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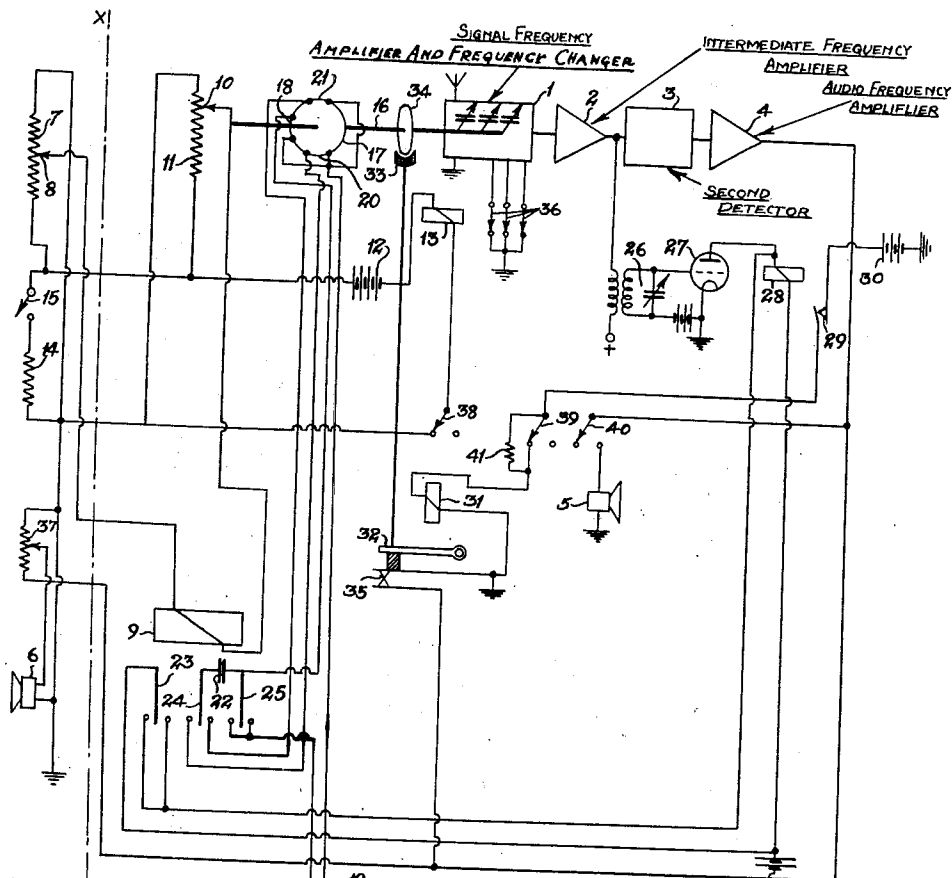


Fig. 1.

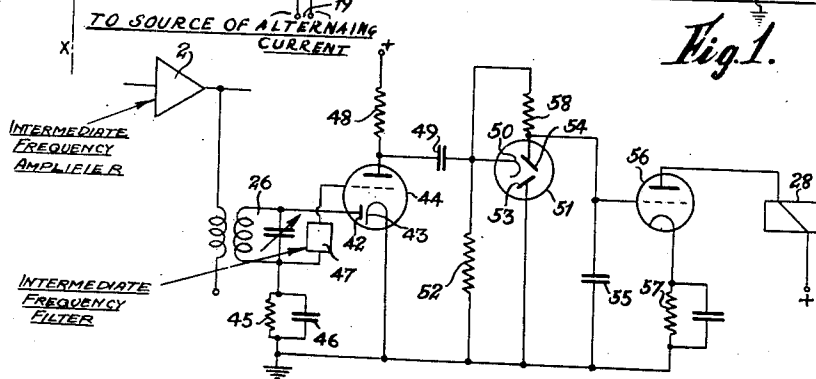


Fig. 2.

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WIRELESS AND LIKE RECEIVER, AND TUNING CONTROL APPARATUS FOR USE THEREWITH

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The present invention relates to wireless and like receivers, and tuning control apparatus for use therewith.

On account of the large numbers of broadcasting stations having wavelengths within the restricted compass of the broadcast wavebands, the selectivity of broadcast receivers of good sensitivity must be made high, so that a desired signal may be received without adjacent channel interference. It is found however, that the operation of tuning a highly selective receiver is one requiring considerable accuracy, since mistuning may result in serious distortion; when such a receiver is not accurately tuned, adjacent channel interference and sideband cutting, among other influences, may mar the reception of the desired signal.

