

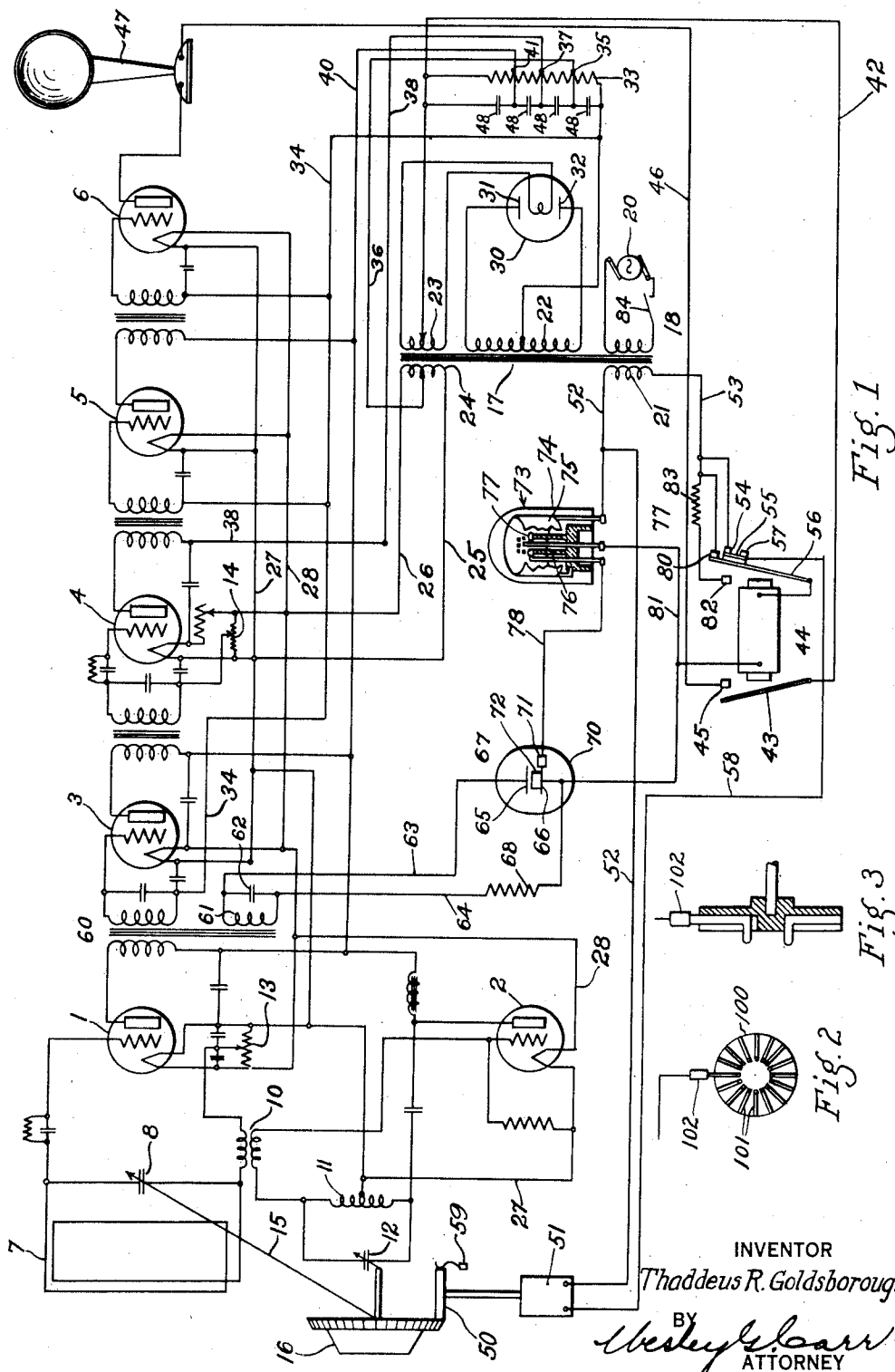
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RADIO APPARATUS

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RADIO APPARATUS

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5 Claims. (Cl. 250—20)

My invention relates to radio apparatus, and it has particular relation to apparatus designed and intended for the reception of radio-signals.

