

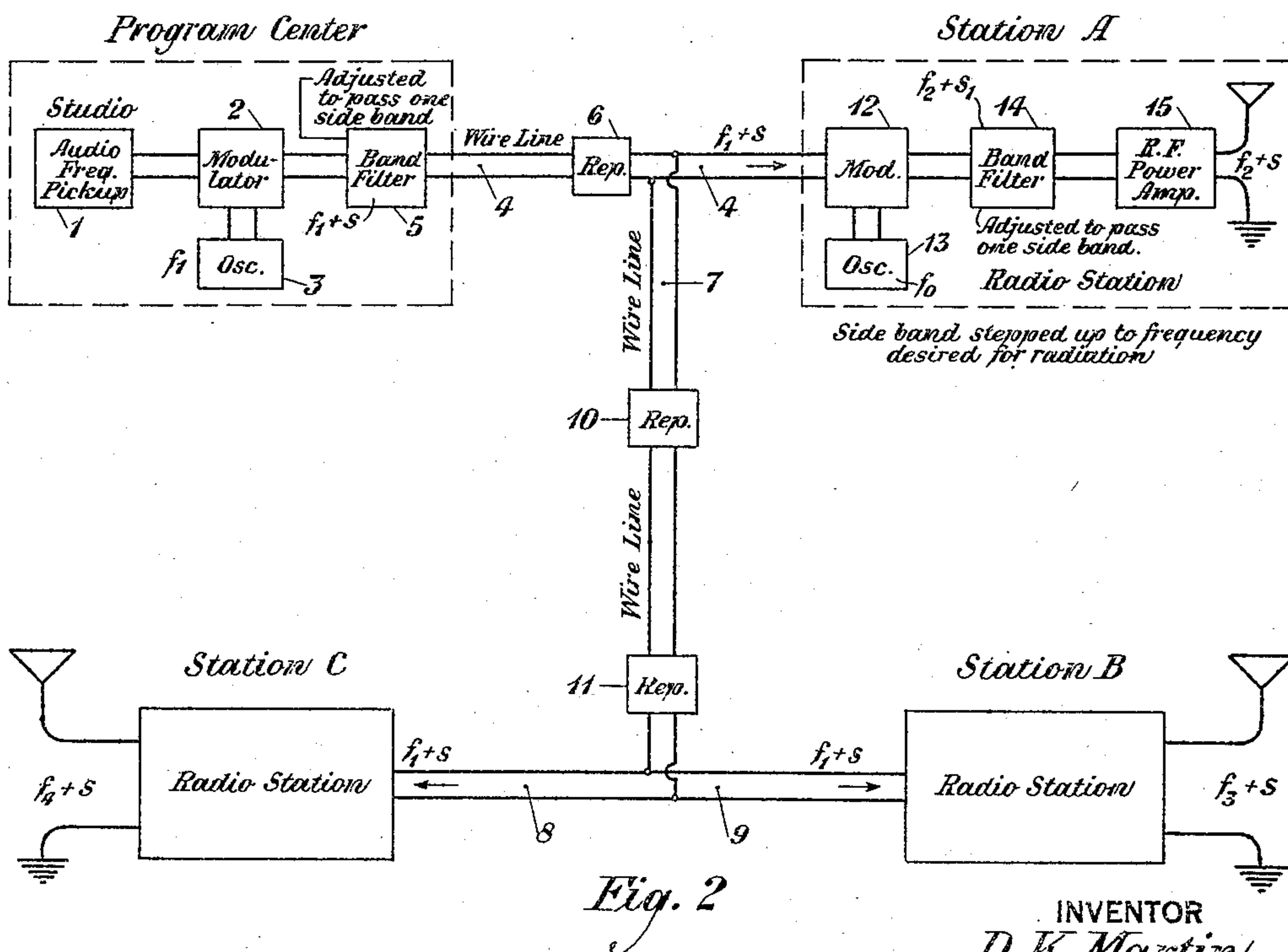
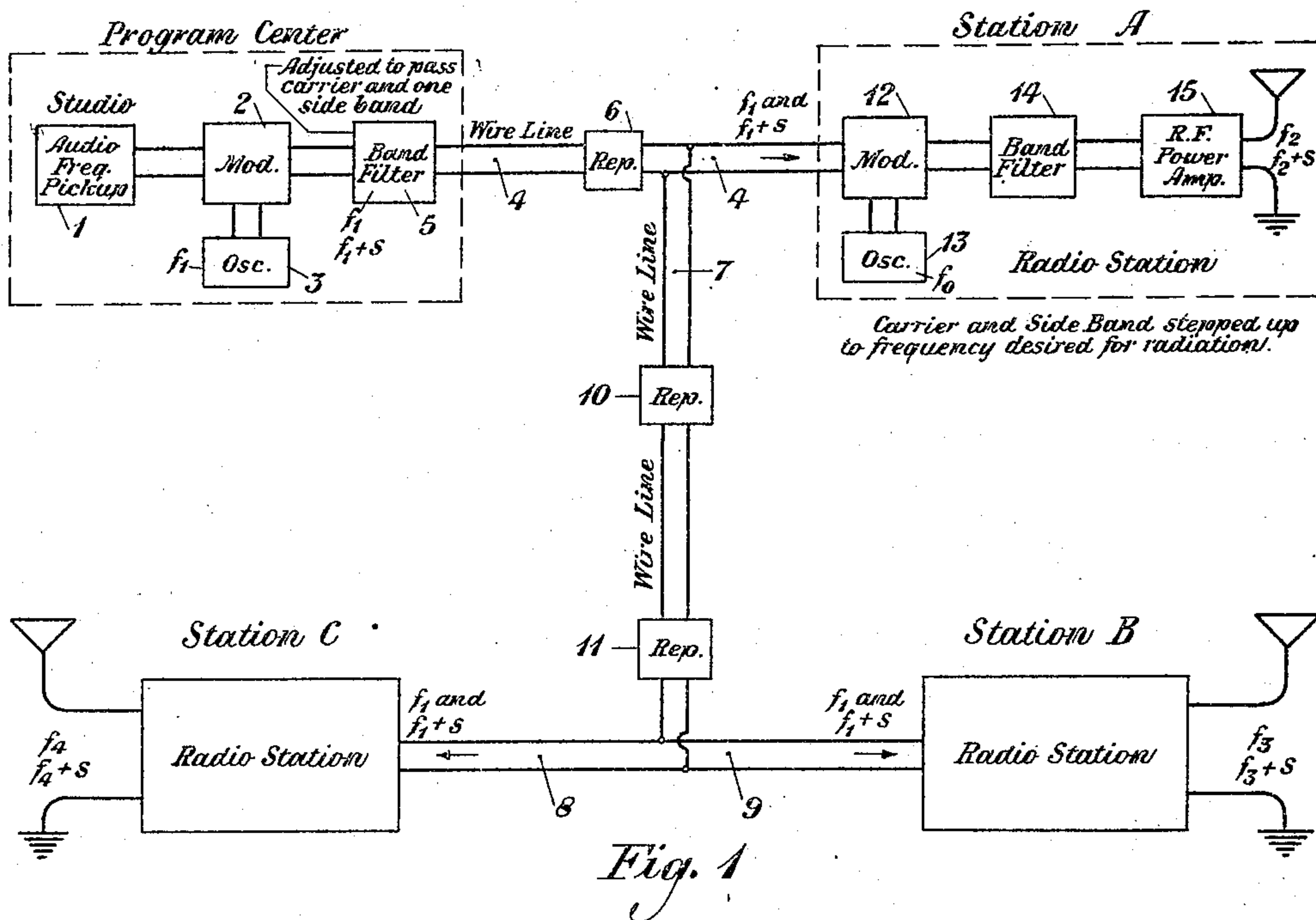
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RADIO SIGNALING SYSTEM

