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REMOTE CONTROL DEVICE FOR RADIO RECEIVERS

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Fig. 1

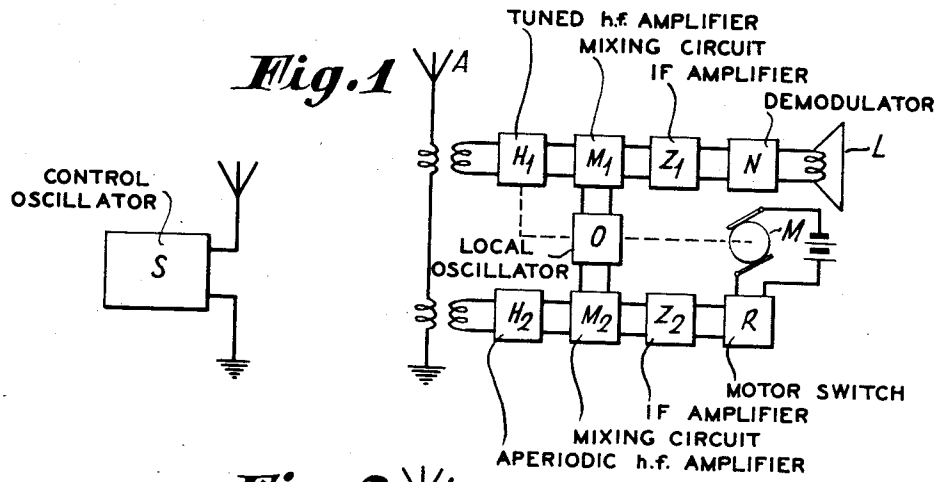


Fig. 2

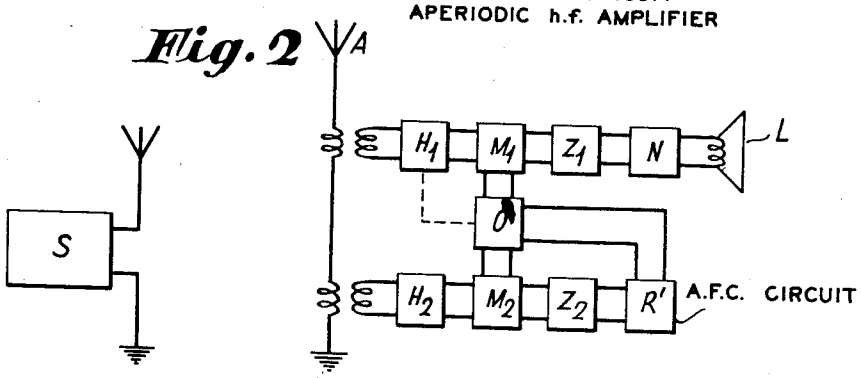
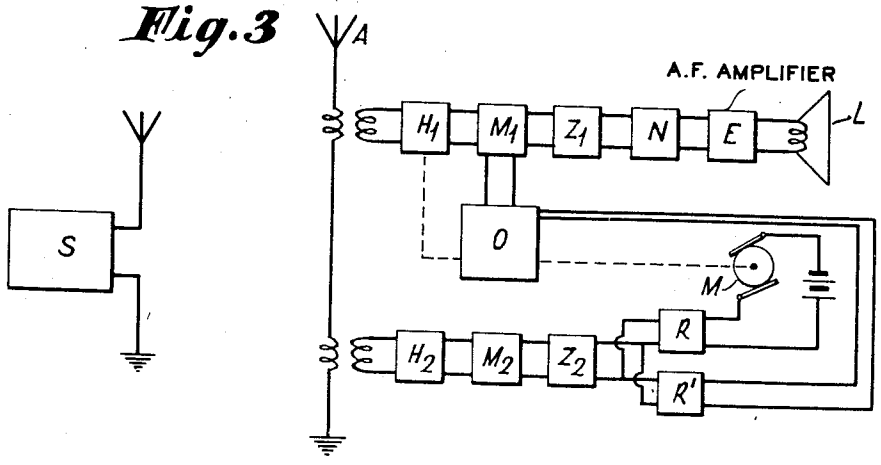


Fig. 3



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REMOTE CONTROL DEVICE FOR RADIO RECEIVERS

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8 Claims. (Cl. 250—20)

It is known in the art to control adjustable elements from a distant point by means of a control frequency energy emitted from the control station. In one such device used to tune a receiver, the rotating plate condenser of a receiver for the control a motor is used which continually varies the tuning of the receiver inside its tuning range. When the receiver is in tune to the emitted control frequency, the working current of the shifting motor is interrupted whereupon the rotating plate condenser stops at that position.

