Aug. 30, 1932. F. SCHRÖTER 1,875,165

METHOD FOR WIRELESS COMMUNICATION

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Fig. 1

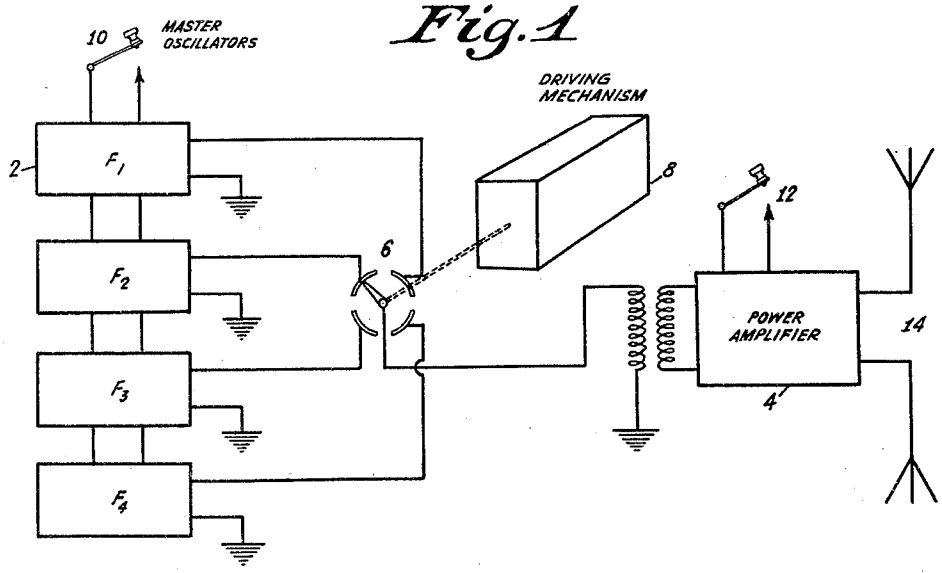
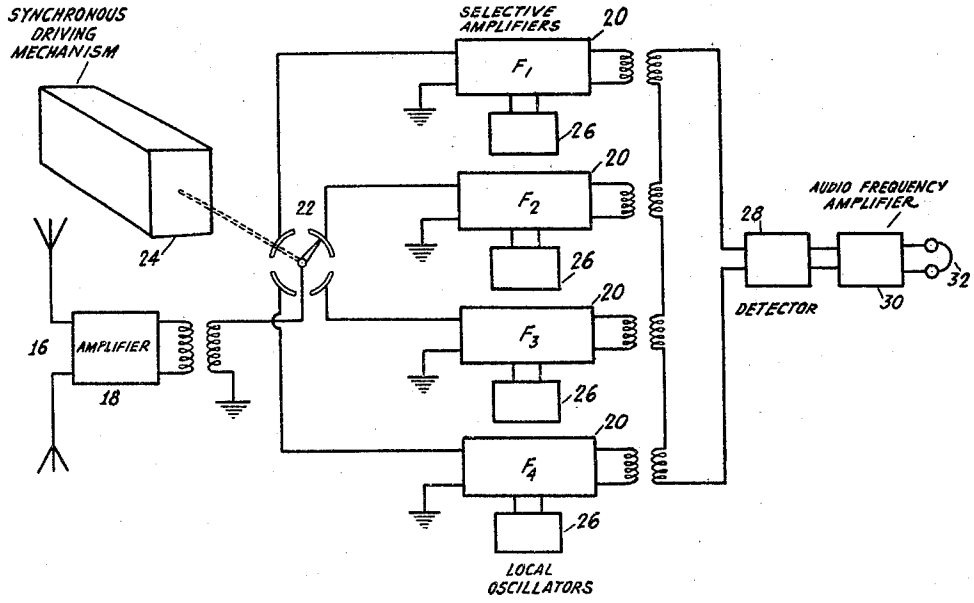


