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APPARATUS FOR DETERMINING THE LISTENING HABITS OF WAVE SIGNAL RECEIVER USERS

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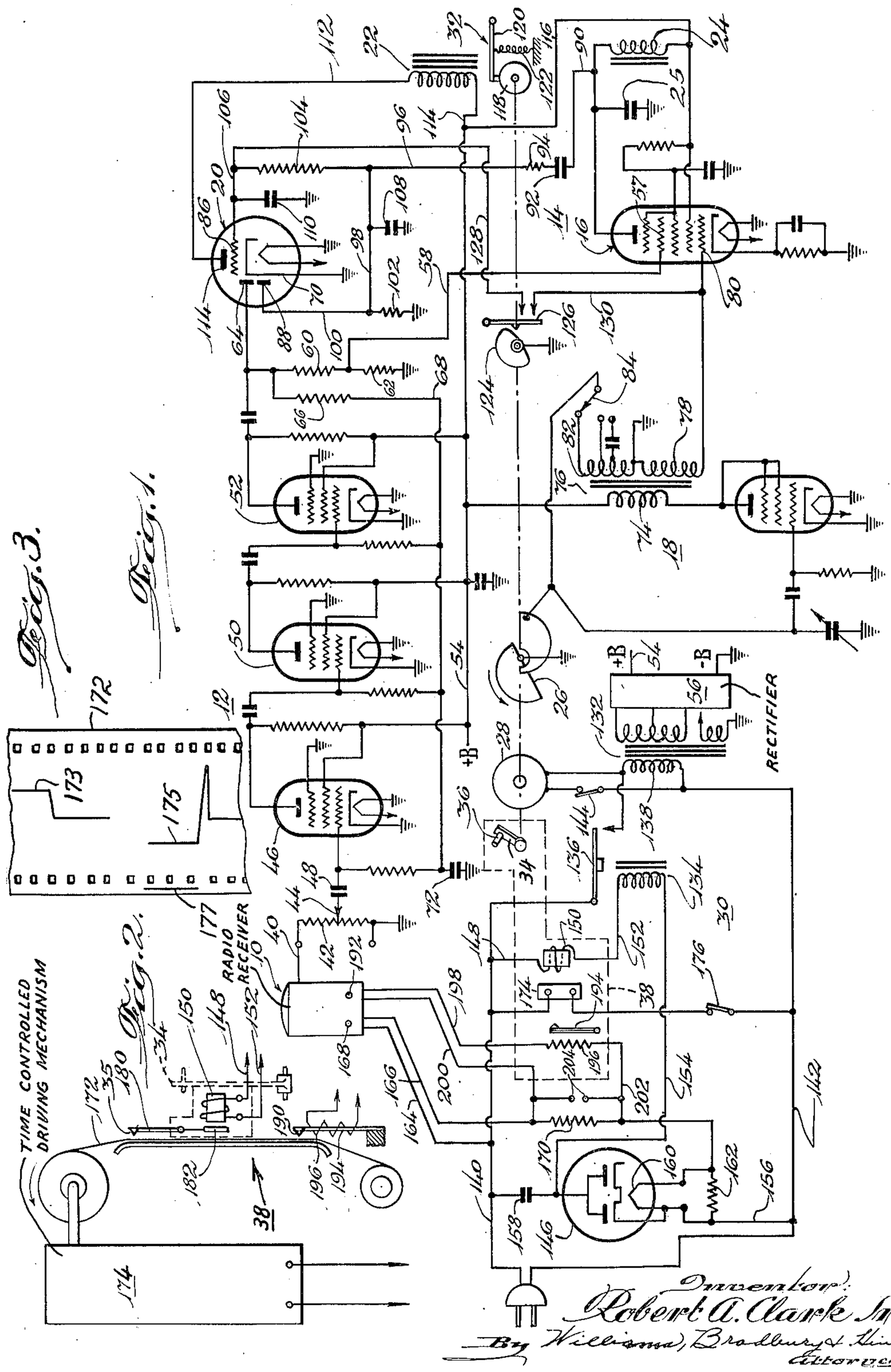

Fig. 1.

Fig. 3.

Fig. 2.

Inventor:
Robert A. Clark Jr.
By Williamson, Bradbury & Hinkle
Attorneys.