A disadvantage of such a device is that the receiver cannot be used for receiving signal oscillations at least as long as the control frequency is emitted. For, either the frequency of the control oscillation departs so far from that of the signal oscillations that the signal oscillations cannot be received during selection to the control frequency or, when the frequencies are nearly equal to each other, the oscillations are superposed one upon the other in an undesirable manner. Such an arrangement therefore, is not applicable to adjusting a receiver proper to the wavelength of a certain signal transmitter.

The present invention is concerned primarily with the problem of remotely controlling a receiver used for the reception of wireless signals. This is accomplished according to the invention by means of a control receiver which like the controlled receiver is designed as a heterodyne receiver. The receivers have a common oscillator and the control frequency for operating the control receiver, which is transmitted by wireless or over lines, is so chosen that with automatically performed selection of the control receiver to the control frequency the receiver is in tune to the transmitting station to be received.

The invention will be more readily understood from the following detailed description thereof when read in connection with the drawing which illustrates several embodiments thereof. In the drawing, Fig. 1 illustrates in schematic form a modification of the invention wherein a tuning motor is controlled by an auxiliary receiver through a motor switch; Fig. 2 illustrates a modification of the invention making use of an automatic frequency control device; and, Fig. 3 is a modification of the invention using both a motor control circuit and an automatic frequency control device.

In the embodiment of the invention as shown in Fig. 1, the antenna A picks up the signal oscillations of various transmitters as well as the unmodulated control frequency of the control oscillator S and transmits them on the one side to the tuned high frequency amplifier H_1 and on the other side to the aperiodic high frequency amplifier H_2. The amplified oscillations then are combined in both mixing stages M_1 and M_2 with the same frequency of the local oscillator O. The both intermediate frequency oscillations produced thereby are separately amplified by by means of the selective intermediate frequency amplifiers Z_1 and Z_2. The signal intermediate frequency is demodulated in the audion stage A the output of which is amplified if desired in a suitable low frequency amplifier not shown and delivered, e. g., to the loudspeaker L or another reproduction device. The control intermediate frequency is conveyed—in case of emergency after a preceding rectification—to a switching relay R so that it breaks, when its amplitude is sufficient, the circuit of the motor M which is coupled, as indicated by the dotted line, by means of a reduction gear to the rotating plate condenser of the oscillator O and to the rotating plate condensers of the high frequency amplifier H_1 being mounted on the same shaft.

The arrangement can be made such that the rotating plate condensers may be turned always in the same direction or a suitable reversing clutch arrangement between the motor and the rotating plate condensers may be provided which arrangement reverses its direction of coupling at the ends of the rotary motion of the rotating plate condensers or again the motor may automatically be changed over at the boundaries of the rotary motion of the rotating plate condensers. As soon as the relay R pulls up the motor is arrested and in case of emergency simultaneously a brake is brought into action on the shaft of the variable condenser. The relay may be arranged so that, as soon as the control frequency assumes another value, the motor circuit is closed again and the variable condensers are adjusted till the selection to the new control frequency is reached.

The advantage of the invention comes forth from the following: There is designated by f_1 the carrier frequency of the modulated signal oscillation to be received, by f_0 the frequency of the control oscillation, by o the adjustable oscillator frequency, by z_1 the presumed amount of the intermediate frequency being determined by the tuning of the intermediate frequency circuits of the main receiver, by z_0 the presumed amount of the intermediate frequency of the second receiver serving only for controlling. In the usual heterodyne receivers accurate tuning is secured to a minor degree by tuning the input high-frequency circuits exactly to the incoming frequency but in

the first rank by choosing an oscillator frequency of such a value that the intermediate frequency produced thereby assumes exactly the amount that ought to be available. In the present case, therefore, the principal condition for an accurate tuning of the main receiver to the signal frequency f_1 and for a simultaneous tuning of the control receiver to the control frequency f_0 is given by the following equations:

