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RADIO REPEATER

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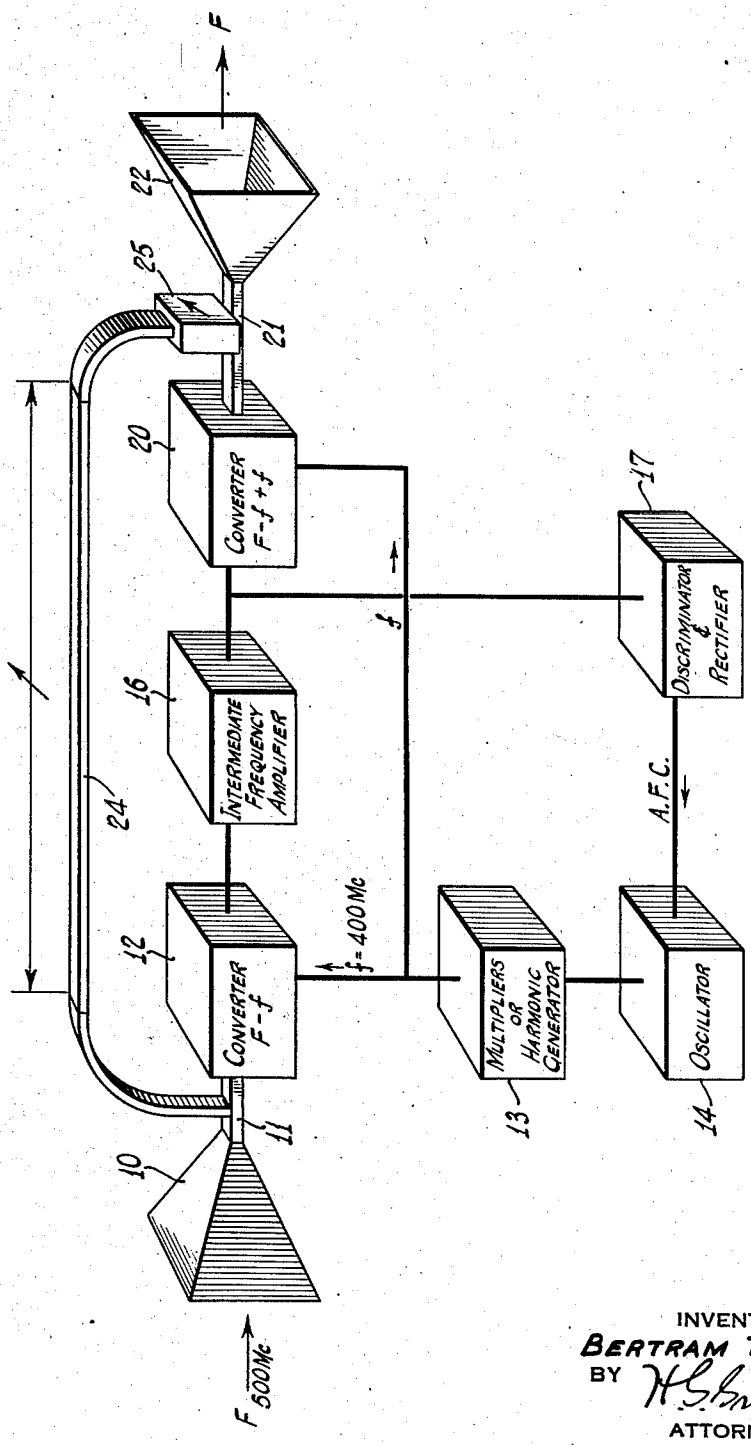

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RADIO REPEATER

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6 Claims. (Cl. 250—15)

The present invention relates to radio repeater systems and, more particularly, to a means for controlling the operating frequencies of the radio links in said system.

An object of the present invention is the provision of a radio repeater station having an accurately controlled output frequency.

Another object of the present invention is the provision of a repeater station in which the incoming frequency is converted to a lower frequency for amplification and reconverted to a high frequency for retransmission.

A further object of the present invention is the provision of a repeater station, as aforesaid, which requires only a single local oscillator for the required frequency conversions.

Another object of the present invention is the provision of a repeater station, as aforesaid, in which a change of oscillator frequency has no effect in the frequency of retransmission.

Still another object of the present invention is the provision of a relay station which does not require careful balancing of the circuits therein.

Still another object of the present invention is the provision of a single frequency relay system.

Still a further object is the provision of a relay station requiring a minimum amount of auxiliary equipment such as oscillation generators, multiplying stages, etc.

The foregoing objects, and others which may appear from the following detailed description, are attained by the provision of a relay station having a single source of high frequency oscillations which is used at the input of the station to change the received signals to an intermediate frequency and at the output to change the intermediate frequency to the frequency of retransmission.

The invention will be more fully understood by reference to the following detailed description, which is accompanied by a drawing illustrating an embodiment of the present invention.

