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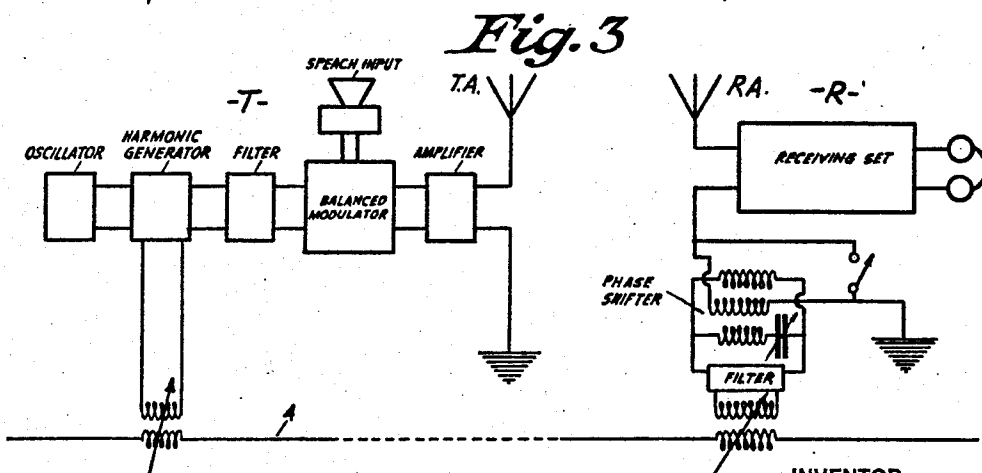
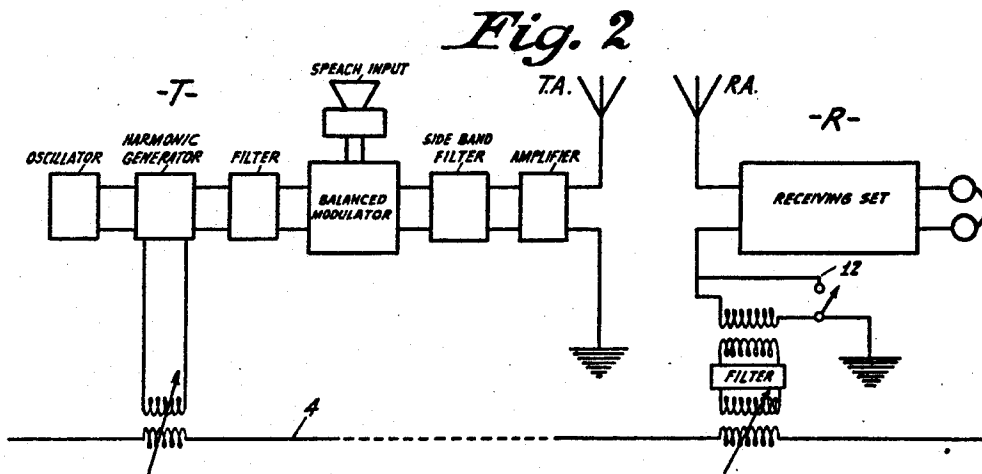
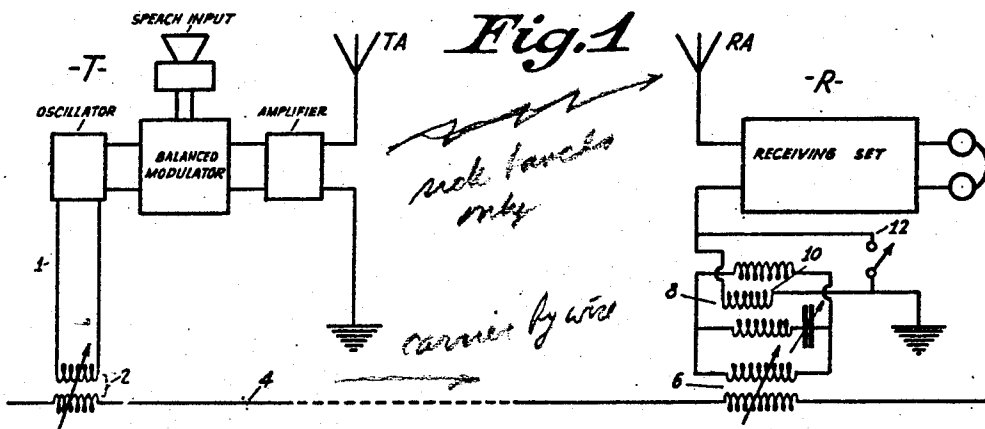
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1,790,486