The need for highly critical tuning is an important factor in the design of remote tuning control apparatus; in a case, for example, in which tuning is effected by the adjustment of a variable condenser, it may be necessary to adjust the condenser to within a fraction of a degree of arc of the correct setting in order to avoid distortion, and remote control apparatus capable of such an accuracy is complicated, difficult to set up, and expensive to manufacture.

It is the principal object of the present invention to provide wireless or like apparatus, comprising a receiver and remote tuning control means therefor, in which a desired accuracy of tuning may be simply achieved, although the remote control means, of itself, may be incapable of effecting such accurate tuning.

The present invention accordingly provides wireless or like apparatus for the reception of modulated carrier oscillations, comprising a receiver having an adjustable tuning member, and tuning control means adapted for effecting adjustment of said member for the reception of a desired carrier, the tuning control means being coupled indirectly with the tuning member, that is to say, other than through a mechanical coupling, so that accurate tuning cannot readily be obtained by manipulation of the control means, characterised by the fact that there is provided, at the receiver, a magnetically operable brake arranged to come into operation automatically, while the tuning member is in motion under the influence of the indirect tuning control means, to brake the motion of the tuning member when said tuning member reaches its correct or substantially correct adjustment for the reception of said desired carrier.

Apparatus according to the present invention

may comprise remote tuning control means of many simple and inexpensive kinds, since it is not necessary that these means shall provide a high order of accuracy of control; suitable remote control means, by way of example, comprise a Wheatstone bridge circuit, and an electric motor arranged to be energised when the balance of the bridge is disturbed. Other features of the invention will appear from the following description and from the appended claims.

An embodiment of the present invention will be described, by way of example, with reference to Fig. 1 of the accompanying drawing, in which parts to the left of the dotted line X—X are arranged at a remote control point.

Reference will also be made to Fig. 2 of the accompanying drawing, which illustrates a modification of the arrangement of Fig. 1.

Referring to Fig. 1, a superheterodyne wireless receiver, which preferably embodies means for effecting automatic gain control, comprises a signal frequency amplifying and frequency changing stage 1, an intermediate frequency amplifier 2, a second detector 3, an audio-frequency amplifier 4, and a loudspeaker 5. The latter will hereinafter be referred to as the local loudspeaker, in contradistinction to the remote loudspeaker 6 which is arranged at the remote control point.

At the remote control point is arranged a potentiometer resistance 7 having a tapping point 8 which is connected through the winding of a polarised motor relay 9, arranged at the receiver, to a tapping point 10 in a potentiometer resistance 11, which is also disposed at the receiver. The relay 9, and other relays to be mentioned hereinafter, are preferably of the kind in which the flow of current in an electromagnet causes movement of an armature associated with one or more contacts; relay 9 has a polarised armature (not shown) associated with contact makers 23, 24 and 25. The resistances 7 and 11 constitute a Wheatstone bridge, the relay 9 being arranged across one diagonal. A source of current such as battery 12 is arranged across the other diagonal of the bridge, and a wave-change relay 13, disposed at the receiver, is connected in series with battery 12. The battery 12 and relay 13 are shunted by a resistance 14 and a switch 15, both of which are arranged at the remote point. The function of these elements will be explained hereinafter.

The initial stage 1 of the receiver has a tuning control shaft 16, which is arranged to be rotatable manually by an operator at the receiver, and is also coupled to the armature of a suitable re-

versible motor 17. The armature winding 18 of the motor is supplied with alternating current from a source 19 such as the mains; the motor windings 20 and 21 are separate stator windings, one of which is energised directly while the other is energised through phasing condenser 22. The direction in which the armature of the motor moves depends upon which of windings 20 and 21 is energised, these windings being connected and arranged in such manner that by disconnecting one of them and switching in the other, the motor is reversed.