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RADIO SIGNALING SYSTEM

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This invention relates to radio signaling systems, and particularly to a system of that type intended for broadcasting purposes.

As is well known, a plurality of radio broadcasting stations are frequently connected by wire lines with what may be termed a program center, that is to say, a station where the program is put upon the wire circuit for transmission to each of the broadcasting stations. In the radio broadcasting art it is not uncommon to connect together a plurality of broadcasting stations which are widely separated geographically. It has been found that the transmission of an audio frequency band over a long transmission line produces distortion of the band, such distortion arising from the characteristics of the line and the transformers in the repeating apparatus. It has been found that by raising the band to a higher position in the frequency spectrum before applying it to the wire line, it is possible to transmit the band with greater uniformity, that is to say, less distortion than where audio frequency transmission is employed.

One of the objects of this invention is to reduce the magnitude of the distortion resulting from the transmission of the frequency bands over the wire network of a multi-station radio broadcasting system by raising the frequencies of the transmitted band.

Another object of this invention resides in modulating the radio carrier frequency at the broadcasting stations directly by the intermediate frequency band received thereat from the wire line. This method eliminates distortion which is present in those systems in which an incoming modulated carrier frequency is demodulated to produce the audio frequency signal which is then employed to modulate the radio frequency carrier. In such systems the trouble arises from the transmission characteristics of the audio frequency circuits at the broadcasting stations which will always, to a certain extent, distort the audio frequency band.