One object of my invention is to provide a radio receiving system that does not require manual adjustment of the tuning controls in order to receive signals from a plurality of broadcasting stations.

Another object of my invention is to provide in a radio receiving system automatic tuning devices that will function to successively adjust the constants of the circuits to receive signals from broadcasting stations transmitting on varying frequencies.

Another object of my invention is to provide in a radio receiving system, automatic tuning means that will function to adjust the circuits to syntonism with another station as soon as the station being received has discontinued broadcasting.

Another object of my invention is to provide a receiving system adapted to either radio or "wired-wireless," that is controlled as to its tuning by the frequency of an incoming carrier wave.

According to the commonly used methods of operating radio receiving apparatus for the purpose of receiving signals from a plurality of broadcasting stations, it is necessary to successively or simultaneously adjust a plurality of tuned circuits to the frequency of the desired station. When it is desired to change the tuning of the set in order to receive different stations the multiplicity of manual operations required necessitates a certain amount of wasted time.

It is accordingly the purpose of the present invention to provide a radio receiving system in which means are incorporated for automatically shifting the reception from one transmitting station to another in the event that the first station ceases broadcasting, or in the event that it is desired to listen to the program from a second station even though the first station is still broadcasting.

To this end I have so modified a receiving system of the superheterodyne type that the intermediate frequency, which results from the inter-action of locally generated oscillations with the incoming carrier wave, is caused to actuate a frequency-sensitive relay which in turn de-energizes a tuning device that is otherwise continuously operating. I have also provided circuit connections and auxiliary apparatus whereby, upon the cessation of an incoming carrier wave, the tuning of the system will automatically be changed until another carrier wave is being

sharply received, at which instant the automatically operating tuning elements cease to function. In addition, I have provided means where the cessation of an incoming carrier wave may be simulated by a slight manual action, thus causing the apparatus to automatically hunt for the next broadcasting station, and to tune it in sharply when found.

Among the novel features of my invention are those particularly set forth in the appended claims. The invention in its generic aspect, however, as well as further objects and advantages thereof, will best be understood by reference to the following description of a specific embodiment thereof, taken in connection with the accompanying drawing.

Figure 1 of the drawing is a diagrammatic view of a receiving system of the super-heterodyne type comprising a preferred embodiment of my invention, and

Fig. 2 is a view of an auxiliary tuning device.

Fig. 3 is a view, in cross-section, of the tuning device shown in Figure 2.

The system comprises a first detector device 1, an oscillation-generator 2, an intermediate, or beat-frequency amplifier 3, a second detector 4, and a plurality of audio-frequency amplifiers 5 and 6. The first detector device is provided with an input circuit in the form of a loop 7 shunted by a tuning condenser 8, the said input circuit being inductively coupled through a transformer 10 to the frequency-determining circuit of the oscillation-generator, the latter circuit comprising an inductor 11 and a tuning condenser 12.

The grid-return of the first detector is connected to the movable arm of a potentiometer 13 which is arranged in shunt to the filament, in order that the grid potential may be adjusted. The grid-return of the second detector 4 is also connected to the movable arm of a potentiometer 14 connected in shunt to the filament of the device in order that the proper grid-bias may be maintained.

The condensers 8 and 12 are connected together by an operating element 15, arranged to be under the control of a manually operable dial 16.

All of the thermionic devices may be energized from batteries of the usual type if desired, or they may be energized from a source of commercial frequency alternating current. If the latter form of energization is deemed preferable, a transformer 17 having a primary winding 18 connected to a source 20 of alternating current, and secondary windings 21, 22, 23, and 24 may be advantageously employed. The terminals of

the secondary winding 24 are connected by means of conductors 25 and 26 to filament supply busses 27 and 28 respectively, and the filaments of all of the thermionic devices may be connected in parallel to the said busses, or may be arranged in other suitable relation thereto.