BROADCASTING SYSTEM

Filed Sept. 3, 1927

2 Sheets-Sheet 1



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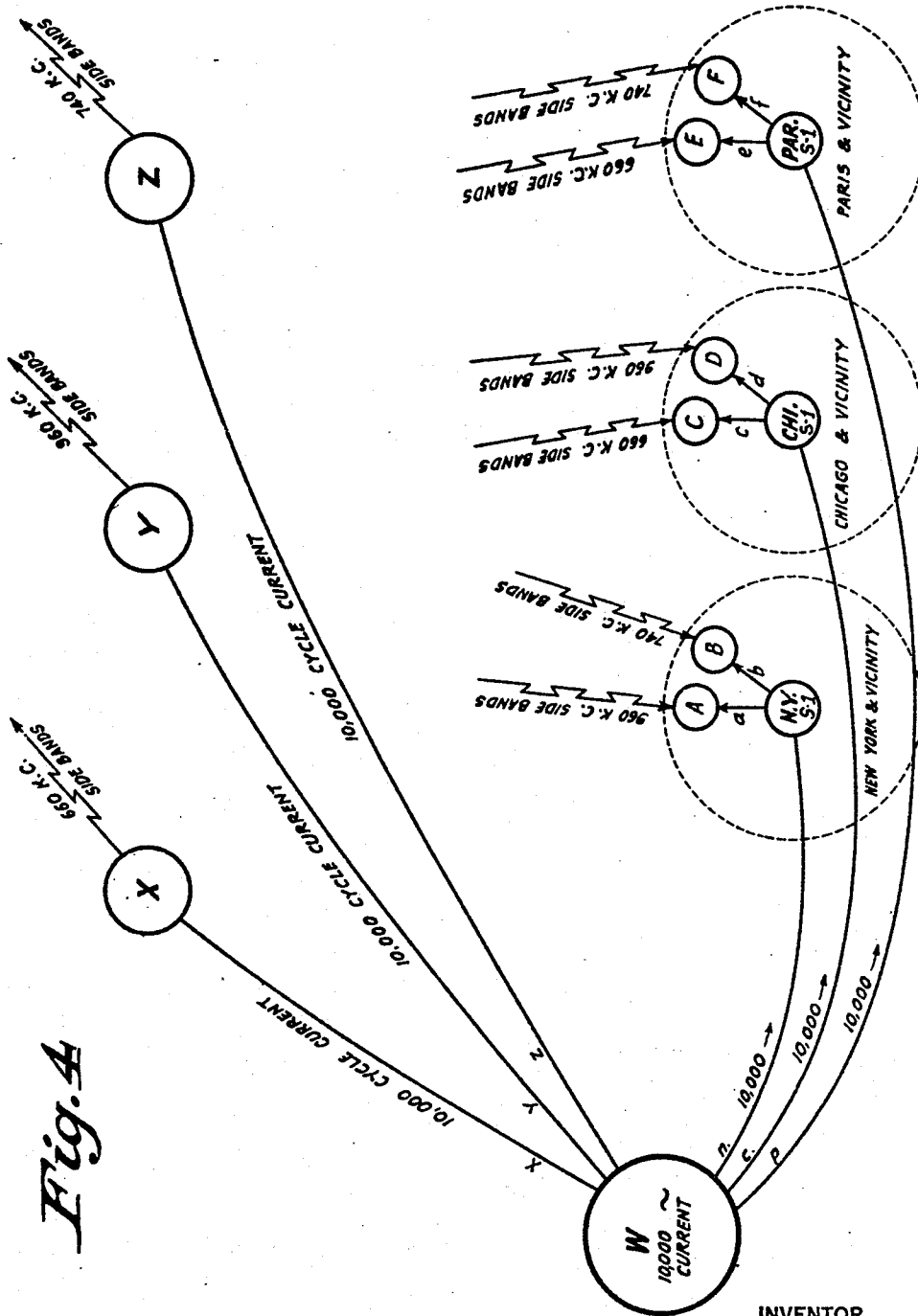
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BROADCASTING SYSTEM

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2 Sheets-Sheet 2



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BROADCASTING SYSTEM

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This invention relates to a broadcasting system, and more particularly to a toll broadcasting system, in which others than subscribers to the system are not able to hear the broadcasted program.