The operation of the apparatus so far described is as follows:

When the bridge 7, 11 is balanced, no current flows in the winding of polarised motor relay 9, and the contact makers 23, 24 and 25 are in their midpositions as shown. When the balance of the bridge is disturbed, by adjustment of the tapping point 8 at the remote point, current flows in the windings of relays 9 and 13. The contact makers 23, 24 and 25 of relay 9 are moved to the right or left, depending on the sense of the unbalance of the bridge, and winding 18, and either of windings 20 and 21, of motor 17 are energised. The motor armature commences to rotate, the shaft 16 is also caused to rotate, and the tuning of the receiver is adjusted. The shaft 16 is also coupled to the movable member of the potentiometer 11, and it is arranged that when the bridge 7, 11 is unbalanced, the position of the tapping point 10 in potentiometer 11 is caused to move in such a way as to tend to restore the bridge to the balanced condition.

It will be clear that if such an arrangement is to provide accurate remote control the relay 9 must be sensitive to extremely small currents, since when the balanced condition of the bridge is approached the potential difference across the diagonal 8, 10 falls to a low value, and the motor 17 must be so arranged that the armature stops instantaneously when the driving current circuit is broken. In practice, the contact makers 23, 24 and 25 are released before the condition of balance of the bridge is achieved, and the armature "coasts" or, in other words, continues to move for a short time on account of its inertia. Accurate tuning would therefore only be achieved if the armature just ceased to coast when the desired tuning position was reached. According to the present invention, however, the armature is arranged so that it would tend to coast through and beyond the desired tuning position, and there is provided a magnetic brake which comes into operation to brake the motion of the armature, during the time in which it is coasting, when the position of accurate tuning is reached. The operation of this magnetic brake will now be described.

A part of the output of the intermediate frequency amplifier 2 is fed through a selective circuit 26 which is sharply tuned to the intermediate frequency to an anode bend detector valve 27 having in its anode circuit the winding of a brake relay 28. The current in the anode bend detector valve 27 increases when a signal is accurately tuned in. It will be seen that when the motor 17 is energised, the armature 23 of relay 9 is in the right or left hand position and short-circuits relay winding 28, but when the motor is de-energised, and is coasting, this short circuit is removed. No current accordingly flows in relay winding 28 until the receiver is tuned to the neighbourhood of the desired signal, and when

the position of accurate tuning is reached, there is an increase in the current in this winding (due to the detected intermediate frequency carrier) which is sufficient to close contact 29. Current then flows from battery 30, or like source of current through the winding of the brake electromagnet 31.

This magnet has an armature 32 which is rigidly coupled to a brake shoe 33; the latter co-operates with a brake drum 34. The brake drum 34 is keyed or otherwise rigidly coupled to the tuning shaft 16 for rotation therewith, and the arrangement is such that when the magnet 31 is not energised, the brake shoe 33 is held out of engagement with the brake drum 34 to allow the latter to rotate freely.

When, however, relay 28 is energized and current flows in the winding of magnet 31, the brake shoe 33 is brought into engagement with the brake drum 34, and exercises a braking action on it. This braking action is made sufficient to stop the armature of the motor 17, and it will be seen that rotation of the tuning control shaft 16 due to the coasting of the armature of motor 17 may be arranged to be arrested in exactly that position in which a desired signal is accurately tuned in.

In a modified arrangement, the drum 34 is made of magnetic material, and the brake shoe 33 is replaced by a magnet having a pole face of a suitable arcuate shape; in this modification, when the relay 31 is energised, the magnet is brought into contact with the drum and adheres thereto, thus producing the desired braking action.

The remote control arrangement described may incorporate a tuning scale engraved, for example, with the names of broadcasting stations, and this scale is preferably associated with the movable element of the remote potentiometer 7. In tuning from one station to another which is several stations removed from the initial tuning position, it will be seen that the brake relay 28 is short-circuited until the tuning control reaches the neighbourhood of the desired station, so that the brake magnet is not actuated for any of the intermediate stations. It is also arranged that until the brake magnet 31 is actuated, a contact 35, which imposes an effective short circuit across the loudspeaker 6, is closed.

The high frequency stage 1 of the receiver is provided with a number of wave-change switches 36, which are arranged to be closed when receiving a programme from a medium wave station, and open when receiving a long wave station. It is arranged that the current in the winding of relay 13 is normally insufficient to open these switches, but when it is desired to operate on the long waveband, the switch 15 at the remote point is closed, the resistance 14 is thrown in shunt across resistance 7, and the current flowing in the relay winding 13 thus increases and reaches a value sufficient to cause switches 36 to open.