Referring, now, to the figure, incoming signals are received on a directional receiving antenna 10 of the horn type directed toward the immediately preceding relay station of the system. An operating frequency F' of 500 megacycles has been assumed, for the sake of illustration, but other frequencies may be used if desired. The received signals are carried through wave guide 11 to a converter 12. Amplifiers (not shown) may be interposed between antenna 10 and converter 12 if desired. Oscillations at a frequency F of 400 megacycles, for example, from oscillator 14 are also applied to the converter 12. The 400 megacycle wave may be generated in oscillator 14 or a lower frequency may be generated and higher harmonics obtained through multiplier 13. Oscillator 14 may be either a line controlled or otherwise stabilized oscillator or it may be controlled from a crystal oscillator source. It should preferably have an output of from 2 to 3 watts though only a small amount of this energy is used in the converter 12 for converting the incoming signal. The resultant output from converter 12 at a first intermediate frequency of 100 megacycles is applied to an intermediate frequency amplifier 16. The output from amplifier 16 is applied to a converter 20 where it is mixed with the output from oscillator 14 and converted to the output frequency F' of 500 megacycles which is radiated by directive antenna horn 22 directed toward the next relay station of the system.

It will be noted that the first conversion in the station requires only a small amount of energy from oscillator 14 and the remainder is used for high level conversion in converter 20.

In the foregoing description the frequencies used were used only as an illustration and it may, under some circumstances, be more economical from the power standpoint to use a higher intermediate frequency so that the oscillator frequency generated by oscillator 14 may be lower and the oscillator, therefore, may be more efficient.

It should further be noted that in an arrangement constructed according to the present invention the incoming and outgoing frequencies are identical and are independent of any change in frequency of the local oscillator. If desired, a frequency discriminator and rectifier 17 may be coupled to the intermediate frequency channel at either side of amplifier 16 and the variable direct potential developed thereby utilized as an automatic frequency control bias on oscillator 14. Thus, any shift of the oscillator frequency which would tend to shift the intermediate frequency is counteracted. This may be desirable in wide band transmission in order to obviate any possibility of side band clipping in amplifier 16 due to frequency shift.

In the arrangement shown in the figure, the amount of gain which can be used will depend upon the degree of feed back from the transmitting to the receiving antenna. This feed back can be reduced by making the antenna directivities very good as by the use of highly directive

horn antennas, though other wave directive structures may be used if desired. An adjustable feed back path may be provided such that the amplitude and phase of the feed back energy are equal and opposite to the extraneous space feed back between antennas 10 and 22. The adjustable feed back path may consist of a transmission line or wave guide 24 extending from one antenna to the other or from wave guide or transmission line 21 to wave guide or transmission line 11. Its electrical length is preferably adjustable as shown by the variable dimension line and should be chosen to be as near as possible to the length of the free space feed back path between the antennas. An adjustable probe may be provided at each end of the line or guide 24 and extending into guides 11 and 21 or into the horns 10 and 22 to allow the amplitude balance to be made or an adjustable amplitude control 25 may be inserted into the wave guide 24. In some cases, antennas with parabolic reflectors may be used.

While I have shown and particularly described several embodiments of my invention, it is to be distinctly understood that my invention is not limited thereto but that modifications within the scope of my invention may be made.

I claim:

1. A wide band radio relay station having input and output circuits operating to cover the same band of frequencies, a frequency converter in each of said circuits, a single source of high frequency energy coupled to said converters, a wide band intermediate frequency channel connecting said input and output circuits and means for obtaining from said intermediate frequency channel a potential variable in polarity and amplitude with departure of energy in said channel from a central position with respect to the pass band of said channel and means for utilizing said potential for controlling the frequency of energy supplied by said source.

2. A wide band radio relay station having input and output circuits operating to cover the same band of frequencies, a frequency converter in each of said circuits, a single source of high frequency energy coupled to said converters, a wide band intermediate frequency channel connecting said input and output circuits, said single source including a low frequency oscillator and frequency multiplying means between said oscillator and said converters and means for preventing side band clipping in said intermediate frequency channel, including means for obtaining from said intermediate frequency channel a potential variable in polarity and amplitude with departure of the mediate frequency of said intermediate frequency band from the midpoint of the pass band of said channel and means for utilizing said potential for controlling the operating frequency of said oscillator.

3. A station as set forth in claim 1 in which feed back means are provided between said input and output circuits.

4. A station as set forth in claim 1 in which feedback means are provided between said input and output circuits, said means including phase and amplitude adjusting means.

5. A station as set forth in claim 1 in which feed back means are provided between said input and output circuits, said means including a restricted channel for high frequency energy, the length of said channel being adjustable.

6. In a radiant energy system, energy receiving means and energy radiating means, each operative over the same wide band of frequencies, each of said means including wave directive structures, wave guides coupled to each of said directive structures, wide band amplifying means coupled between said wave guides and means for obtaining from said amplifying means a potential variable in polarity and amplitude with departure of energy in said amplifying means from a central position with respect to the pass band of said amplifier and means for utilizing said potential to restore the energy distribution in said amplifier to a central position with respect to said pass band, and another wave guide constituting a feed back path between said first mentioned wave guides.

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