Customarily, the cost of radio programs has been borne by a certain small number of advertisers. It seems, however, that the more logical way of paying for these programs should be by making those who receive benefits therefrom, that is, those persons owning radio receivers "listening in" on the programs, pay for them. Accordingly, I have devised a system the object of which is to provide means and a method for broadcasting a radio program which can be heard by only those who have subscribed to the system.

Unsatisfactory service to non-subscribers I accomplish by radiating a wave the carrier of which is suppressed, that is, a wave in which one or more of the side bands only are transmitted. These side bands when received in an ordinary receiver, when detected, will not give an intelligible response. A desired response may be obtained only when a beat frequency is supplied to the side bands at the receiver which coincides with the carrier that has been suppressed at the transmitter. In my system, the beat frequency is supplied over land lines such as electric power lines, or telephone lines, and for such supply, each subscriber is made to pay a certain amount, preferably by paying a flat rate per month. My method of broadcasting is not only advantageous as a toll system but it also allows of improved reception in that static and fading are reduced, for the reason that the carrier which is transmitted by wire is not subject to these annoyances. Another advantage of my system resides in the fact that because of the control of the carrier, that is, of the amplitude of the carrier, and because the carrier is not subject to fading or static a more powerful response may be had. For somewhat similar reasons, the quality of the received program would also be bettered.

Another advantage lies in the fact that since only carrier frequencies are transmitted by wire, no distortion can be introduced by

the wire line, no matter how sharp a frequency discrimination it may possess.

My invention has still another advantage, in that reception may be had from stations outside of the toll chain of transmitting stations, and in the fact, that at the receiver, there is the psychological advantage in having the receiver operator feel that he is tuning in on the air at all times.

Another object of this invention is to provide a broadcasting system wherein frequency separation between various stations is maintained constant. The manner in which this is done will be explained below.

Other objects as well as advantages of my system will be self-evident from the following description of my invention taken in connection with the accompanying drawing in which:

Fig. 1 shows according to my invention, a system wherein two side bands are radiated and in which the carrier, the fundamental of a local oscillator, is transmitted by a power line to a receiving set.

Fig. 2 shows according to my invention, a system wherein a single side band may be radiated and wherein a harmonic of the locally generated oscillations is used as a carrier and transmitted over a power line to a receiver.

Fig. 3 is a system, according to my invention in which two side bands are radiated and in which the carrier is a harmonic of locally generated oscillations which harmonic is transmitted over power lines to a receiver, and

Fig. 4 shows diagrammatically a preferred plan for carrying out my toll system and for maintaining frequency separation between various transmitting stations.

Referring to the drawings, and more particularly to Fig. 1 T indicates a transmitting station, and R a receiving station adapted for operation under my toll system. I have also indicated in that figure a local oscillator which may be of any one of the well known types, such as for example, a high frequency alternator, or a crystal oscillator. A balanced modulator is also indicated in Fig. 1, which may comprise a pair of vacuum tubes, whose filaments are connected together, whose

plates are connected together through an inductance, whose grids are connected together through a common inductance, high frequency energy being fed from the oscillator shown in Fig. 1 between the midpoint of the inductance connecting the grids together and the common connection of the filaments, and audio frequency energy, as indicated being fed into the inductor connecting the two grids. The output of the modulator or the side bands which have frequencies equal to the oscillator frequency plus the speech frequency or the oscillator frequency minus the speech frequency is fed into the amplifier, indicated in Fig. 1, which may be of any well known type such as the resistance coupled thermionic tube type, where it is amplified and then radiated over the transmitting antenna T.A.

Part of the locally generated high frequency energy is fed into a power line for example, by means of coupling 2. This coupling may consist of a few turns of wire in the lead 1 from the oscillator, and a correspondingly few turns of wire in the power line. In many cases, it will be found sufficient if simply straight portions of the lead 1 and the power line 4 are laid together for some distance. Similar coupling means should be provided at the receiving station as indicated at 6. At the receiving station there may also be provided a phase shifter 8, comprising an inductance and an inductance and a capacitance in parallel. If desired, a phase shifter comprising resistances and inductances may be utilized or in fact any other suitable phase shifter. By means of coil 10, and the receiving antenna R. A. carrier frequency energy and side band frequency energy may be combined at the receiving set.

