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AUTOMATIC TUNING CONTROL

Filed April 30, 1936

Fig. 1

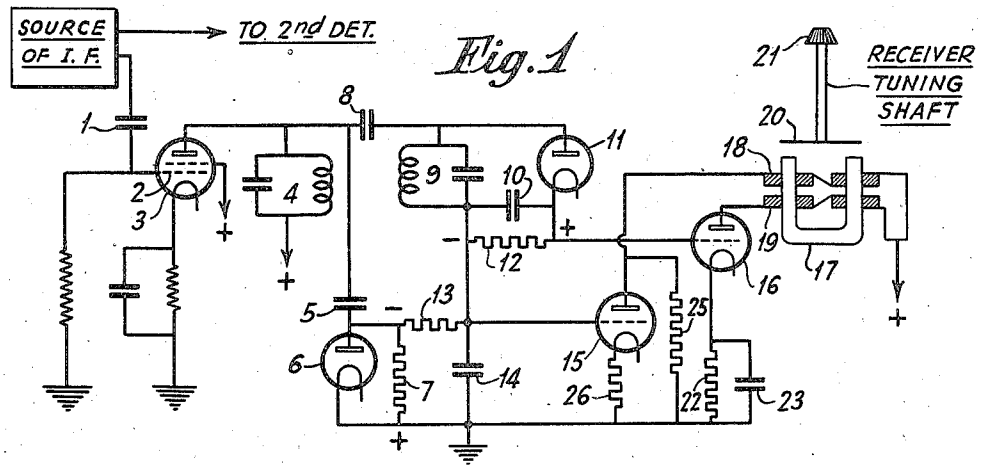


Fig. 2

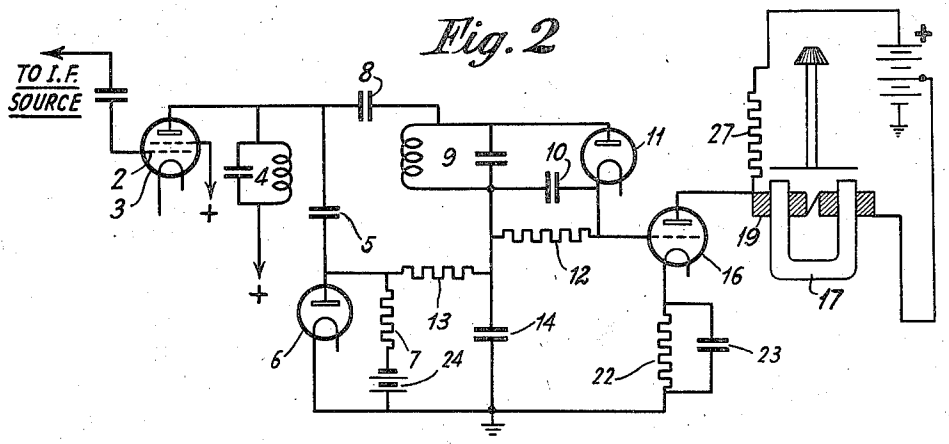
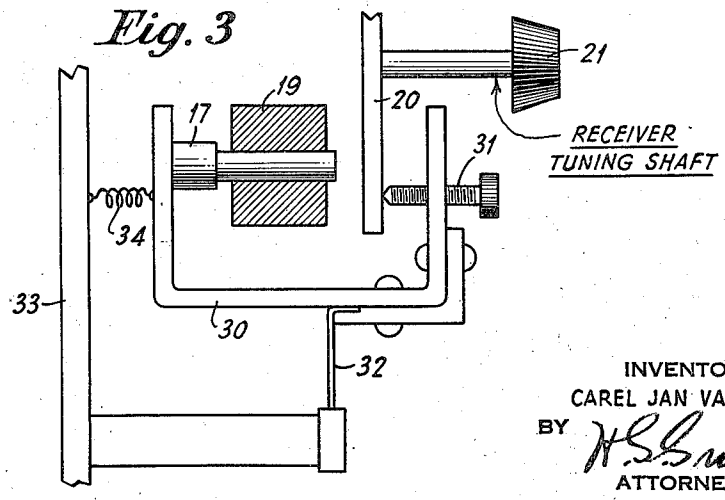


Fig. 3



INVENTOR
CAREL JAN VAN LOON
BY H. S. Snow
ATTORNEY

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AUTOMATIC TUNING CONTROL

Carel Jan van Loon, Eindhoven, Netherlands, assignor to N. V. Philips' Gloeilampenfabrieken, Eindhoven, Netherlands

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8 Claims. (Cl. 250—40)

This invention has reference to an arrangement for automatically tuning wireless receiving sets; that is to say, a circuit arrangement in which once correct tuning is effected, further rotation of the tuning member is prevented, for example, by a brake being set into operation.

