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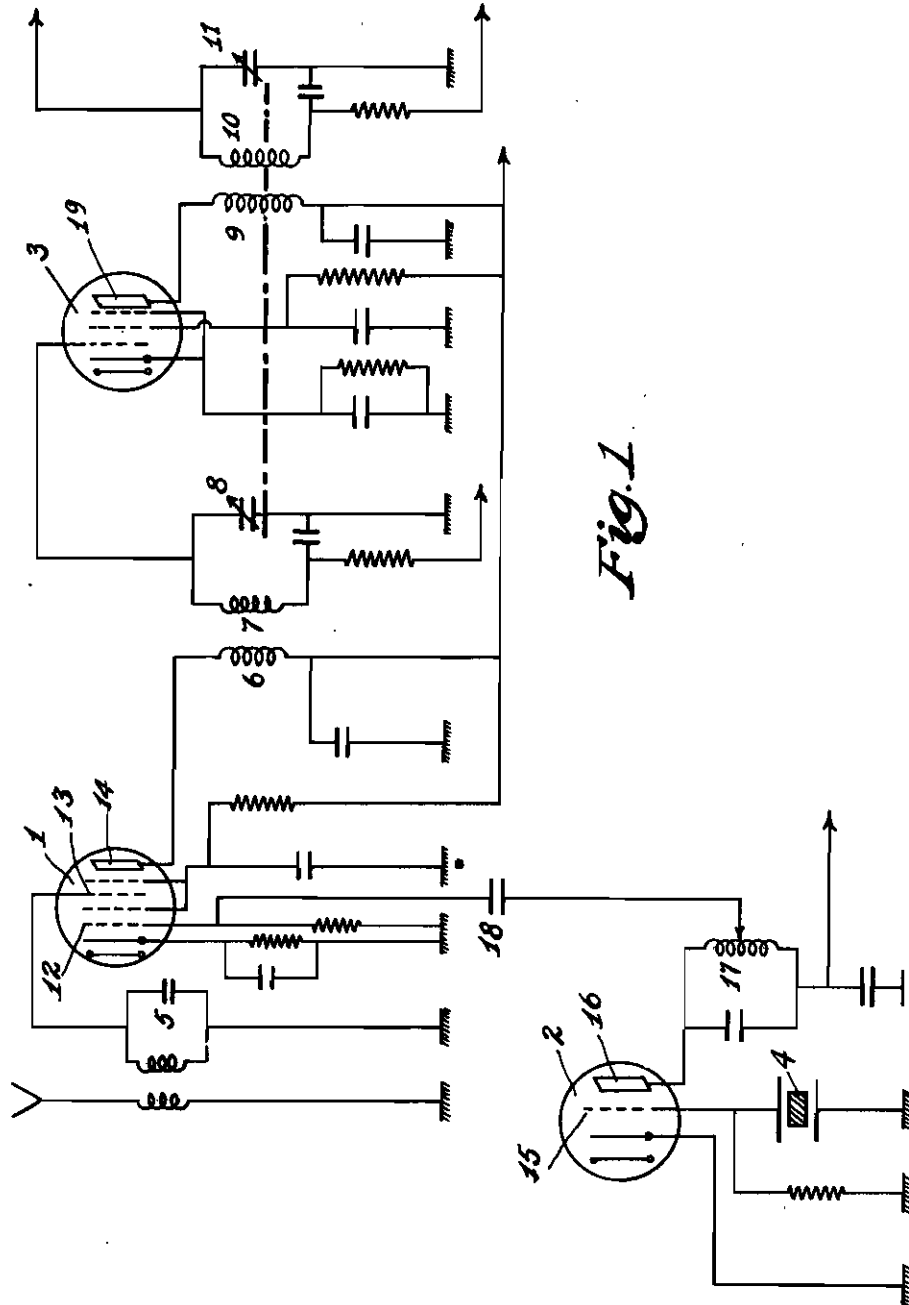
SYSTEM OF RADIO COMMUNICATIONS