It will be thus seen that, by the use of my system, no changes will be necessary in the many receiving sets in operation today. The phase shifter and coupling 6 should be installed by the members of the chain of transmitting stations utilizing my toll system. The subscriber at the receiving end may then be charged at a flat rate for being provided with current of the correct carrier frequency.

When receiving an ordinary program from a station not under the toll system, the phase shifter coil 10 to the receiving set may be short circuited by a suitable switch 12. In each case, with either switch 12 open or closed, the receiving set is operated in the usual manner.

While Fig. 1 shows a modification which illustrates the underlying principles of my invention, it is unadapted for use where, for example, more programs than one are to be transmitted at more than one station at the same time, the stations being part of the same toll system. Under such conditions, it will be found advisable to use modifications such as shown for example, in

Figs. 2 and 3. In the transmitting station T shown in Fig. 2 there is provided, as indicated, an oscillation generator and a harmonic generator which may be of any of the well known types. By means of the harmonic generator, the transmitter station T is operated on a harmonic of the waves generated by the local oscillator. As another refinement, a side band filter may be placed after the balanced modulator shown in Fig. 2 for the purpose of transmitting only one side band by means of electro magnetic waves from the antenna T. A. At the receiver by means of the filter coupled to the antenna circuit R. A. and to the power line 4, the correct harmonic utilized by the transmitter T may be combined with the side band wave received by antenna R. A.

Another transmitting station of the toll system may have allocated to it another carrier frequency which may be obtained from the same power lines by suitable filters. By adjusting the filter at the receiving set this other station in the toll system utilizing a different harmonic for its carrier than that utilized by the transmitter T may be received, with of course the additional adjustments necessary on the receiving set itself. When receiving ordinary programs from transmitting sets not in the toll chain, the switch 12, as in Fig. 1, may be closed and the receiving set may be operated in the usual manner.

Fig. 3 shows a system similar to the one given in Fig. 2 with the exception that both side bands are radiated and with the additional feature that at the receiving set, in addition to the filter, there is added the phase shifter described in Fig. 1. In view of the description given above, of Figs. 1 and 2 further information as to the apparatus and operation of the system shown in Fig. 3 is thought to be unnecessary.

Frequency separation between the various transmitting stations may be had by transmitting by wire the fundamental oscillatory frequency generated by the local oscillator to each of the transmitters in the toll system, each transmitter having its own harmonic generator. Each transmitting station will then select widely different harmonics for its carrier and will radiate a side band or side bands and transmit by wire the carrier used. This method of maintaining frequency separation and an improved way of providing proper carriers to the receivers is illustrated in Fig. 4, the system shown there being adapted for nation-wide or even world-wide use.

X Y and Z represent three transmitting stations transmitting on wave lengths as indicated, in the vicinity of New York, Denver and London, for example. A, B, C, D, E and F represent receivers tuned as indicated in the drawing, A and B located, say within a

radius of a New York substation indicated N. Y. S1, C and D located within a similar radius of a Chicago substation Chi. S1, and E and F located within the same radius of a Paris substation PAR S1. By means of land lines x, y, z , and n, c, p the transmitting stations X, Y, Z and the substations are supplied from a generating station W located at, for example, Washington with 10,000 cycle current.

Each of the transmitting stations and each of the substations generate harmonics utilizing the supplied 10,000 cycle current as a fundamental. By suitable filters each station will transmit side bands of a suppressed harmonic of the supplied 10,000 cycle current. Thus, as indicated, X will transmit on a suppressed 66th harmonic, Y on the 96th and Z on the 74th suppressed harmonic.

At each substation there will also be generated harmonics utilizing the supplied 10,000 cycle current as a fundamental. These will be supplied over power or telephone lines a, b, c, d, e, f to the various consumers or subscribers to the system. Each of the receiving sets will then be coupled in the manner shown in Fig. 3 to the power lines for obtaining the correct carrier to combine with the received side bands.

The lines transmitting the 10,000 cycle current may, as indicated in the foregoing paragraphs be power, telephone, telegraph lines or submarine cables or the like. If desired, the 10,000 cycle current may be transmitted by directional antenna to each of the transmitting stations. However, it will be found more feasible and hence it is preferred that the fundamental frequency be transmitted by means of conductors.

