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CRYSTAL OSCILLATOR RECEIVING SYSTEM

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Fig. 1

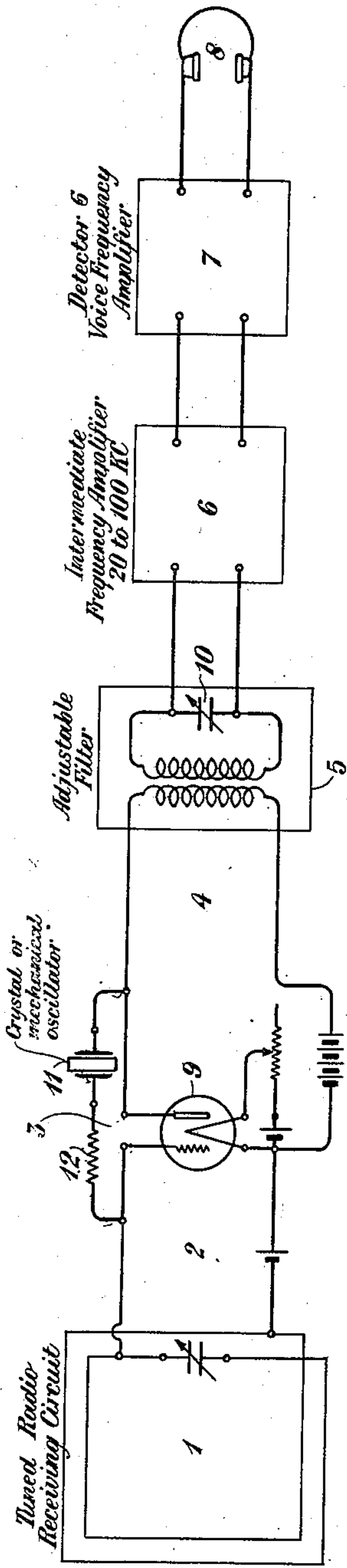
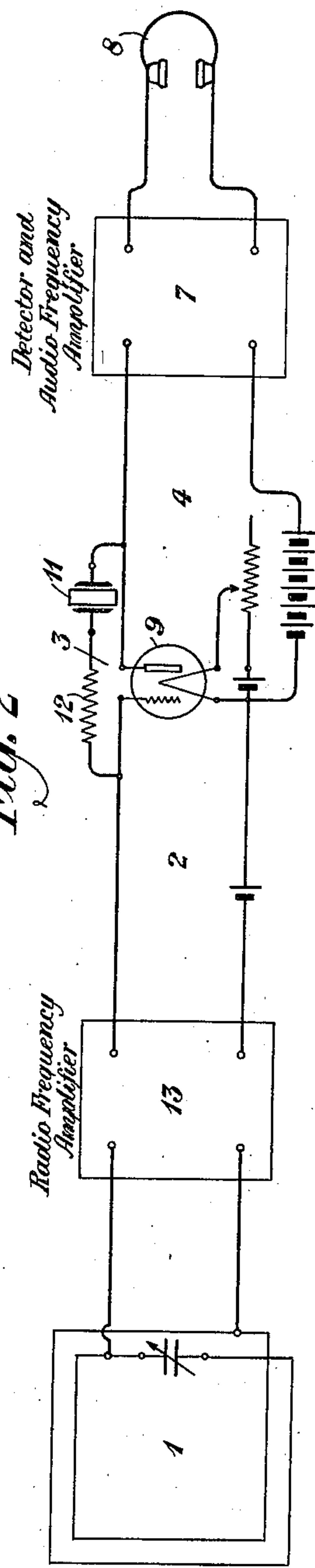


Fig. 2



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CRYSTAL OSCILLATOR RECEIVING SYSTEM

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4 Claims. (Cl. 250—20)

This invention relates to radio signaling systems, and particularly to a receiving system for radio messages.

In double detection radio receiving systems generally, if it is desired to obtain the proper frequency for the filter and amplifier, both of which are maintained constant, it is the practice to vary the frequency of the oscillator along with the frequency to which the receiving circuit is tuned. The arrangement of this invention discloses a radio receiving system which differs from the arrangements in general use in that the frequency of the filter is varied over the band of the amplifier, while the frequency of the oscillator is maintained constant, or is varied only in steps.