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Fig. 3

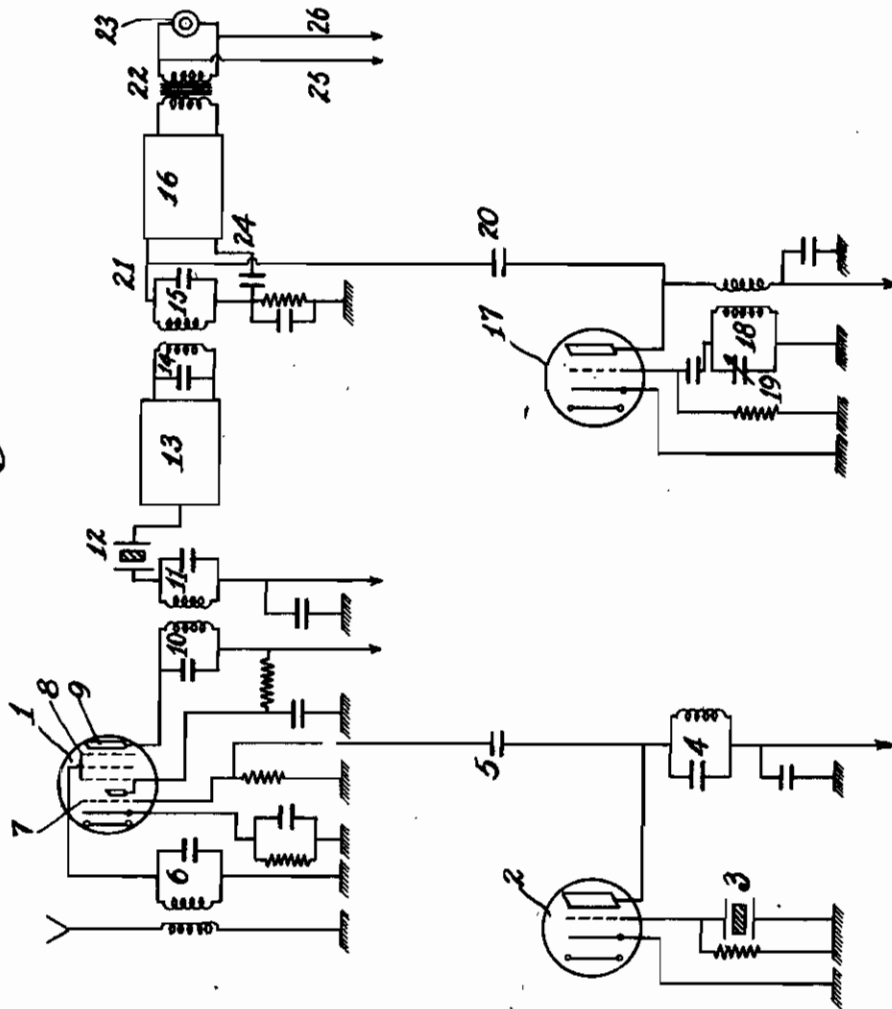
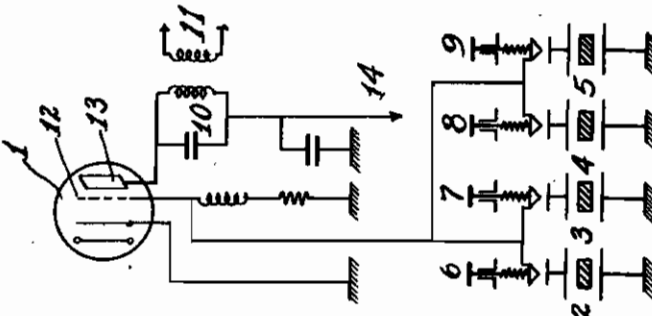


Fig. 2



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ALIEN PROPERTY CUSTODIAN

SYSTEM OF RADIO COMMUNICATIONS

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The present invention refers to the existing systems of radio communications, and in particular to a system supplying the means of suppressing certain defects in receivers generally utilized and known under the name of superheterodyne receivers, or receivers based on the principle of frequency conversion.

These defects appear especially when receiving short and ultra short wave signals. Namely:

1. *The defects of frequency changes.*—This effect is due to the accidental changes in the supply voltage, variations in the temperature of tubes, reactions of exterior circuits, mechanical vibrations, etc. These phenomena influencing the frequency of the local oscillator, augment with the increase of the frequency of reception and prevent the realisation of stable or automatic communications.

2. *Difficulties of accurate tuning.*—This defect of manipulation in superheterodyne receivers is due to the great selectivity of these receivers. The difficulties increase with the frequency of reception, and in the case of short waves limit the possibilities of selectivity which can be imposed to the receivers. This brings about a reduction of the number of net work systems for a band of frequency.

3. The ratio noise/signal increases with the sensibility of the receivers, which diminishes the possible efficacy of the superheterodyne receivers. The principal reason of this defect is due to the irregularity of the local oscillations of these receivers.

The present invention offers an improvement, permitting the elimination or at least the reduction of the stipulated defects.

Above this, beginning with this improvement, it has for object a system of communications remaining secret, and having the advantage of being undetectable by third parties.

Rules

The formula of frequency conversion is as follows:

$$F_s = F_o \pm F_{if}$$

or

F_s is the frequency of the signal to be received.
 F_o is the frequency of the local oscillator.
 F_{if} is the frequency of tuning of intermediate frequency transformers.