The system has a decided advantage over wired wireless in that the ether, over which the side bands are radiated, does not accentuate certain frequencies but transmits them all alike. The fact that the conducted harmonics may be distorted by the land lines is immaterial, since at the receiving set, a single harmonic is filtered out whose strength may be varied as indicated in Fig. 2 by varying the coupling to the power line, or by varying the coupling from the output side of the filter, or as indicated in Fig. 3 by means of a phase shifter, or by any other means that will readily suggest themselves to those skilled in the art.

It is to be understood however, that this system for frequency separation may be used for the transmitting stations alone, that is, with a slight modification a part of my system may be used for ordinary broadcasting where no charge is exacted for the program transmitted. When so used the substations and harmonic generators there may be dispensed with, as well as the coupling means to the land lines at the various receivers. In

this manner, frequency separation between the transmitting stations is maintained without any possibility of "overlapping."

However, when using this method of frequency separation in connection with the other elements of my toll system, improved reception will result. By having the harmonics generated at various substations, the difficulties involved in transmitting high frequencies (the harmonics) will be lessened, since they will be conducted only relatively short distances from the various substations. It is clear then, that at the receiver the strength of the carrier may be made large and even though the received side band energy is small, the signal heard will be strong since the strength of the heard signal will be proportional to the product of the side band strength and carrier strength.

The fundamental, or 10,000 cycle supply being of relatively low frequency, no difficulty will be met in transmitting it to the various broadcasting stations and substations.

In other words, by the use of the system shown in Fig. 4 lessening of both the side band energy and the carrier energy when transmitting over long distances is prevented. While the side band amplitude may decrease, the carrier by means of the substations is left high, and as a result, distant stations may be very satisfactorily received.

Various changes may be made in the oscillators, or in the harmonic generators, filters, modulators, antennae, phase shifters, couplings, and connections without departing from the scope of my invention, whose breadth shall be limited only by the claims which shall follow.

Having thus described my invention, what I claim is:

1. The method of radio transmission which includes the generation, at a single point, of oscillations, transmitting the oscillations to a plurality of radio transmitting stations utilizing at each of the stations, as a carrier for its transmitted electromagnetic waves, a harmonic of the received oscillations suppressing the carrier at each of the stations, radiating only the sidebands to a receiver, and supplying by conduction the suppressed carrier to the receiver.

2. The method of radio transmission which includes the generation, at a single point, of oscillations, conducting the oscillations to a plurality of radio transmitting stations utilizing at each of the stations, as a carrier for its transmitted electromagnetic waves, a harmonic of the received oscillations, suppressing the carrier and radiating only, at the transmitter, sidebands.

3. The method of radio broadcasting which includes the supplying to a plurality of radio transmitting stations and to a plurality of

substations of the character described, oscillations from a single generating point, utilizing as a carrier at each of the radio transmitting stations a harmonic of the supplied oscillations, modulating the carrier and transmitting from each of the transmitting stations one or more of the resulting side bands only, generating at each of the substations harmonics corresponding to those utilized by the radio transmitting stations, and supplying by wire to a receiver the harmonics generated at the substation.

4. In a radio communication system comprising a radio transmitter and a receiver, the transmitter comprising a harmonic generator for generating a carrier, a modulator, means for radiating only sidebands caused by the utilization of the modulator and separate means for transmitting said carrier; the receiver comprising means for receiving said side bands, and separate means for receiving said carrier, said last named means including a filter, a phase shifter and means for short circuiting the phase shifter.

5. In a radio transmission system, a supply station having means for generating oscillations, a plurality of radio transmitting stations, means for transmitting said oscillations to said plurality of transmitting stations, means at each of said stations for generating harmonics of said oscillations, means for utilizing at each of said stations an individual predetermined harmonic of said oscillations as a carrier for its transmitted electromagnetic waves, a carrier wave suppressing device and means at each of said stations for radiating only sidebands.

6. In a signalling system a supply station having means for generating oscillations, a plurality of radio transmitting stations, means for transmitting said oscillations to said transmitting stations means at each of said transmitting stations for translating said transmitted oscillations into frequencies of transmission means at each of said stations for modulating the translated frequencies in accordance with signals desired to be transmitted for producing a carrier and sidebands, means for radiating only said side bands, a plurality of receiving stations all thereof being connected by conduction with all of said transmitting stations and means for transmitting the carrier from each of said transmitting stations to each of said receiving stations each of said receiving stations having means for receiving and distinguishing said side bands and means at each of said receiving stations for combining the proper carrier with the proper sidebands.

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