Such an arrangement is particularly suitable for devices with automatic volume or gain control, since in this case it is often difficult for laymen to find the point at which tuning is correct. The invention has for its object to provide an arrangement for automatically tuning which is not set into operation until exact tuning to the desired carrier wave is effected, and the operation of which is not, or slightly, dependent upon the intensity of the incoming signal.

According to the invention, the arrangement comprises a relay the energization of which is governed by the difference of two voltages; one of which is derived by rectification from the voltage across a circuit or an impedance respectively which has supplied to it part of the signal voltage, and the other being similarly derived by rectification from the voltage which is operative in a second circuit tuned to the signal and having a very low damping, and which second circuit is coupled to the first mentioned circuit or impedance respectively, the proportioning being such that in the case of sharp tuning, the said difference is equal to zero, in which case the relay is energized.

In order that the invention may be clearly understood and readily carried into effect, two embodiments thereof will now be set out more fully with reference to the accompanying drawing, wherein Figs. 1 and 2 are circuit diagrams of different embodiments of the invention; Fig. 3 shows a braking device adapted for this invention.

In the circuit arrangements shown, part of the signal energy which may be received from an amplifying stage, preferably a medium frequency (I. F.) amplifying stage of the set (not shown) is supplied across a condenser 1 to the grid 2 of an amplifier valve 3. The output circuit of the latter includes a circuit 4 which contains, connected in parallel, an inductance and a condenser, and which may be tuned to the frequency received. An ordinary impedance, for example an ohmic resistance, may, however, be chosen instead of a tuned circuit. In the circuit arrangement shown in Fig. 1, the voltage operative in the circuit is supplied across a condenser 5 to a detector 6, shown as a diode, having connected a resistance 7 in parallel with it. Upon the occurrence of a signal such a voltage drop is set up across this resistnce 7 that the lower end becomes positive with respect to the other end. The circuit 4 has coupled to it, by means of a condenser 8, a second circuit 9 having a very light damping. The voltages occurring across it are supplied to a second detector 11. The rectified currents pass through a resistance 12 having a condenser 10 connected in parallel with it, so that the right hand end becomes positive relative to the left hand end. The circuit 9 is grounded by means of a condenser 14 having a low impedance for high frequency currents. For the reasons mentioned hereinafter, the condenser 14 is, however, such that the impedance is high for low frequency currents. The resistances 7 and 12 are connected in series so that the voltages set up across them counteract each other. In addition, the resistances 7 and 12 have interconnected between them a resistance 13 preventing the high frequency currents from flowing away across the condensers 5 and 14.

The resistances are connected into the grid circuits of two amplifier valves 15 and 16 (shown as triodes) in such manner that the grid voltage of the valve 15 is solely governed by the voltage across the resistance 7; that of valve 16 by the difference of the voltages across the resistances 7 and 12. The diodes are, in addition, connected in such manner that the voltage across the resistance 7 makes the grids negative. The anode circuits of the valves 15 and 16 include relay windings 18 and 19. The latter energize a magnet core 17 and are so arranged as to counteract each other. This relay may set into operation, for example, a braking device. For this purpose, the shaft of the tuning knob 21 may have fast on it a braking disc 20 of soft-iron which, upon energization of the magnet 17, is drawn against the magnet poles to a greater extent. Due to the increased friction between the disc 20 and the magnet poles, further adjustment of the knob 21 is prevented. The cathode conductor of the valve 16 includes a resistance 22 the function of which is to place a negative bias upon the grid of the valve 16. It has connected in parallel with it a condenser 23 the operation of which is described more fully hereinafter. The cathode conductor of valve 15 may similarly include a resistance 26.

The arrangement shown in Fig. 1 operates as follows. Assume the grid of the valve 3 not to have supplied to it any signal voltage. Neither of the resistances 7 and 12 then has current passing through it so that the valves 15 and 16 have but a low negative grid bias, and allow cur-

rent to pass. Since the currents counteract each other, the relay is not energized in this case so that the set can be tuned without any difficulty.