The usual method consisted in making F_{if} a fixed frequency (generally in the region of 100 to 500 Kc. or around 1600 Kc. for short waves) and for the reception of a signal of F_s frequency,

the adjustment in the frequency of the local oscillator on F_o .

This method carries with it the inconveniences cited in Paragraphs 1, 2, 3.

Our method consists in rendering absolutely fixed the frequency of the oscillations of the local heterodyne F_o stabilizing them by a piezo-electric crystal, and for a signal to be received of frequency F_s , to vary (e. g. by variable condensers) the tuning of transformers of intermediate frequency until their circuits are adjusted on F_{if} .

The diagrammatical principle of this method is given on Fig. 1.

The tube 2 serves as local heterodyne where oscillations are engendered by a crystal 4 of frequency F_o inserted for example in the grid 15 circuit. These oscillations are injected through the condensers 18' in one of the grids 12 of the mixer tube 1, whose control grid 13 is attacked by the signal to be received of frequency F_s through the input circuit 5. In the plate circuit of this mixer tube is found the primary of the transformer of intermediate frequency 8, the secondary 7 being (or the primary and the secondary) one tunes by a variable condenser 9, on a frequency F_{if} so that:

$$F_{if} = F_s - F_o$$

in supposing that one uses a frequency inferior to the heterodyne.

The tube 3 forms the intermediate frequency amplifier and possesses in its plate circuit an intermediate frequency transformer (identical to the first) 8 and 10, and on which is adjusted also on F_{if} the secondary (or the primary and the secondary) by the variable condenser 11. These two condensers can be ganged.

Various scales of reception can be obtained by employing a number of crystals, which are switched; one can also use for ultra-high frequencies of an harmonic of the oscillation engendered by a crystal.

Once tuned the organs 8 and 11 of adjustment of the intermediate transformers can be rendered fixed or blocked mechanically, allowing one to obtain through this, entirely automatic communications, on condition of having received transmissions stabilized in the same manner, i. e. by piezo-electric crystal.

The input circuit 5 being much deadened (especially in short waves) is easily adjustable.

The advantages of the system are as follows:

1. Complete suppression of frequency changes.
The local heterodyne being stabilized by a crys-

tal, no variation of local frequency is to be feared, even for the highest frequencies.

This permits absolutely sound tuning precisely checked. One can establish too automatic communications with automatic tuning even for ultra high frequencies.

One may thus push the selectivity of the receiver up to limits which are technically possible and increase the number of net work systems for a band of frequency.

2. Possibilities of pushing the sensibility of receivers without notably increasing the ratio noise/signal.

The noise of the receivers stabilized by crystal, being diminished by the fact that the oscillations are supplied by a quartz.

Our method permits the establishment of a system of grids, of which the correspondents each own a transmitter with many frequencies of transmissions stabilized by crystals, brought successively into play by switches and a receiver with automatic tuning, possessing only a single frequency of reception defined by its quartz, inserted in the local heterodyne of the receiver.

The correspondents of this net work system can thus call and communicate automatically as in the telegraphic or telephone wire systems.

Another advantage of the system is that it is impossible for other correspondents of the net work system to tap messages transmitted; as it is only possible to receive them on a single and well defined frequency of reception.

Fig. 2 and Fig. 3 represent the principles of such transmission-reception with automatic tuning.

Tube 1 and Fig. 2 forms the crystal controlled oscillator of the transmitter with its tank circuit 10 in the plate 13 and whose oscillations are engendered by one or more piezo-electric quartz 2, 3, 4, 5 mounted in the grid 12; the quartz are brought into play by a switch represented in the diagram by 6, 7, 8, 9. An output circuit 11 excites the following stage.

Fig. 3 represents the principle of a receiver destined to receive with an automatic tuning one of the frequencies transmitted by the transmitter mounted as in Fig. 2. This receiver possesses a local oscillator formed by the tube 2 with a quartz 3 inserted in the circuit of the grid, and whose frequency equals lets us suppose F_0 ; the tank circuit 4 is in the plate and its oscillations are injected by the condenser 5 into the tube 1 forming the mixer; the control grid of this tube is attacked by the signal to be received of frequency which we shall call F_s by the input circuit 6.

In the plate 9 of the mixer is the tuned circuit 10 forming the primary of the intermediate frequency transformer, the circuit 11 forms the secondary; the circuits 13, 14, 15 present in the diagram the amplifier of the intermediate frequency the which if one wishes to obtain a very advanced selectivity, will be mounted with a quartz filter represented by 12.