The secondary winding 23 supplies filament power for a full-wave rectifying device 30, the anodes 31 and 32 of which are connected to the terminals of the high-potential secondary winding 22.

A potentiometer 33 is connected between a mid-tap on the secondary winding 23 and a mid-tap on the secondary winding 22, and constitutes the output circuit of the rectifying device 30. The lower, or most negative, end of the potentiometer is connected to the grids of the thermionic devices 3, 5 and 6 by means of a conductor 34. An intermediate point 35 on the potentiometer is connected by a conductor 36 to a mid-tap on the filament-transformer secondary 24, thus impressing on the filaments a potential more positive than the potential of the grids of the devices 3, 5 and 6, or, in other words, impressing a negative potential on the said grids with respect to the filaments of the corresponding devices.

A point 37 somewhat further up toward the positive end of the potentiometer 33 is connected to the plate of the second detector tube by means of a conductor 38, and a conductor 40 connected to a still more positive point 41 on the potentiometer supplies plate potential to the thermionic devices 1, 2, 3 and 5.

The upper, or most positive, end of the potentiometer is connected by means of a conductor 42, to a movable armature 43 associated with a relay device 44, and a fixed contact device 45 associated with the said armature is connected by a conductor 46 to the plate of the audio-frequency amplifying device 6, a loud-speaker 47 being included in the latter connection.

The several portions of the potentiometer may be shunted by condensers 48, if desirable, in order to by-pass the alternating components of the several plate currents.

The dial 16 is frictionally-connected through a disc-like member 50 to the shaft of a small motor 51. The power supply for the motor may be traced through a conductor 52 to the secondary winding 21, through a conductor 53, a fixed contact 54, a conducting element 55 carried by a movable armature 56 associated with the relay device 44 and insulated therefrom, a second fixed contact 57, and a conductor 58. The movable armature 56 is so biased that its normal position, when the relay 44 is de-energized, completes the circuit between the fixed contacts 54 and 57.

A frictional brake-device 59 is associated with the member 50 in order that its motion may at once be stopped upon de-energization of the motor 51.

The transformer 60 which couples the first detector device 1 to the intermediate-frequency amplifying device 3, is provided with an additional secondary winding 61. A condenser 62 is connected in shunt to the secondary winding 61, forming therewith a circuit tuned to the intermediate frequency or a harmonic thereof.

The terminals of the secondary winding 61 are connected by conductors 63 and 64 to electrodes 65 and 66, respectively, of a frequency-responsive relay device 67, a resistor 68 being included in the latter connection. The relay device 67, which is more fully described in a copending application

in the name of V. K. Zworykin et al, Serial No. 158,608, filed January 3, 1927, Patent No. 1,869,829, granted August 2, 1932, comprises a container 70 filled with a gas, such as neon, under reduced pressure, and provided with an auxiliary electrode 71 in addition to the two electrodes previously referred to. A piezo-electric crystal 72 is positioned between the electrodes 65 and 66, the crystal being chosen to have a natural period equal to frequency to which the circuit including the inductor 61 and the condenser 62 is tuned.

As explained in the application of Zworykin, referred to above, if an alternating potential at a frequency equivalent to the natural frequency of the crystal is impressed thereacross, the gas adjacent the crystal becomes ionized, and a conductive leakage-path is accordingly formed between the electrodes 71 and 66.

Advantage is taken of the formation of the said conductive path by associating the frequency-responsive relay 67 with a grid-controlled glow-tube 73 of the type disclosed in a copending application in the name of D. D. Knowles, Serial No. 149,290, filed Nov. 19, 1926, Patent No. 2,062,263 granted November 27, 1936.

The grid-controlled glow-tube comprises a container 74 filled with neon or other inert gas under reduced pressure in which a cathode-element 75, an anode-element 76, and a grid-element 77 are positioned. The cathode-element 75 is connected to one terminal of the secondary winding 21, and the grid-element 77 is connected by means of a conductor 78 to the electrode 71 of the frequency-responsive relay device 67.