As early as 1880 it was discovered that upon subjecting the opposite sides of certain crystals to pressure, a difference in electrical potential at certain sides of the crystal is produced, and conversely, a difference in the electrical potential at certain sides of a crystal produces a change in the shape or size of the crystal. This was known as the piezo-electric effect.

The main feature of this invention relates to the operation of a crystal or mechanical oscillator, preferably a piezo-crystal oscillator, to effect a beating frequency which is independent of the frequency to which attached circuits are tuned and to control the intensity of these oscillations by imposing a resistance or capacity serially in the circuit of the crystal or mechanical oscillator. The arrangements of this invention are capable of receiving radio telegraph as well as radio telephone signals.

The invention, both as to its organization and method of operation as well as the further objects, features and advantages thereof, will be more clearly understood by reference to the following description when read in connection with the accompanying drawing, Figures 1 and 2 of which illustrate two different embodiments of the invention.

Referring to Fig. 1, let it be assumed that at a given station it is desired to select all frequencies lying in the band of frequencies between 600,000 and 610,000 cycles and to exclude all frequencies lying outside of that range. The various received frequencies may be impressed upon the receiving circuit 1, consisting of a loop antenna and condenser that is tuned to about 605,000 cycles, the mean of limiting frequencies of the desired band. Since the desired band is narrow as compared with the range of frequencies extending from zero up to the desired frequency,

it results that there is almost uniform reception for frequencies between 600,000 and 610,000 cycles, and decreasing and negligible reception for other frequencies.

The next step of the method involves beating the various frequencies of the band with a locally supplied frequency for the purpose of stepping down the frequencies of the desired band. The locally supplied frequency is obtained from the crystal or mechanical oscillator 11 vibrating in circuit 3, which circuit, along with the tuned circuit, are connected to the input of the detector 9. Assuming that a frequency of 550,000 cycles is used for beating the received frequencies, a reduction of the desired frequencies to a band between 50,000 and 60,000 cycles results and appears in the output circuit of the detector 9. Although frequencies between 50,000 and 60,000 cycles are also produced by the reaction of the locally supplied 550,000 cycle currents with the received currents in the range between 490,000 and 500,000 cycles, since the last mentioned band is quite distant from the frequency to which circuit it is tuned, the resultant frequencies between 50,000 and 60,000 cycles will be of very small amplitude as compared with the frequencies within the same range resulting from the stepping down of the desired band of frequencies. The output circuit 4 is connected with the filter 5 and can be so adjusted by condenser 10 that only the selected band, the band between 50,000 and 60,000 cycles will pass through. Moreover, by proper adjustment filter 5 combines with the tuned radio receiving circuit 1 to pass the particular band of frequencies desired, i. e., the band between 600,000 and 610,000 cycles, practically to the exclusion of all other bands. The band thus passing through the filter is amplified by the intermediate frequency amplifier at 6, and after the band passes through the amplifier it is detected at 7 and is again amplified so that the output 8 receives signals that have sufficient audibility.

If a different local beating frequency is desired, the crystal of the oscillator 11 may be replaced by a crystal that has different physical properties, a crystal that is different in size, shape, quality, etc. The resistance 12, or a capacity, is serially connected in circuit 3 so that the intensity of the locally supplied beating frequency may be changed to a lower or higher value.

There is a saving of one tube by the use of a crystal or mechanical oscillator of this invention in double detection radio receiving systems. The

magnitude of the oscillations can be adjusted so that the detector tube is not overloaded by these oscillations or any harmonics thereof. A crystal or mechanical oscillator does not, of itself, generate harmonics, but harmonics may be introduced by the vacuum tube under certain conditions. The frequency of this crystal or mechanical oscillator is quite constant and is independent of the characteristics of the vacuum tube. Because of the high impedance of the crystal or mechanical oscillator circuit, practically no reaction is introduced into the tuning circuits, thereby making it possible to tune the circuits exactly to the frequency desired.