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APPARATUS FOR DETERMINING THE LISTENING HABITS OF WAVE SIGNAL RECEIVER USERS

Robert A. Clark, Jr., Chicago, Ill., assignor to A. C. Nielsen Company, Chicago, Ill., a corporation of Illinois

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6 Claims. (Cl. 346—37)

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The present invention relates to recording apparatus and particularly to apparatus for recording upon a moving record sheet the radio stations to which a radio receiver is tuned.

One of the primary objects of the present invention is to provide new and improved recording apparatus for recording the various radio stations to which a radio receiver is tuned and also the time that the receiver is tuned in to the stations.

One of the most important requirements in recording apparatus of the character to which this invention pertains is reliability and accuracy. The recorders are provided with record tapes having a length such that they need be changed but once a month. For this reason, and because frequent service calls should be avoided in order not to interfere with the listening habits of the radio owners, the apparatus should be both reliable and accurate. Furthermore, dependability is required to avoid errors as to the stations received and as to the time the receivers may be tuned in to the various stations.

The recording apparatus of the present invention is of the type including a circuit supplied with a frequency indicative of the frequency (and thereby the station) to which the radio receiver is tuned. This frequency is, preferably, the frequency of the local oscillator of a superheterodyne type radio receiver. The circuit to which the local oscillator frequency is supplied includes another or second oscillator and a variable impedance for controlling the frequency of this other oscillator. The frequencies derived from the two oscillators are heterodyned and the heterodyne frequency is utilized to render the impedance varying means ineffective further to vary the impedance when the impedance bears a predetermined value and positional relationship relative to the frequency of the second oscillator and, therefore, to that of the local oscillator of the radio receiver and the station to which the receiver is tuned. The impedance varying means also operates means for producing a record of the value and position of the variable impedance thereby to produce a record of the two oscillator frequencies and of the station to which the radio receiver is tuned.

An object of the present invention is to provide a new and improved recording apparatus wherein the ineffectiveness of the impedance varying means (more specifically, the stopping of a motor rotating a variable condenser) is controlled more effectively.

A further object of the present invention is to provide a new and improved recording apparatus which may be readily applied to radio receivers

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having local oscillators of widely varying characteristics and which will not operate in response to harmonics of the fundamental voltage generated by the local oscillators.

A further object of the present invention is to provide a new and improved arrangement for rendering the station recording apparatus operative whenever the radio receiver is placed into operation.

Another object of the present invention is to provide a new and improved apparatus having means for readily checking the operation of the apparatus actually making the record upon the record tape.

Another object of the present invention is to provide recording apparatus with new and improved means for recording short wave reception of the radio receiver.

Other objects of the present invention will become apparent from the ensuing description, in the course of which reference is had to the accompanying drawings, in which:

Fig. 1 is a schematic representation of recording apparatus embodying the principles of the present invention;

Fig. 2 is a similar representation illustrating in greater detail a portion of the apparatus embodied in Fig. 1; and

Fig. 3 is a fragmentary view of a representative record produced on the record tape of the recording apparatus of the present invention.

Referring now to the drawings and particularly to Fig. 1, the apparatus of the present invention shown therein may be utilized to record the various stations to which a radio receiver of any conventional type may be tuned. In view of the fact that most radio receivers are of the superheterodyne type, the present invention has been illustrated in conjunction with apparatus for recording the operation of a receiver of this type.

Inasmuch as the particular construction of the radio receiver **10** is not any part of the present invention, it has not been illustrated in detail. A radio frequency voltage indicative of the radio station to which the receiver is tuned, is supplied from the receiver (preferably the local oscillator of the receiver) to a broad band amplifier **12** and thence to heterodyning means **14**, including a mixer tube **16**. The mixer tube is also supplied with a radio frequency voltage from another local oscillator, indicated generally by reference character **18**. The output of the mixer is utilized to produce a control voltage to control a tube **20** controlling, in turn, the operation of a brake releasing relay **22**. In order to prevent operation of

the relay to release the brake except when the frequency derived from the oscillator 18 is close to the frequency supplied from the local oscillator of the radio receiver, a low frequency choke coil 24 and a parallel resonant condenser 25 are interposed between the mixer tube 16 and the control tube 20. The frequency of oscillator 18 is controlled by impedance means, in this case a variable condenser 26 rotated by a motor 28, which is energized continuously whenever the radio receiver is energized through a control unit indicated generally by reference character 30.