The tuning frequency of the intermediate frequency amplifier will be adjusted on a frequency F_{if} so as to satisfy the formula:

$$F_{if} = F_s - F_0 \text{ if } F_0 < F_s$$

or

$$F_{if} = F_0 - F_s \text{ if } F_0 > F_s$$

Practically one can fix in advance F_{if} , and choose the frequency of the quartz, by one of these two formulae, and adjust, once the receiver is mounted, the intermediate frequency trans-

formers, on the oscillation which will result from the beat of the signal to be received F_s , and the local signal F_0 ; the circuits 16, 22 represent in the diagram the detecting and amplifying circuits of low frequency.

The tube 17 and the circuits 18 form a beat oscillator, so as to receive non modulated waves; 23 represents the phone.

The method of communication permits the establishment of a system of transmission and reception enabling one to keep the messages secret.

The transmitter will then contain a number of frequencies of transmissions each supplied by a piezo-electric quartz; these quartz will be brought successively and systematically into play by a special switch varying continually its contacts; each of the frequencies of transmission will serve then only for a small fraction of the message to be transmitted.

At the receiving station one will dispose of a number of superheterodyne receivers, equal to the number of transmission frequencies.

Each of these receivers will be of automatic tuning and stabilized by a crystal coupled with one of the crystals of the transmitter as in the principles described; in this way each of the receivers will automatically receive a portion of the message.

These different receivers will function simultaneously and will bring into action after having selected and detected the signals received a common phone. Thus at the reception will be obtained a complete message corresponding to that of the transmitter.

The essential diagrams of this method may be given by Figs. 2 and 3 previously used, we shall only dispose of at the transmission for the switch of a system with press buttons, similar to typewriter keys of which each key 6, 7, 8, 9 corresponding to different transmission frequencies and will represent a code already agreed on. If one wishes to avoid having to switch the tuned circuits, one will fix these different frequencies very close to each other. These will be chosen in preference in the short wave bands.

At the reception one will dispose of a quantity of sets erected as Fig. 3, the number of these sets will be equal to the number of crystal contacts of the transmitter. Each of these receivers will be automatically tuned, through a quartz inserted in its local oscillator, and whose frequency will correspond to one of the frequencies of the transmitter.

These receivers who will function simultaneously, will select easily the different frequencies of the transmitter, thanks to the great selectivity which can be imposed on them in our system of reception.

This selectivity can be obtained e. g. by crystal filter 12 of intermediate frequency, as shown on Fig. 3.

So as to detect and differentiate the signals thus received by the various receivers, one can use the beat oscillator 17. In fact by adjusting the variable condenser 19 one will obtain different sounds for each receiver.

These sounds will be picked up by a common phone 23.

Thus for each push button of the transmitter one will obtain a different sound at the receiving station and thus "read" by the sound the transmitted message.

A communication established in this manner will keep the transmission secret. In effect to

receive and read it a third person will be obliged to know:

a. The different frequencies of the transmissions utilized.

b. The convention of the correspondents, concerning the signification of each of the frequencies transmitted.

It would be necessary as well, for them to dispose of a system of reception permitting them to select the signals received.

Another advantage of the system is that it is practically impossible to use a radiogoniometer for a signal thus transmitted. This signal keeping a frequency determined only during a very short period.

Summary

The present patent offers an improved method of radio communications and consists of:

A. A reception system of radio electric signals, by applying the principles of frequency changes.

The receiver is erected in the following manner:

The frequency of the local oscillations of the receiver are rendered fixed, by stabilizing them with a piezo-electric crystal inserted in one of the circuits of the local heterodyne, the resonant circuits of the intermediate frequency transformers are tuned on the frequency resulting from the beat of the two oscillations: that of the signal to be received, and that of the local oscillator engendered by the crystal.

B. A transmission-reception system of automatic tuning consisting of:

a. A transmitter with one or more transmission frequencies, each stabilized by a piezo-electric crystal.

b. A receiver whose local oscillator is stabilized by one or more piezo-electric crystals whose frequencies are chosen in such a manner that the successive differences between the two frequencies; that of the transmission to be received and that of the local heterodyne are always equal to the frequency on which are adjusted the intermediate frequency transformers.

C. A method of transmission-reception enabling the transmitted messages to be kept secret and consisting of:

a. A transmitter possessing several transmission frequencies, each of which is stabilized by piezo-electric crystal and whose transmission varies systematically in wave length by a successive switching of stabilizing crystals; each of the transmission frequencies thus serves only for a small part of the message to be transmitted.

b. A reception system which permits the reception and selection of the signals thus transmitted, and consisting of a number of super-heterodyne receivers equal to the number of transmission frequencies, and of which each possesses a local oscillator, stabilized by a piezo-electric crystal coupled with one of the transmitter crystals, according to the principles described in paragraph B of the present summary.

In this manner each of the receivers, receive automatically a part of the message transmitted; the different receivers functioning at the same time can bring into action the same phone, thus enabling the entire message to be obtained.

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