The remote loudspeaker 6 is provided at the remote point with a volume control potentiometer resistance 37.

A multiple switch comprising coupled switch units 38, 39 and 40 is provided for changing over from remote control to manual control at the receiver itself. When switches 38, 39 and 40 are moved out of the left hand, or remote, position into the right hand, or local position, the battery 12 is disconnected from the bridge 7, 11, a resistance 41 is connected in series with brake electromagnet 31, and the local loudspeaker 5 is connected to the output of the receiver. The

function of resistance 41 is to reduce the current flowing in the brake magnet 31, and hence to reduce the strength of the braking effect due to magnet 33. This is desirable so that when the tuning control is operated manually, it is possible to turn the tuning shaft readily through an undesired station against the action of the magnetic brake.

The arrangement described has, however, the disadvantage that after a desired station has been tuned in, the brake 33, 34 remains operative as long as the station being received continues to transmit a carrier oscillation. Thus if it is desired in these circumstances to change over to another station, further tuning must be carried out against the action of the brake; rotation of the tuning shaft 16 may then commence with a sudden jerk, and difficulty may be encountered in tuning from one station to another in its immediate neighbourhood.

In the modified arrangement illustrated in Fig. 2, it is arranged that a short time after a desired station has been tuned in, the brake is automatically released, even though the desired station continues to transmit. Referring to Fig. 2, in which parts which are common to Fig. 1 have the same references, intermediate frequency oscillations from amplifier 2 are fed to a sharply-tuned circuit 26 and established between the diode anode 42 and cathode 43 of a diode-triode valve 44. The circuit of diode 42, 43 contains a load resistance 45 with its associated by-pass condenser 46, and potential differences set up across resistance 45 due to the flow of current in the diode are passed through an intermediate-frequency filter 47 of any known or suitable form to the control grid of valve 44.

The anode of valve 44 is connected through a resistance 48 to a source of anode current, and through a condenser 49 to the cathode 50 of a double diode valve 51. The cathode 50 of valve 51 is earthed through a resistance 52, and anode 53 is connected directly to earth. The anode 54 of valve 51 is earthed through condenser 55, and is connected to the control grid of an amplifier valve 56, having its cathode connected to earth through a biasing resistance 57. A resistance 58 is connected in shunt with diode 54, 50, and the relay winding 28 is connected in the anode circuit of valve 56.

When a signal is accurately tuned in, current flows in diode 42, 43, and the anode current of valve 44 falls sharply. The resultant positive pulse at the anode of valve 44 charges condensers 49 and 55, and causes the anode current of valve 56 to increase, thus actuating relay 28 and hence the magnetic brake. The charge on condenser 49 then leaks away through resistance 52, the anode current of valve 56 decreases and the brake is released, the time elapsing before the brake is released being determined by the time constant of elements 49 and 52.

If now the receiver is detuned while signals are still being received, a negative pulse appears at the anode of valve 44, and condenser 49 tends to charge up negatively; in these circumstances, however, the diode 50, 53 serves to keep condenser 49 discharged, and thus to prevent condenser 49 from holding a negative charge for long enough to prevent the magnetic brake from operating when a new station is tuned in.

It has been found that, with the modified arrangement as so far described, the magnetic brake may come into operation when tuning manually from one station to another through a

number of intermediate stations, at a position in which the tuning control is set for the reception of one of the intermediate stations. The diode 50, 54 serves to prevent this effect from taking place by preventing condenser 55 from charging up except in the presence of a potential across resistance 52 which persists for more than a predetermined time. The time constant of condenser 55 and resistance 58 are so chosen that the brake is not actuated when the receiver is tuned rapidly through a number of intermediate stations.

Many modifications of the arrangements described, within the scope of this invention as set forth in the appended claims, will readily occur to those versed in the art. For example, the invention is not limited to the use of a Wheatstone bridge method of remote control; other suitable systems which allow the tuning control to be urged through the desired position, such as the known system employing two electric induction motors so connected that the armature of one follows the motion of that of the other, may be employed. Furthermore, a mechanical or piezo-electric resonator may be employed as selector in the circuit 26, and the arrangement may be adapted for the reception of single side-band signals by suitably choosing the frequency to which that selector is tuned. The rectifier 27 may be replaced by any other suitable rectifier.