When the frequency of oscillator 18 approaches that derived from the local oscillator of the radio receiver, the relay 22 is de-energized to render motor 28 ineffective further to rotate condenser 26. This is accomplished by the release of a motor brake mechanism, indicated generally by reference character 32.

The position of the condenser 26 bears a predetermined relation to the frequency generated by oscillator 18 and to the frequency derived from the local oscillator of the radio receiver 10. The two frequencies also bear a predetermined relation to the station to which the radio receiver is tuned, so that the position in which condenser 26 is stopped, is ultimately determined by the station to which the receiver 10 is tuned. The motor also drives an arm 34, to which is secured a stylus 35, (see Fig. 2) through a crank 36 suitably connected to the arm by a connecting rod, not shown. Thus, the program stylus is operated to positions indicative of the position of condenser 26 and of the station to which the radio receiver is tuned. The recorder is indicated generally by reference character 38.

The radio frequency voltage indicative of the station to which the receiver 10 is tuned is supplied to the input of the amplifier 12 through an input conductor 40 and a potentiometer arrangement including resistor 42 and an adjustable contact 44. The conductor 40 may be connected to a coil or plate adapted to pick up radiations from the local oscillator coil. The desired portion of the voltage drop across resistor 42 is applied to the control grid of the first tube 46 of the amplifier through a small condenser 48 (having a value of about .0001 mf.). The amplifier 12, which is of the resistance coupled type, includes also two other amplifier tubes 50 and 52 (the tubes may be of the 7C7 type). The cathodes of all the tubes are grounded, as to the chassis of the apparatus, and the plates are supplied with suitable plate voltage through a supply conductor 54 leading to a full wave rectifier 56, which may be of conventional construction and which is energized when the receiver is energized through the control 30 in a manner to be described hereinafter.

A portion of the output from the amplifier 12 is supplied to a grid 57 of the mixer tube 16 (which may be of the 7B8 type) through a conductor 58 leading from the junction of resistors 60 and 62 which are connected in series across the output circuit of the final amplifier tube 52. Another portion of the amplifier output is supplied to a plate 64 of a diode rectifier portion of control tube 20 to provide a fast-acting, automatic volume control voltage applied to the control grids of the amplifier tubes 46, 50 and 52 through a resistor 66 and conductor 68. The automatic volume control voltage is developed across the resistors 60 and 62, the latter of which is connected to ground, as is the cathode 70 of the tube 20. A condenser 72 is connected between conductor 68 and ground, but inasmuch as it has a value of about .05 mf. it does not materially delay the action of the volume control.

The fast-acting, automatic volume control voltage applied to the amplifier insures the application of uniform signal voltages to the mixer tube despite variations in the output from different types of local oscillators in radios to which the apparatus is connected and prevents false operation by harmonics which may be present in the radio local oscillator output, thereby to render more uniform and reliable the operation of the brake mechanism.

In general, the amplifier and volume control are adjusted to supply the mixer with a uniform input voltage, which may be, for instance, about 1½ volts, thereby to provide a uniform input in spite of variations in the voltage output of the local oscillator, which may well vary say between 6 and 1½ volts, or less. Usually, however, there is a considerable variation in the local oscillator output and the greatest output occurs at the lowest frequency. In the broadcast band (550 to 1550 kc.), and with an intermediate frequency of about 460 kc. (for example) then, when the receiver is tuned to about 550 kc., the local oscillator generates a frequency of about 1000 kc. The second harmonic of this frequency is 2000 kc.

The frequencies generated by the oscillator 18 are in the same range as those generated by the radio local oscillator. Thus, while "hunting" for the 550 kc. station, the oscillator 18 may go by the 2000 kc. frequency, and the voltage supplied by it and the second harmonic of that obtained from the radio local oscillator might, if steps were not taken to prevent it, result in the stoppage of condenser 26 and give a false record. By limiting the amplifier output to a uniform and relatively low value, this difficulty is avoided.