The opposite terminal of the secondary winding 21 is connected to the anode 76 of the grid-controlled glow tube 73 through a circuit which may be traced through the conductor 53, a fixed contact 80, the movable armature 56, the winding of the relay 44, and a conductor 81, the conductor 81 also being connected to the electrode 66 of the device 67. A second fixed contact 82 associated with the armature 56 is also connected to the same terminal of the secondary winding 21 through a resistor 83, for the purpose that will later be explained.

The energization of the rectifier device 30 and the application of potential across the electrodes of the grid-controlled glow-tube is controlled by a switch 84 interposed in the connection between the source 20 of alternating current and the primary winding 18.

When it is desired to set into operation the receiving system just described, the switch 84 is moved to the closed position, completing the primary circuit of the transformer. The filaments of the various thermionic devices are accordingly energized from the secondary winding 24, and filament and plate-potential is supplied to the rectifying device 30, which in turn supplies plate potential for the thermionic devices.

The motor 51, being energized through the circuit previously traced, starts to slowly rotate, and to thus change the adjustment of the variable condensers 8 and 12.

As soon as the input circuit of the first detector tube 1 arrives at syntonism with the frequency of an incoming carrier wave, a beat frequency, formed by the interaction of the locally generated oscillations with the incoming carrier, appears in the output circuit of the said tube, and is applied both to the input circuit of the frequency-responsive relay device 67, and to the input circuit of the intermediate frequency amplifier 3.

An ionized condition is accordingly initiated in 75

the relay-device 67, which establishes a leakage path between the grid 77 and the anode 76 of the grid-controlled glow-tube 73. The glow-tube accordingly becomes conductive, and the potential applied across the anode and cathode thereof by the secondary winding 21 causes a current to flow therein. The path of the current may be traced through the conductor 52, the secondary winding 21, the conductor 53, the fixed contact 80, the movable armature 56, the winding of the relay 44, and the conductor 81 connected to the anode 76.

The relay 44, being thus energized, pulls up both armatures, breaking thereby the supply circuit for the motor 51, and at the same time completing a circuit including the loud speaker, the fixed contact 45, and the movable armature 43, over which plate potential is applied to the audio-frequency amplifier tube 6.

Inasmuch as it is necessary that the relay device 44 shall remain energized while the carrier wave from a desired station is present, the pulling up of the armature 56 completes a holding circuit including the resistor 83, permitting only sufficient current to energize the winding of the relay 44 to maintain the armatures in contact with the fixed contacts 45 and 82.

Should the broadcasting station to which the system is temporarily tuned discontinue transmitting, the beat note will disappear from the output of the first detector tube, and the ionized condition of the frequency-responsive relay device 67 will disappear. The cessation of the ionization causes an interruption in the leakage path between the grid and anode of the grid-controlled glow-tube 73, which accordingly resumes its original non-conductive state. The winding of the relay 44 is therefore at once de-energized, releasing the armatures 43 and 56, thus permitting the motor 51 to be again energized and causing thereby a further gradual change in the adjustment of the variable reactors. As soon as another carrier wave is tuned in, the sequence of operations previously described is repeated, the system thus continuing to operate as long as any stations within range are broadcasting.

If, at any time, it is desired to change from a station being received to another station, without waiting for the first station to discontinue transmitting, it is only necessary to give the tuning dial a slight turn, thus de-tuning the circuits of the system, and causing the same sequence of operations that takes place upon the disappearance of the first station's carrier-wave.

It is of course feasible to incorporate a plurality of stages of tuned radio-frequency amplification ahead of the first detector tube, as well as a plurality of stages of intermediate-frequency amplification. In the former case, all of the tuning condensers would be actuated by a single device analogous to the connecting element 15.

The condensers employed should preferably be of the straight-line-frequency type, in order that a constant frequency difference may be maintained between the tuning of the radio-frequency stages and the tuning of the oscillation generator.