Other objects of this invention will also be apparent from the following description when read in connection with the attached

drawings, of which Figure 1 shows schematically a form of embodiment of the invention to effect transmission over a wire line to a plurality of broadcasting antennae of a carrier frequency and also one of the side bands of the carrier, the frequencies employed throughout the wire system being of course different from this transmitted from the antennae; and Fig. 2 represents a similar arrangement to effect single side-band transmission over the lines and also from the antennae, the band transmitted over the line being, however, of different frequency from that sent from the antennae.

Fig. 1 represents a program center connected with three broadcasting stations designated A, B and C. It will of course be understood that the invention may be embodied in a system employing any number of stations. The program center comprises what is termed an audio frequency pick-up, designated 1, which is connected with the modulator 2, having connected therewith a source of oscillations 3, of the frequency f_1 . While the modulator and the oscillator may be of any type, a desirable form would of course be the vacuum tube type. The output of the modulator 2 is connected with the wire line 4 through the band filter 5. This filter, which is of the type shown in the patent to Campbell, 1,227,113, is designed to transmit the carrier f_1 and one of the side bands resulting from modulation of the carrier frequency f_1 by the audio frequency s , the band being represented by $f_1 + s$. The frequency f_1 of the carrier is within the range suitable for transmission over a wire circuit, that is to say, between 5 and 30 kilocycles. The wire line 4 extends to the broadcasting station A and has therein a repeater 6 to compensate for the attenuation of this circuit. Another wire line 7 is connected with the line 4 and also with the lines 8 and 9 to connect the stations B and C with the program center. Repeaters 10 and 11 are included in the wire line 7. It will of course be understood that the number of repeaters employed will depend upon the transmission level that it is desired to maintain over the system. The broadcasting station A, which is similar to B and C, comprises a

modulator 12 with which is connected an oscillator 13, producing a frequency f_0 . The output side of the modulator is connected through the band filter 14 with a radio frequency power amplifier 15. The band filter, which is of the Campbell type, is designed to pass a radio frequency carrier f_2 equal to $f_0 + f_1$ and also one of the side bands $f_2 + s$ produced by the modulation of the radio frequency f_0 by the side band $f_1 + s$. As stated, the stations B and C are similar to station A with the exception that the oscillations produced by oscillators similar to 13 would preferably have a different frequency, so that the carrier frequency and the side band frequencies transmitted from the antennæ of B and C would each be different from the corresponding frequencies transmitted from station A. Thus the carrier frequency from B and C may be represented by f_3 and f_4 , respectively, and the side bands by $f_3 + s$ and $f_4 + s$, respectively.

It seems desirable to point out that the essential parts of the audio frequency pick-up 1, shown in connection with the program center, are a source of audio frequency current obtained from voice, music, or other sources of sound, together with the necessary apparatus for picking up and amplifying such currents. It is desired to point out that the source of sound, that is to say, the voice or instrument, may be at the studio where the modulator, oscillator and other apparatus constituting the program center, are located, or such sources of sound may be at some distance from the program center and connected therewith by a wire circuit, the length of which would not be sufficiently great as to introduce the distortion mentioned hereinbefore with reference to the wire lines, so that it would be unnecessary to employ a carrier frequency over the wire line connecting the transmitter at the source of the sound with the program center.

The audio-frequency current set up in the voice frequency pick-up line will be impressed upon the modulator 2 and will be beaten therein with the carrier oscillations f_1 from the source 3. The frequencies resulting from modulation will be impressed upon the band filter 5, which is designed to pass the frequency f_1 and also side band $f_1 + s$. These frequencies, when amplified by repeaters 6, would be impressed upon the station A, and with the additional amplification of repeaters 10 and 11 upon stations B and C. It will be necessary to describe what happens at station A only, because the action of stations B and C is substantially identical, the difference residing only in the frequencies employed. The low frequency carrier f_1 and the frequencies of the side band $f_1 + s$ will be impressed by the line 4 upon the modulator 12 wherein they will be beaten with the radio frequency f_0 supplied by the

oscillator 13. Without setting forth all the frequencies that result from this modulating step which would be impressed upon the band filter 14, it may be stated that this filter is designed to pass only the frequency f_2 and the band of frequencies $f_2 + s$, f_2 being equal to $f_0 + f_1$, and $f_2 + s$ being equal to $f_0 + f_1 + s$. These frequencies, when amplified by the power amplifier 15, are radiated from the associated antenna.

By modulating a low frequency carrier current by the audio frequency and transmitting one of the bands resulting from modulation instead of transmitting the audio frequency directly over the wire line to the broadcasting stations, the distortion inherent in audio frequency transmission is eliminated. This arises from the fact that by transmitting at the higher range of frequencies the distortion in the band of frequencies equal to the voice frequency range may be made negligible for the complete circuit, including the wire line and repeating apparatus. Furthermore, by modulating the radio frequency carrier directly by this intermediate frequency band instead of detecting the audio frequency from the intermediate frequency before modulating the radio frequency carrier, it is practicable to eliminate the loss incidental to the use of audio frequency apparatus.