Fig. 2



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Fig. 3

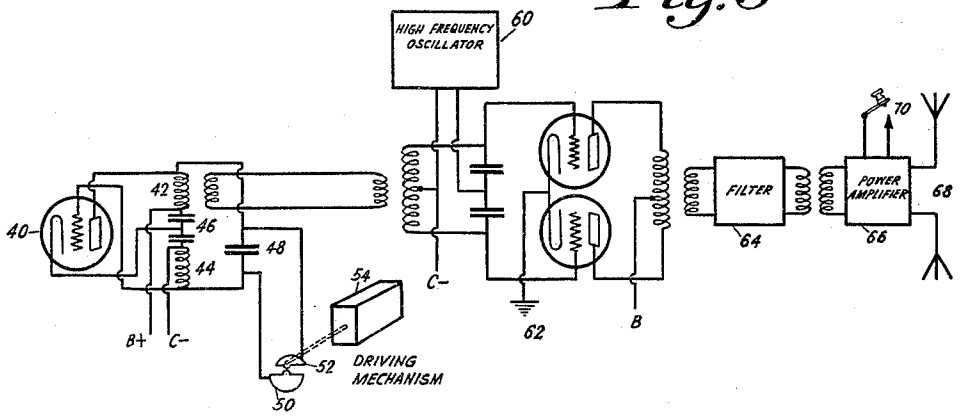


Fig. 4

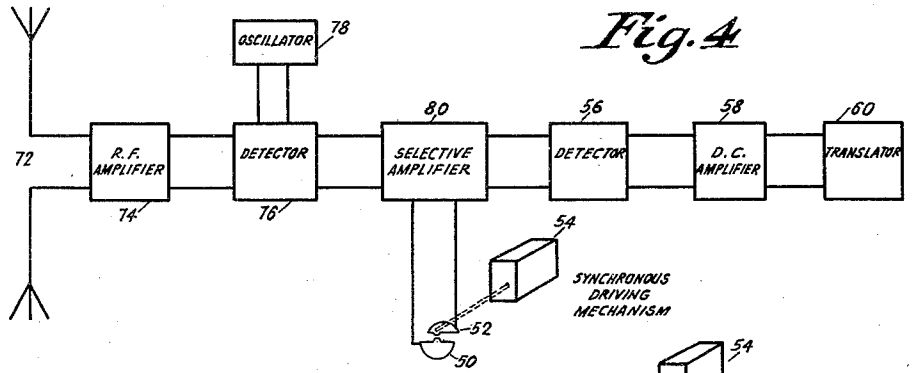
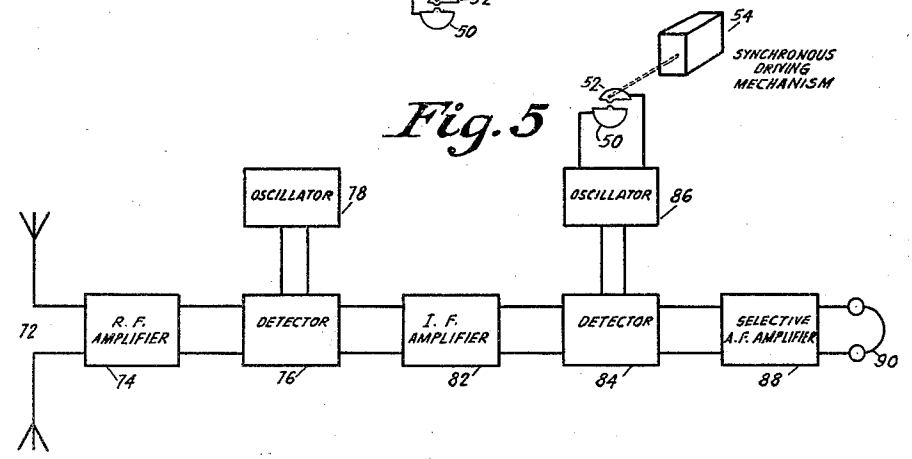


Fig. 5



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UNITED STATES PATENT OFFICE

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METHOD FOR WIRELESS COMMUNICATION

Application filed June 11, 1928. Serial No. 284,285.

In the practical application of wireless intelligence transmission on short waves it has been found that at the receiving station one and the same signal comes in several times at short intervals of time. Such multiple reception of one and the same signal, on the one hand, is due to the signal reaching the receiving station not only in one direction, but also in the opposite direction around the earth, and, on the other hand, is due to the waves which carry the signal being able to pass around the earth several times. The source of disturbance first mentioned is remedied by providing either or both the receiving and transmitting antennæ with reflectors whereby radiations from the rear are screened off.

Now, the object of the present invention is to eliminate such disturbances in communication and traffic as are caused by the signal reaching the receiving point several times from the same direction. Experiments have shown that the same signal is heard two or three or even more times at the receiving station from the same direction, at time intervals corresponding to a complete circulation around the earth, for the time interval until recurrence of a group of signals at the receiving station due to one circulation around the earth amounts to slightly less than 1/7th of one second.