Inasmuch as a crystal tuned at 45,000 cycles, the usual intermediate frequency employed in superheterodynes, would be inconveniently large and commercially impracticable, in certain cases it is better to first step-up the incoming frequency by heterodyning, using the higher frequency to control a frequency-responsive relay. This modification, being believed obvious, is not illustrated.

I have also considered the possibility of equipping one of the variable condensers with a plu-

ality of adjustable short-circuiting devices, which may be so arranged with reference to the various angular positions of the said condenser that whenever the adjustment thereof corresponds to the tuning of the carrier wave from an undesired station the signals from the said station will be short circuited and will not be impressed on the input circuit of the system. By utilizing a short-circuiting device of this character it is possible to pre-determine the total number of stations the device will tune-in during any one evening, the signals from all stations intermediate the desired ones being by-passed.

As illustrated in Fig. 2, the short circuiting device might take the form of a metal disc 100 connected to and rotating with the rotor of the condenser 3, the said disc carrying a plurality of metallic elements 101 slightly radially movable with respect thereto. At the resonance point a flexible copper brush 102 could be positioned adjacent the disc, and in the path of travel of the movable elements when such elements are moved to project beyond the periphery of the disc, the brush being electrically connected to the stator of the condenser.

When it is desired, therefore, to make the system unresponsive to a given station, or to a plurality of stations, it would only be necessary to move the corresponding elements radially of the disc so they will make contact with the brush to short circuit the condenser at angular positions corresponding to undesired stations.

It is also perfectly feasible to control the switch 84 by a clock-work mechanism, which could be arranged to open and close the circuit at predetermined time intervals.

A system constructed according to my invention finds its principal field of usefulness in apartment houses, and similar locations, where it is desired to furnish a continuous radio program throughout a given time interval. No attention on the part of an operator is needed, the system functioning entirely automatically to furnish the program as long as any stations within range are broadcasting.

My invention is also applicable to situations where it is desirable to have a receiving set at all times responsive to a plurality of transmitting stations, as for example, a shore station to which messages from a plurality of ships are to be sent. In such case, the loud speaker could well be replaced by a recording device analogous to the now well known telegraphone, and the energization of the motor controlling the feed of the blank wire therethrough could also be placed under the control of the relay device 44.

Although I have illustrated and described only a single specific embodiment of my invention, I am aware that many modifications thereof are possible. My invention is therefore not to be limited except insofar as is necessitated by the prior art and by the spirit of the following claims:

I claim as my invention:

1. In a radio receiving system including an amplifying stage, and a sound reproducing device supplied thereby with signal energy, continuously operating tuning devices under the control of an incoming carrier wave, and means responsive to the operation of the tuning devices for automatically rendering said amplifying stage and sound reproducing device operative only when said tuning devices are not operating, whereby noises incidental to the tuning operation are not heard.

2. In a radio receiving system including a sound reproducing device, tuning means, means

- for continuously operating said tuning means, means for deriving a beat frequency from an incoming signal, means whereby said beat frequency is utilized to control said operating means, and means responsive to the operation of the tuning means for de-energizing said sound reproducing device during such time as the tuning means is being operated.
3. In a radio receiving system, continuously operable tuning means, means actuated by an incoming signal for causing said tuning means to cease operating, and means for rendering said second named means inoperative at at least one pre-determined position of said tuning means.
4. In a radio receiving system, continuously operating tuning means, means actuated by an incoming signal for causing said tuning means to cease operating, and means for rendering said second named means inoperative at a plurality of pre-determined positions of said tuning means.

5. In a radio receiving system, an electron discharge device having a filamentary circuit, a progressively adjustable tunable circuit associated therewith, a sound reproducing device for reproducing received energy into an intelligible form, means whereby to progressively adjust said tunable circuit, a switch associated with said sound reproducing device independently of said filamentary circuit, switch operating means associated with said switch and normally controlling said switch to maintain said sound reproducing device ineffective during periods of progressive tuning between stations, and means associating said switch operating means with said progressively operated tunable circuit adjusting means for rendering said sound reproducing device effective upon the tuning in of a station with said circuit adjusting means.

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