As has been explained, in order that the receiver may be rapidly tuned manually from one station to another, without being continually braked, means for increasing the time constant of the brake relay circuit may be employed. These means may take the form of an inductance connected in series in the relay circuit, a condenser connected in shunt with the relay winding, or both. It can thus be arranged that when the tuning member is rotated rapidly, the effect of the brake is weak, but when the neighbourhood of a desired station is reached, and the tuning member is turned more slowly, the braking effect is stronger. Any known or suitable means for suppressing key-clicks may be employed.

The invention is, of course, not limited in its application to superheterodyne receivers.

I claim:

1. Apparatus for the reception of modulated carrier oscillations, comprising a receiver, an adjustable tuning member forming part of said receiver, tuning control means for pre-selecting a desired carrier and for adjusting said member for the reception of said selected carrier, an indirect coupling between said tuning control means and said member, and, at the receiver, a magnetic brake and means to operate said brake automatically in response to the reception of the desired carrier upon adjustment of the tuning member to the correct position for reception of said selected carrier, and while said member is in motion, to brake said tuning member, and means for effecting automatically the release of said brake a pre-determined time after the operation thereof.

2. Apparatus for the reception of modulated carrier oscillations, comprising a receiver, an adjustable tuning member forming part of said receiver, tuning control means for preselecting a desired carrier and for adjusting said member for the reception of said selected carrier, an indirect coupling between said tuning control means and said member, a magnetic brake, means to operate said brake automatically in response to the reception of the desired carrier, upon adjustment

of the tuning member to the correct position for reception of the selected carrier, and while said member is in motion, to brake said tuning member, and means for rendering said tuning control means inoperative and for simultaneously decreasing the strength of the braking effect of said magnetic brake.

3. Apparatus for the reception of modulated carrier oscillations, comprising a receiver, an adjustable tuning member forming part of said receiver, tuning control means for preselecting a desired carrier and for adjusting said member for the reception of said selected carrier, an indirect coupling between said tuning control means and said member, a magnetic brake, means to operate said brake automatically in response to the reception of the desired carrier, upon adjustment of the tuning member to the correct position for reception of the selected carrier, and while said member is in motion, to brake said tuning member, and means for preventing the actuation of said brake except when said tuning member remains in the neighborhood of the position in which said receiver is tuned for the reception of said selected carrier for a predetermined time.

4. In apparatus for the reception of modulated carrier oscillations which apparatus includes a variable tuning means adapted to be operated by means of a rotatable shaft, the method of tuning the receiver to receive signals transmitted from any one of several broadcasting stations which method includes the steps of applying a driving force to the tuning shaft to start the shaft rotating from a position of rest toward the position at which the desired carrier is received and to impart sufficient momentum to the shaft and tuning means to continue the rotation thereof so as to carry the same an appreciable distance after discontinuance of the driving force, discontinuing the driving force prior to the point at which the desired carrier is most efficiently received and utilizing the received desired carrier to arrest the rotation of the shaft and tuning means at sub-

stantially the position at which the carrier is received with maximum efficiency.

5. A radio receiver comprising a tunable circuit for selecting a carrier wave, said tunable circuit including a variable tuning unit, an electrical driving means coupled to the tuning unit, an energizing circuit for the electrical driving means, said energizing circuit including means for determining the extent of operation of the driving means, a brake connected with the tuning device and means for automatically de-energizing the electrical driving means when said driving means has been operated to a point which is near enough the desired position so that the momentum of the moving parts of the tuning unit carry the tuning unit at least as far as the desired position, and means for automatically applying said brake in response to the selection of a carrier wave by said tunable circuit, said brake being applied only after de-energization of the driving means.

6. In combination with tunable multi-range radio receiving apparatus, means for tuning the receiver, means for actuating the tuning means, circuit means for controlling the actuating means from a remote point, wave band change-over means for the receiver including actuating means therefor located at the receiver and circuit means connectible to said first named circuit means at the remote point for controlling the last named actuating means.

7. In radio receiving apparatus of the type provided with means for adapting the apparatus to tune to various widely separated frequency bands, means for tuning the receiver, means for actuating the tuning circuit means, means located at a point remote from the receiver and electrically connected with the actuating means for remotely controlling the actuating means, wave band change-over means for the receiver including actuating means therefor located at the receiver and additional circuit means connectible with the circuit means at the remote point for controlling the second named actuating means.

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