According to the invention, consecutive signal groups or signals of different frequencies are sent out at the transmitting station, while at the receiving end a receiver arrangement is provided which responds alternately at the rhythm of such change in frequency at the sending stations, to these different frequencies. In so far as the alterations in the frequency of the oscillations serving for the transmission of the signals are concerned, either the carrier radio frequency may be altered or else, in case of modulating frequencies, these latter may be varied. Arrangements at the receiving station, in accordance with this invention, are so chosen that the signal transmitter automatically changes its frequency at the end of each group of signal or previous to the beginning of a new group. The number of signals which are comprised in one group and are transmitted at the same frequency depends, of course, upon the rate of the signal transmission, in which connection it must be kept in mind that the first repetition at the receiving station occurs only 1/7th of one second later. For instance, if the rate of transmission is slow so that the duration of a signal takes almost one-seventh of a second, then the next signal should, of course, be sent out at a different frequency. In so far as the arrangements at the receiving end are concerned, these can be properly made permanent according to the nature of the frequency changes and other operating conditions. If at the sending end it is not the carrier frequency itself which is varied, but rather a modulating frequency, then the selection of the signals at the receiving station can be effected by variation of the tuning of the selective means after rectification. Hence, separation of the incoming signals is possible in such a manner that the frequency of the selective circuit is varied before the signal is repeated due to its circulation around the earth.

Another embodiment of the basic idea would be to provide different selective circuits having different constant tuning, and these could be connected in rotation between the incoming aerial and the receiver apparatus, this being accomplishable by the agency of a revolving commutator or change-over switch revolving in synchronism with the rate of change in frequency at the transmitter station. As regards the number of frequencies to be employed in order to eliminate the said disturbances due to recurrence or repetition of the signal, from two to three frequencies may be supposed to be adequate to satisfy practical conditions and requirements,

since the intensity of the repeated signals is naturally subject to marked attenuation.

It is furthermore possible to leave the incoming frequency at the receiver unchanged, if heterodyne reception is resorted to, in such a way that the frequency of the heterodyne is varied by the same amount as the frequency of the next signal in the transmitting station, with the result that the ensuing beat note is unvaried. The group of signals which has once travelled around the earth, has a different frequency for the next signal so that it will not be received or that a different note will be heard, while all consecutive signals invariably result in the same note.

The specification is accompanied by drawings in which

Fig. 1 is a transmitter employing fixed tuning and mechanical switching;

Fig. 2 is a receiver similarly utilizing fixed tuning and mechanical switching;

Fig. 3 is a transmitter employing variable tuning;

Fig. 4 is a receiver arranged to cooperate with the transmitter shown in Fig. 3; and

Fig. 5 is another receiver arranged to provide a constant frequency heterodyne tone.

Referring to Figure 1 there are a suitable number of master oscillators 2, permanently tuned to different frequencies. In the present case four have been indicated but two or three are sufficient. The master oscillators are coupled successively to a power amplifier 4 through intermediate switching device 6, the contact arm of which is rotated at a fixed speed by a suitable driving mechanism 8. The time of duration of signals on any one frequency is to be one-seventh of a second or slightly less, and the speed of rotation of the driving mechanism 8 is adjusted accordingly, taking into account the number of frequencies employed. In the present case a speed of 120 revolutions per minute will result in a constant frequency duration of one-eighth of a second. The transmitter may be keyed either by a key 10, arranged to simultaneously key all of the master oscillators, or by a key 12, arranged to bias the control electrode of an amplifier tube, in known manner. The energy is radiated over a suitable radiating means 14.

In Figure 2 the receiver consists of a suitable antenna 16, the energy collected by which is amplified in a relatively broadly tuned amplifier 18, and the amplified energy is fed successively and cyclically to selective or sharply tuned amplifiers 20, each of which is tuned to a frequency corresponding to one of the transmission frequencies of the master oscillators 2, through a distributing switch 22, the contactor of which is rotated by a driving mechanism 24 adjusted to rotate in synchronism with the transmitter switch. The outputs from the selective amplifiers are combined, and if the signal is to be translated audibly the audible note may be provided by beating the received signal with a plurality of local oscillators 26, each of which is tuned to a frequency differing from the corresponding signal frequency by the desired tone frequency, and this tone may be detected by a detector 28, and amplified in an audio frequency amplifier 30, and translated by telephones 32.