The chief advantages of this invention are, briefly, tube economy, simplicity in operation, reliability, and stability in that both the tuned frequency of circuit 1 that is received and the local beating frequency are maintained practically constant. In addition to the advantages enumerated, the local beating frequency does not introduce distortion and in any way overload the high frequency detector with useless frequencies, such as is being done in the existing method which uses the harmonics generated by the oscillating detector for the beating frequency.

Fig. 2 diagrammatically represents another arrangement of this invention, whereby signals are received at the output 8 without the use of the filter and several of the stages of amplification of Fig. 1. In this arrangement the radio frequency amplifier 13 is connected to the input of detector 9, and the detector and audio frequency amplifier 7 is interposed in the circuit connecting the receiver 8 with plate and filament of the detector 9. The amplifier 7 intensifies the signals in the output circuit of detector 9 so as to be audible at the receiver 8.

It will be understood that the frequencies hereinbefore described are merely illustrative and may be varied in practice as conditions may require.

Although one embodiment of the invention has been described, it is further to be understood that the invention is not limited to any specific construction, but might be embodied in various systems without departing from the spirit of the invention or the scope of the appended claims.

What is claimed is:

1. In a radio receiving system, in combination, means for receiving any one of a plurality of bands of radio frequency currents representing signals, a three-element vacuum tube to act both as an oscillator and as a detector, a piezo-electric crystal opposite sides of which are connected between the plate and grid electrodes of the vacuum tube, said piezo-electric crystal coupling the grid circuit of the vacuum tube with its plate circuit, said piezo-electric crystal producing current of the frequency to be beaten with the received band of radio frequency currents, means coupled to the output circuit of the vacuum tube for selectively receiving the modulation products derived from the piezo-electric crystal oscillations and the received band of radio frequency currents to the exclusion of

all other currents, and means for deriving the signals from the selectively received products of modulation.

2. In a double detection radio receiving system, in combination, an oscillator-detector tube, an adjustable radio receiving circuit to receive any given band of frequencies emitted by a distant station, a piezo-electric device acting as a capacitance element opposite sides of which are connected between the grid and plate of said tube, said piezo-electric device generating a practically constant local beating frequency, the band of radio frequencies received and current of the frequency of the piezo-electric device being impressed on the input circuit of said tube, the products of the reaction being obtained in the output circuit of said tube, an adjustable filter for selecting from said products only the given band of radio frequencies changed in the frequency spectrum, and means for detecting the signals represented by the band of frequencies selected by said adjustable filter.

3. In a radio receiving system, the method of receiving radio signals representing speech with apparatus including a vacuum tube of the three-electrode type and a piezo-electric crystal opposite sides of which are connected between the plate and grid electrodes of the vacuum tube, which consists in selectively receiving any one of a plurality of bands of radio frequencies, impressing the received band on the input circuit of said vacuum tube, beating with said band current of the natural frequency of the piezo-electric crystal which is also impressed on the input circuit of the vacuum tube, current of the frequency of the piezo-electric crystal being unchanged in its frequency characteristic even when other bands of radio frequencies are selectively received, selectively transmitting any received band stepped down in the frequency spectrum as a result of the beating process, and detecting the signals from the selectively transmitted band.

4. In a double detection radio receiving system, in combination, an oscillator-detector tube of the three-electrode type, a radio receiving circuit coupled to the input circuit of said tube, said circuit receiving any one of a plurality of bands of radio frequencies and impressing any selected band on the input circuit of said tube, a piezo-electric crystal, a resistance, opposite sides of the piezo-electric crystal being connected between the plate and grid electrodes of said tube in series with said resistance, said piezo-electric crystal producing current of a frequency which is also to be impressed on the input circuit of said tube, said resistance controlling the intensity of the vibrations of the piezo-electric crystal, the output circuit of the tube obtaining the products of the two beating components, an adjustable filter coupled to the output circuit of said tube and passing only the band of frequencies received by said radio circuit changed in the frequency spectrum, and means to detect the signals impressed on the band transmitted by said adjustable filter.

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