If the set is tuned to slightly at the side of the desired wave length, first a voltage is set up across the circuit 4. The circuit 9, which has a sharp resonance curve, is still inactive in this case. The detector 6 comes consequently into play so that the resistance 7 has operative across it a voltage which makes the grids of the valves 15 and 16 negative so that both anode currents are cut off. Consequently, even then the relay does not yet come into play, and further tuning is still possible. Not until very sharp tuning has been effected does the circuit 9 come into play. Thus, the grid of the valve 16 receives, in addition to the negative voltage which was operative across the resistance 7, a positive voltage across the resistance 12. This results in the grid of the valve 16 again receiving the original low bias so that it has again current passing through it. The relay is thus set into operation, and further rotation of the tuning knob is prevented.

Correct proportioning of the condenser 8 and of the resistances ensures that in the case of sharp tuning to a signal the voltages set up across the resistances 7 and 12 are equal. Thus, it is ensured that the operation of the device is independent of the intensity of the signal received, and that practically independently thereof the tuning mechanism is always arrested when tuning exactly on the carrier wave has been effected. The resistances 7 and 12 have occurring across them in addition to the direct voltage the low frequency alternating voltage at which the signal is modulated. These voltages are, however, oppositely directed so that upon the correct tuning being obtained an alternating voltage is not operative at the grid of the valve 16, it being premised that the condenser 14 has a high impedance for low frequency currents.

Upon the correct tuning being obtained a sudden current impulse becomes manifest across the winding 19. In this case, the resistance 22 brings about negative reaction which prevents the current from rising rapidly. In order that even in the case of comparatively rapid rotation of the knob, the relay may be sufficiently energized, the resistance 22 has connected in parallel with it a condenser 23 which removes the counter-coupling in the case of quick variations in current. If upon the correct tuning being obtained, the knob is forcibly rotated further, the voltage across the resistance 12 again disappears and the current passing through the relay winding 19 falls down to the zero value. In order that the magnetism may disappear at once, the arrangement comprises a resistance 25 which has always passing through it a low current which demagnetizes the relay.

As is apparent from the foregoing, it is the valve 16 which sets the relay into operation. The function of the second valve 15 is only to supply, in the absence of signals, a current balancing the current of the valve 16 as regards the operation of the relay. A similar effect may be obtained by connecting a source of voltage into the circuit formed by the rectifier 6 and the resistance 7. Such a circuit arrangement is shown in Fig. 2, and is essentially similar to that of Fig. 1. The resistance 7 has connected in series with it a source of voltage 24 which is so connected, and the voltage of which is such, that in the absence of a signal, the anode current of the valve 16 is cut off. This permits omission of the valve 15. Instead of using a differential relay, use may be made of a relay having only one winding 19. It may, however, be desirable that a demagnetizing counter-winding having a few windings should be provided.

As shown in Fig. 2, a similar effect can be obtained by connecting one end of the winding, across a high resistance 27, to a higher positive voltage than the ordinary supply voltage. The source of voltage 24 has the effect of current not starting to flow in the resistance 7 until the signal voltage in the circuit 4 exceeds a given value. In the case of more powerful signals the operation of the arrangement is identical with that of the arrangement shown in Fig. 1. It is possible for the circuit arrangement to be arranged in such manner that the detector action takes place in the valve 16. For this purpose, the upper point of the circuit 9 needs only to be connected to the grid of the valve 16.

One form of construction of the braking device is shown in Fig. 3. The magnet core 17 provided with its coil 19 is mounted on a non-magnetic U-shaped member 30. The shaft of the knob 21 has fast on it a braking disc of soft-iron. The member is secured by means of a spring plate 32 to a stationary bottom piece 33 so that it is capable of slightly moving in the direction of the axis of the magnet pole. In "off" position, there is between the magnet poles and the braking disc 20, an air gap, the width of which can be adjusted by means of a set screw 31. A spring 34 permits of the member being maintained in the position shown in Fig. 3. Upon the relay being energized the member 30 moves to the right, the pole pieces producing a powerful braking action on the disc 20. Owing to the presence of the air gap between the magnet poles and the braking disc, there is the advantage that the braking action starts suddenly.

The effect obtained is similar to that which would be achieved if upon the tuning being obtained, the tuning device would abut against a stationary pawl. This permits of ensuring that accurate tuning to the carrier wave received is obtained automatically. In addition, it can thus be ensured in a simple manner that the device can operate as a switch, the switch contacts being formed, for example, by the magnets and the disc.