Referring to Figure 3 there is an oscillator tube 40, the electrodes of which are coupled in regenerative fashion to the inductances 42 and 44, in series with which there are blocking condensers 46, and in parallel with which there is a fixed tuning condenser 48, slightly varied by a relatively small variable condenser 50, the rotatable plate 52 of which is rotated by a driving mechanism 54. If the carrier energy is to be directly varied in frequency the energy from the oscillator thus far described may be radiated by a suitable antenna system.

In the arrangement illustrated, however, it is proposed to vary a modulating or intermediate frequency, and accordingly the high frequency carrier is supplied by a constant frequency oscillator 60. If desired, the variable and fixed frequencies may be combined, as indicated, in a carrier suppression modulator 62, and by suppressing one of the two resulting side bands in a suitable filter 64, the remaining side band may be amplified in a power amplifier 66 and radiated from antenna 68. Signal modulation may be accomplished by a key 70, arranged in the circuit in a conventional manner.

In Figure 4 a receiver adapted to cooperate with the transmitter described in Figure 3 is indicated. This receiver comprises pick-up means 72, the energy from which is amplified in an amplifier 74, and combined in a detector 76 with energy from an oscillator 78. This oscillator is preferably adjusted to the same frequency as the oscillator 60, so that the beat frequency is the same as that generated in the oscillator 40. A selective amplifier 80 is arranged with a variable condenser 50, just as in the transmitter, and the rotor 52 of this condenser is rotated by the driving mechanism 54, arranged to rotate in synchronism with that at the transmitter. The output from the amplifier may be rectified in suitable detector 56, and amplified in a direct current amplifier 58, and thereafter used in a translator 60, which may be a tape recorder or other suitable device responsive to the direct current signal energy.

It will be understood that when the transmitter is so arranged that the oscillator 40 provides the carrier energy directly, the rereceiver may be arranged so that the antenna 72 feeds the energy which it collects directly to the amplifier 80, without the use of intermediate heterodyne 76 and 78.

An alternative receiver is indicated in Fig-

ure 5, and comprises an antenna 72, an amplifier 74, a first detector 76 and an oscillator 78, all as was described in connection with Figure 4. In this case, however, the intermediate frequency amplifier 82 is sufficiently broadly tuned so that an intermediate frequency corresponding to that generated by the oscillator 40 in the transmitter is passed therethrough. The intermediate frequency energy is combined in a second detector 84 with energy from a local oscillator 86, the frequency of which is varied by a rotatable condenser 50, the rotor 52 of which is driven by mechanism 54 arranged to rotate in synchronism with the equivalent mechanism at the transmitter. In this way a constant frequency tone signal is obtained, which is fed through an audio frequency amplifier 88, preferably tuned to the desired tone signal, and translated in telephones 90.

In the arrangements shown in Figures 3, 4 and 5, the speed of rotation of the variable condenser is so chosen that the generated frequency will be repeated at intervals of time such that the original signal transmitted at like frequency will have attenuated to a negligible value, and may be for example three-sevenths of a second, or thereabouts. The frequencies may vary continuously, or if it is desired that the frequency be constant for periods in the neighborhood of a seventh of a second, the rotatable plates may be so cut that this effect will be obtained.

I claim:

1. The method of signaling in order to avoid interference of a signal with itself due to traveling along different paths to a receiver, which includes transmitting at different frequencies successive portions of the signal, and selectively and successively translating the signal portions in the order and at frequencies corresponding to those at which the signal was transmitted, the portioning of the signal being chosen such that the time of transmission of a portion thereof precludes interference at the receiver due to reception of the same signal portion along other paths.

2. The method of minimizing interference of a signal with itself which includes transmitting successive portions of the signal at different frequencies, synchronously and selectively collecting and translating signal energy so transmitted, the time of changeover from one frequency to another being chosen so that when signal portions arrive at the translation point along paths other than that desired, another portion of the signal is being selectively translated.

3. The method of avoiding interference due to the receipt of the same signal at different time intervals which includes transmitting successive portions of the signal at different frequencies within a range of frequencies, selectively and synchronously altering the frequency of a receiver to correspond to the transmitted frequencies, the time of changeover in frequency being such that each portion of the signal is received and translated once, and cyclically repeating transmission of the signal portions over the same range of frequencies after the portion of the signal transmitted on one frequency of the range has attenuated to a negligible value.

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