$$f_1 - o = \pm z_1$$
$$f_0 - o = \pm z_0$$

In both equations o means the same frequency of the common oscillator, z_1 and z_0 differ from each other and are fixed in a receiver according to the invention. The act of adjusting proceeds —disregarding tuning of the preselector circuits which has to be approximate only—so that the oscillator frequency is varied till the condition $f_0 - o = \pm z_0$ is met. By this means, however, naturally also the condition $f_1 - o = \pm z_1$ is met with the same accuracy. By the fact that the adjustment is carried out according to the control frequency an accurate tuning of the main receiver to a certain incoming frequency is to be accomplished even when the signal oscillation to be received is not yet existing or discontinues, fluctuates, is very weak or disturbed by neighbouring transmitters. On the other side reception of the signal oscillations is permanently possible even with the control frequency being emitted.

The additional control receiver may be rather simply constructed and comprise either no high-frequency amplifier at all or, as in the embodiment given above, only an aperiodic one. In addition the intermediate-frequency amplifier of the control receiver may be very simple as the intermediate frequency which is produced by the control oscillation has to serve only for effecting the variation of the tuning or for bringing it to an end when correspondence with the presumed amount is accomplished.

A further possibility consists in performing rough tuning by hand and having only sharp tuning automatically done. In an arrangement of this kind as shown in Fig. 2, R′ denotes a frequency-control device as it is known per se for the purpose of automatic sharp tuning by means of electrical fine tuning of the heterodyne local oscillator. This device here acts upon the oscillator, the adjustment of which is supposed to be already approximately correct, till the control intermediate-frequency and therewith also the signal intermediate-frequency have assumed accurately the respective values that ought to be available. The oscillator frequency is kept by the device at the value required in spite of thermal variations and the like. With this arrangement no special precautions need be taken to make the heterodyne oscillator capable of itself to generate strictly constant in frequency.

Fig. 3 shows an arrangement combining the arrangementes according to Fig. 1 and Fig. 2 wherein both, the rough tuning acting but once and the continually acting sharp tuning are automatically done. The relay R as well as the frequency control device R′ are coupled to the output of the intermediate-frequency amplifier Z_2 and connected to the oscillator O as shown in Figs. 1 and 2. If the control frequency oscillator is comparatively near or anyway delivering very large amplitudes, in case of emergency the high-frequency amplifier H_2 may be entirely omitted and in certain cases the intermediate-frequency amplifier Z_2, too, may be replaced by intermediate-frequency filters without amplifying tubes. The difficulty arising from automatic rough tuning, viz., the relay R pulling-up on account of the image frequency on two different oscillator frequencies of the variable condensers, may be avoided by making the control frequency z_2 lower than the required degree of exactitude of adjustment, e. g., equal to 100 cycles. The intermediate-frequency amplifier Z_2 in this case is a low-frequency amplifier.

Further, it is possible to use the control oscillator and the controlling receiver only for the single rough tuning of the main receiver to a certain signal frequency, e. g., by means of an arrangement according to Fig. 1, and to provide the main receiver with a device for automatic sharp tuning by means of which the main receiver is automatically maintained sharply tuned to the signal frequency.

A single control oscillator of course may be used for several receivers.

In Fig. 3 an audio frequency amplifier E has been inserted between the demodulator N and the load L.

In some cases the invention even may be applied when the control oscillator, which then may be linked-up over a line, is situated close by the receiver or some parts of the receiver. Such an arrangement is particularly suitable when only the intermediate-frequency portion and the low-frequency portion of the main receiver are situated at the listener's position while the high-frequency portion and the mixer stage are placed immediately close to the antenna being arranged as favourably as possible with view to the reception. In these cases it is recommendable to make use of the invention so that the adjustable control oscillator is situated at the listener's position and so, e. g. by a line, connected to the control receiver situated close to the antenna that the latter tunes itself to the control frequency and at the same time the high-frequency part of the main receiver being coupled to it and utilizing the same oscillator to the incoming frequency. Tuning of the receiver accordingly is effected by varying tuning of the control oscillator and by this means it is feasible to place all the control knobs of the receiver at the listener's position.

We claim:

1. In signalling apparatus, a main receiver including operable means for tuning the receiver to any frequency within a band of frequencies, a motor for driving said operable tuning means, an auxiliary receiver provided with relay means for controlling the operation of said tuning motor, control means for generating and transmitting to the auxiliary receiver a control carrier wave a characteristic of which is representative of the frequency to which it is desired to tune the main receiver, said auxiliary receiver being responsive to the control carrier waves transmitted by the control means and arranged so that the relay means causes operation of said motor to tune the main receiver to the frequency corresponding to the transmitted control carrier wave and to maintain said tuning of the main receiver as long as the control wave is received by the auxiliary receiver.