What is claimed is:

1. In a radio receiver of the type provided with an adjustable tuning mechanism, a resonant circuit tuned to a desired frequency, a rectification network coupled to the resonant circuit and including means for developing a direct current voltage from high frequency energy of said frequency, a second resonant circuit tuned to said frequency and coupled to the first resonant circuit, a second rectification network coupled to the second resonant circuit and including means for developing a direct current voltage from high frequency energy therein of said frequency, and means, responsive to the difference of said two voltages, for controlling adjustment of said tuning mechanism.

2. In a radio receiver of the type provided with an adjustable tuning mechanism, a resonant circuit tuned to a desired frequency, a rectification network coupled to the resonant circuit and including means for developing a direct current voltage from high frequency energy of said frequency, a second resonant circuit tuned to said frequency and coupled to the first resonant circuit, a second rectification network coupled to the second resonant circuit and including means

for developing a direct current voltage from high frequency energy therein of said frequency, means, responsive to the difference of said two voltages, for controlling adjustment of said tuning mechanism, and said second resonant circuit having a relatively sharper selectivity characteristic than the first resonant circuit.

3. In a radio receiver of the type provided with an adjustable tuning mechanism, a resonant circuit tuned to a desired frequency, a rectification network coupled to the resonant circuit and including means for developing a direct current voltage from high frequency energy of said frequency, a second resonant circuit tuned to said frequency and coupled to the first resonant circuit, a second rectification network coupled to the second resonant circuit and including means for developing a direct current voltage from high frequency energy therein of said frequency, means, responsive to the difference of said two voltages, for controlling adjustment of said tuning mechanism, said last means including at least one electron discharge tube having its input electrodes connected across both of said rectification network means, an electro-responsive device constructed and arranged to stop adjustment of the tuning mechanism, and said last device being electrically connected to said tube output circuit.

4. In a radio receiver of the type provided with an adjustable tuning mechanism, a resonant circuit tuned to a desired frequency, a rectification network coupled to the resonant circuit and including means for developing a direct current voltage from high frequency energy of said frequency, a second resonant circuit tuned to said frequency and coupled to the first resonant circuit, a second rectification network coupled to the second resonant circuit and including means for developing a direct current voltage from high frequency energy therein of said frequency, means, responsive to the difference of said two voltages, for controlling adjustment of said tuning mechanism, and both of said rectification network means being connected to produce said difference in voltages.

5. A radio receiver comprising a tuning device adapted to be adjusted for selection of a carrier wave, an electro-responsive brake mechanism adapted to prevent adjustment of the tuning device when energized, at least two resonant rectifier circuits tuned to a common frequency, each circuit including an impedance for developing a direct current voltage from impressed carrier wave energy of the common frequency, and means responsive to the voltages from both rectifier circuits in polarity opposition to energize said brake mechanism.

6. A radio receiver comprising a tuning device adapted to be adjusted for selection of a carrier wave, an electro-responsive brake mechanism adapted to prevent adjustment of the tuning device when energized, at least two resonant rectifier circuits of relatively different selectivity characteristics tuned to a common frequency, each circuit including an impedance for developing a direct current voltage from impressed carrier wave energy of the common frequency, and means responsive to the voltages from both rectifier circuits in polarity opposition to energize said brake mechanism.

7. A radio receiver comprising a tuning device adapted to be adjusted for selection of a carrier wave, an electro-responsive brake mechanism adapted to prevent adjustment of the tuning device when energized, at least two resonant rectifier circuits tuned to a common frequency, each circuit including an impedance for developing a direct current voltage from impressed carrier wave energy of the common frequency, and electron discharge tube means responsive to the voltages from both rectifier circuits in polarity opposition to energize said brake mechanism.

8. A radio receiver comprising a tuning device adapted to be adjusted for selection of a carrier wave, an electro-responsive brake mechanism adapted to prevent adjustment of the tuning device when energized, at least two resonant rectifier circuits of relatively different selectivity characteristics tuned to a common frequency, each circuit including an impedance for developing a direct current voltage from impressed carrier wave energy of the common frequency, and electron discharge tube means responsive to the voltages from both rectifier circuits in polarity opposition to energize said brake mechanism.

CAREL JAN VAN LOON.