and that portion enclosed by the dotted line block 11 comprises the circuit for generating a signal at the said carrier frequency. A variable frequency local oscillator 22 is common to both circuits as shown, and is connected to mixers 13 and 24 through isolating stages 20 and 23, respectively. There is also connected to mixer 13 an input circuit from an antenna 12. The output of mixer 13 passes through a low-pass filter 14 to two filters 15 and 18 having their input circuits connected

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in parallel. The outputs of filters 15 and 18 are connected to direct reading meters 17 and 20 through bolometer circuits 16 and 19, respectively. A fixed frequency oscillator 25 is connected to a mixer 24, and the output of the mixer 24 passes through a high-pass filter 26 to an output terminal 27 as shown.

In operation, the frequency modulated signal received at the antenna 12 is fed into the mixer 13 where it is combined with the signal generated by local oscillator 22. The output of mixer 13 passes through the low-pass filter 14, which is designed to pass only the difference frequency of the incoming signal and the local oscillator, into the pair of filters 15 and 18. The energy passed by each of these filters 15 and 18 is measured by means of the bolometer circuits 16 and 19 and the output meters 17 and 20, respectively. Filters 15 and 18 are high-pass and low-pass filters, respectively, having transmission characteristics interrelated as indicated in Fig. 2, and are hereinafter referred to as matched filters. The frequency of local oscillator 22 is adjusted until the two output meters indicate that the same amount of energy is being passed by the high-pass filter 15 as is passed by the low-pass filter 18. Thus, the local oscillator 22 is then so tuned that the difference in frequency between the local oscillator and the carrier of the incoming frequency modulated signal is equal to the common cutoff frequency f_0 of the matched filters 15 and 18.

In the frequency generating or transmitter circuit shown in dotted line block 11, the fixed frequency oscillator 25 is pre-set to operate at the cutoff frequency of the matched high-pass and low-pass filters 15 and 18. The combination of the local oscillator signal with the fixed oscillator signal in mixer 24 produces a jamming signal having the carrier frequency of the incoming signal. The output of mixer 24 passes through a high-pass filter 26 designed to transmit only the sum frequency which results from the addition of the fixed oscillator frequency and the frequency of the local oscillator 22. The frequency of the output signal from filter 26 is thus the same as the carrier frequency of the received frequency modulated signal.

As an example of operation, we may assume that the apparatus is to operate over a frequency range between 175 and 225 megacycles. The low-pass filter 14 is then designed to have a cutoff frequency of 100 megacycles. The matched filters 15 and 18 are designed to have a common cutoff frequency of 75 megacycles. The local oscil-

lator 22 is adapted to be tuned between 100 and 150 megacycles. For an incoming frequency modulated signal having a carrier frequency of 200 megacycles, when the local oscillator 22 is tuned to 125 megacycles the energy passed by the high-pass filter 15 will be equal to that passed by the low-pass filter 18, and the two output meters will give identical readings. The frequency of the incoming signal may be determined by adding the cutoff frequency of matched filters 15 and 18 to the frequency of local oscillator 22. Thus, in this instance, the carrier frequency of the incoming signal so determined is 200 megacycles. Local oscillator 22 may, if desired, be calibrated, although this does not alter or increase the effectiveness of the described jamming apparatus in generating a signal at the carrier frequency of the incoming signal.

In the transmitter circuit, the fixed frequency oscillator 25 generates a signal of the same frequency as the cutoff frequency of matched filters 15 and 18, which in this example is 75 megacycles. This signal combines with that of the local oscillator in mixer 24, and, from the high-pass filter 26 connected thereto, there is obtained a jamming signal having, in this instance, a carrier frequency of 200 megacycles which is the same as that of the received signal.

It will be seen that the invention herein described provides a simple and effective means for determining the carrier frequency of a frequency modulated signal and for simultaneously generating a jamming signal having the same frequency.

While there has been described what is at present considered to be a preferred embodiment of the invention, it will be obvious to those skilled in the art that various changes and modifications may be made therein without departing from the scope and spirit of the invention as set forth in the appended claims.

What is claimed is:

1. A circuit for determining the carrier frequency of a received frequency modulated signal and for transmitting a signal at said carrier frequency, said circuit comprising a carrier frequency determining means, a carrier frequency generating means, and a variable frequency local oscillator; said carrier frequency determining means comprising an antenna, an input mixer connected to said antenna and to said local oscillator, the output of said mixer containing the difference frequency between said received signal and the output of said local oscillator, a high pass filter and a low pass filter connected in parallel to receive said difference frequency, said filters being matched and having a common predetermined cutoff frequency, and energy indicating means connected to the output of each of said filters for indicating when the difference frequency between said variable frequency local oscillator and said received signal is equal to said predetermined cut-off frequency; said frequency generating means comprising a fixed oscillator operating at said cutoff frequency, an output mixer connected to said local and fixed oscillators, the output of said output mixer containing the sum frequency of said oscillators, said sum frequency being equal to the frequency of said received signal when said means indicate equal values.

2. A method for jamming an undetermined frequency modulated signal comprising receiving said signal, generating a local signal, heterodyning said signals, deriving a modulated frequency difference signal therefrom, filtering all frequencies contained in said difference signal above a predetermined frequency into a first channel, filtering all frequencies contained in said difference frequency signal below said predetermined frequency into a second channel, measuring the outputs of each channel, varying the frequency of the locally generated signal until the outputs of said channels are equal, generating a second local signal at said predetermined frequency, heterodyning both of said local signals, deriving a sum frequency therefrom, and transmitting said sum frequency.

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