The arrangement shown in Fig. 2 is structurally the same as that shown in Fig. 1, the difference being in the adjustment of the band filters, which are designed to suppress the carrier and one band of frequencies resulting from modulation, and to transmit only the other band. Thus, in Fig. 2, the band filter 5 transmits only the band $f_1 + s$, and in like manner the filter 14 transmits the band $f_2 + s$. By this method it is possible to transmit and broadcast signals of uniform high quality from a large number of radio broadcasting stations connected in multiple to an extensive wire distributing network. This is due to the fact that the accumulated transmission distortion of audio frequency circuits and apparatus has been eliminated by changing the audio frequency to an intermediate frequency for transmission over the wire circuit. The advantage of single side band transmission over transmission of the side band with the carrier, resides in the ability to use smaller amplifiers at the repeating points, which is rendered possible from the smaller amount of energy transmitted over the wire lines.

While this invention has been disclosed as embodied in particular forms, it is to be understood that it is capable of embodiment in other and different forms without departing from the spirit and scope of the appended claims.

What is claimed is:

1. In a system comprising a plurality of

radio broadcasting stations, a program center, and a plurality of circuits connecting the said center with each of said broadcasting stations, the method which consists in modulating by an audio frequency a carrier current of intermediate frequency suitable for transmission over a wire line, transmitting to each broadcasting station the carrier frequency and one of the side bands resulting from modulation of the said carrier by the said audio frequency, modulating at each broadcasting station a radio frequency carrier by the said intermediate frequency carrier and its side band, and radiating one of the side bands produced by the modulation of the said radio frequency carrier by a band of frequencies consisting of the said intermediate frequency carrier and the side band transmitted therewith over the said wire line.

2. In a system comprising a plurality of radio broadcasting stations, a program center, and a plurality of circuits connecting the said center with each of said broadcasting stations, the method which consists in modulating by audio frequencies a carrier current of intermediate frequency suitable for transmission over a wire line, selecting the carrier frequency and one of the side bands and transmitting to each broadcasting station the said carrier and the selected side band, modulating at each broadcasting station, a radio frequency current by a band of frequency comprising the said intermediate frequency carrier and its side band, selecting and radiating one of the side bands produced by the modulation of the said radio frequency carrier by the said band of frequencies consisting of the said intermediate frequency carrier and side band transmitted therewith over the said wire line.

3. In a system comprising a plurality of radio broadcasting stations, a program center, and a plurality of circuits connecting the said center with each of said broadcasting stations, the method which consists in modulating by audio frequencies a carrier current of intermediate frequency suitable for transmission over a wire line, selecting the said carrier and one side band, transmitting to each broadcasting station the selected carrier and side band frequencies and amplifying such frequencies during the said transmission, modulating at each broadcasting station a radio frequency carrier by a band of frequencies comprising the said intermediate frequency carrier and its side band, selecting one of the side bands produced by the modulation of the said radio frequency carrier by the said band consisting of the said intermediate frequency carrier and the side band transmitted therewith over the said wire line, and radiating the side band as thus selected.

4. In a system comprising a plurality of radio broadcasting stations, a program cen-

ter, and a plurality of circuits connecting the said center with each of said broadcasting stations, the method which consists in modulating by audio frequencies a carrier current of intermediate frequency suitable for transmission over a wire line, selecting the said carrier and one side band, transmitting to each broadcasting station the selected carrier and side band frequencies and amplifying such frequencies during the said transmission, modulating at each broadcasting station a radio frequency carrier by a band of frequencies comprising the said intermediate frequency carrier and its side band, selecting one of the side band combinations resulting from the last modulating step the said combination comprising a broadcast carrier resulting from beating the radio frequency carrier by the intermediate frequency carrier, and that side band resulting from modulating the radio frequency carrier by the intermediate frequency side band which, when beaten with the said selected broadcast carrier, will produce the audio frequency, and amplifying and radiating the selected frequencies.

5. The method of effecting radio broadcast transmission of a single side band, together with its carrier to permit of ready detection of the program by broadcast receivers, which consists in modulating by the audio frequencies of the program a carrier whose frequency is intermediate between the audio frequencies and the frequency of broadcast radiation, eliminating one of the side bands and transmitting the carrier with the remaining side band, modulating a radio frequency carrier by a band of frequencies comprising the single side band and the first mentioned carrier, selecting and radiating one of the resulting side band combinations, comprising a carrier and a single side band, and suppressing the other components comprising the radio frequency carrier and the opposite side band combination.

In testimony whereof, I have signed my name to this specification this 23rd day of September 1925.

DE LOSS K. MARTIN.