2. In signalling apparatus, a main receiver including operable means for tuning the receiver over a band of frequencies, a motor for driving the tuning means, auxiliary receiving means including a relay for controlling the operation of

the motor, selectively operable control means for generating and transmitting to the auxiliary receiver a control carrier wave the frequency of which is representative of the frequency within said band of frequencies to which it is desired to tune the main receiver, said auxiliary receiver being responsive to the control carrier wave transmitted by the selectively operable control means and arranged so that upon reception of a control carrier wave said relay causes operation of the motor to tune the main receiver to the frequency corresponding to the received controlled carrier wave.

3. In signalling apparatus, a tunable main receiver of the superheterodyne type including a local oscillator, a control receiver, means for generating and transmitting a pilot carrier wave a characteristic of which is representative of a controlling action desired to be imparted to the main receiver, said control receiver including means for combining the transmitted pilot wave and the energy from said local oscillator to produce therefrom a beat frequency and means responsive to said beat frequency for imparting said controlling action to said main receiver.

4. In signalling apparatus, a main receiver of the superheterodyne type including a local oscillator, operable means for varying the frequency of the energy generated by the local oscillator for tuning said receiver over a band of frequencies, a control receiver, means for generating and transmitting to the control receiver a pilot carrier wave a characteristic of which is representative of the frequency to which it is desired that the main receiver be tuned, said control receiver including means for combining the transmitted pilot carrier wave and energy generated by said local oscillator to produce therefrom a beat frequency, and means responsive to said beat frequency for acting upon the local oscillator to determine the frequency of the energy generated thereby.

5. In a remotely operated signalling system, a main receiver of the type provided with a local oscillator utilized to generate oscillations which are combined in the receiver with desired signal modulated carrier oscillations to produce energy of a predetermined intermediate frequency, means for generating and transmitting control signals from a remote point, an auxiliary receiver adapted to receive said control signals and combine them with the oscillations generated by said local oscillator to produce a beat frequency, a relay device responsive to said beat frequency and operatively connected to said local oscillator for controlling the frequency of the oscillations generated by said local oscillator, said relay being arranged so as to determine the frequency of said last named oscillations in accordance with said control signals so that when said oscillations are combined with the desired incoming signal modulated carrier oscillations in said main receiver said predetermined intermediate frequency is produced.

6. In signalling apparatus, a main receiver of the superheterodyne type including a tunable local oscillator, a control receiver, means for generating and transmitting to the control receiver a pilot carrier wave a characteristic of which is representative of the frequency to which it is desired that the main receiver be tuned, said control receiver including means for combining the pilot wave transmitted thereto and energy from said local oscillator to produce therefrom a beat frequency and means responsive to said beat frequency for varying the frequency of said local oscillator to thereby maintain the main receiver tuned to the desired frequency.

7. In signalling apparatus, a main receiver of the superheterodyne type including a local oscillator and a tuned input circuit, said receiver being tunable over a band of frequencies by varying the frequency of the energy generated by the local oscillator and also the frequency to which said tunable circuit is tuned, a control receiver associated with the main receiver, means for generating and transmitting to the control receiver a pilot carrier wave a characteristic of which is representative of the frequency to which it is desired that the main receiver be tuned, said control receiver including means for combining the transmitted pilot wave and energy from said local oscillator to produce therefrom a beat frequency and means responsive to the produced beat frequency for varying the tuning of said tuned circuit and said local oscillator simultaneously to a point where the frequency of said beat frequency assumes a predetermined value.

8. In a remotely operated radio receiving system adapted to be controlled by means of control signals transmitted from a remote point, the combination of a main receiver of the type provided with a local oscillator used to generate oscillations which are combined with received signal modulated carrier oscillations to produce energy of a predetermined intermediate frequency, an auxiliary receiver adapted to receive the control signals transmitted from the remote point and a relay device operatively connected between the output of said auxiliary receiver and the local oscillator for controlling the frequency of the oscillations generated by the local oscillator in accordance with the control signals received by the auxiliary receiver.

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