The voltages derived from the local oscillator of the radio and from local oscillator 18 are supplied to the mixer tube 16. The frequency of the local oscillator 18 is varied by the condenser 26, which is rotated by the motor preferably at a speed such as about 1 R. P. M. The oscillator may be of any suitable construction. It is supplied with plate voltage from the supply conductor 54 through a circuit including the primary winding 74 of the transformer 76. The secondary winding of the transformer has its center tap grounded and a portion 78 thereof is connected to a grid 80 of the mixer tube 16. The other portion 82 of the secondary winding has associated with it an adjustable tap switch 84 movable into different positions in order that the apparatus may be utilized with radio receivers having different intermediate frequencies. In the position indicated, the apparatus may be utilized with receivers having an intermediate frequency of 175 kc. The other two taps are for use with receivers having intermediate frequencies of 260 and 460 kc., respectively.

The output circuit of tube 16 includes the low frequency choke coil 24 and condenser 25, which prevents any substantial alternating current flow from the mixer tube until the heterodyne frequency reaches some low value, as of about 3000 cycles. In other words, the two oscillator frequencies have to be within about 3000 cycles of each other.

The low frequency output of the mixer tube 16 is rectified to provide a direct current control voltage to the control grid 86 of the triode section of control tube 20. The grid is normally maintained at cathode potential to maintain the

tube conductive and the relay 22 energized sufficiently to permit free rotation of the motor 28. The tube is rendered less conductive and the relay 22 releases the brake to stop the motor when the condenser 26, controlling the frequency of oscillator 18, reaches a position such that the oscillator frequency is within about 3000 cycles of the frequency derived from the radio receiver. The tube 20 is rendered less conductive by the application of the direct current control voltage thereto, as indicated above. This voltage is obtained by rectifying the low frequency voltage obtained from the output of mixer tube 16. This voltage is applied to the second diode plate 88 of the tube 20 through a circuit including conductor 90, condenser 92, resistor 94, and conductors 96, 98 and 100. A direct current control voltage is thus produced across the resistor 102, connected between the diode plate 88 and the cathode 70 of the tube 20 and it is applied to the grid 86 of tube 20 through resistor 104 and conductor 106. The resistor 102 is shunted by a smoothing condenser 108 and the grid 86 is connected to ground through a bypass condenser 110.

The relay 22 controlling the brake 32 is connected in the plate circuit of tube 20 by conductors 112 and 114, the former of which connects the coil to the plate 115 of the tube, and the latter of which connects the coil to the plate voltage supply conductor 54. In passing, it may be noted that the mixer tube 16 is supplied with plate voltage through a conductor 116 leading to the plate voltage conductor 54.

The motor brake mechanism includes a brake disc 118 on the condenser shaft and a pivotally movable brake arm 120 biased toward the disc by a spring 122 and operable out of engagement with the disc by the relay 22. As already indicated, the relay 22 is normally energized sufficiently to release the brake, but when the motor operates the condenser 26 to a position corresponding to the particular station to which the receiver is tuned, then the brake arm 120 is released to stop the motor. The drive possesses some inertia so that while the relay is de-energized when the frequency generated by oscillator 18 is about 3000 cycles different from the radio receiver oscillator frequency, the condenser 26 is stopped with the local oscillator frequency differing only about 2000 cycles from that of the radio receiver local oscillator frequency.

To improve the accuracy of the equipment which includes a stylus movable back and forth across a relatively narrow tape, the effect of backlash is eliminated by recording stations as the stylus moves in one direction only across the face of the tape. It will be noted that, in view of the operation of the stylus carrying arm 34 by the rotatable crank 36 and in view of the fact that the condenser 26 varies between a minimum and a maximum and then from a maximum to a minimum during a single revolution of the shaft, the shaft would be stopped with the program stylus moving in either direction if means were not provided to prevent it from being stopped when moving in one of the two directions. In the instant case, the shaft is prevented from being stopped, during a half of its rotation (during the time that the stylus is being returned to its initial position) by a cam 124 mounted on the condenser shaft and adaped to ground the grid 86 of the control tube and the grid 80 of the mixer tube for 180° rotation of the shaft. The grids are grounded when the cam 124 engages a contact 126 associated therewith and operable thereby to ground the grids through conductors 128 and 130, the contact, cam and cam shaft.

The various tubes heretofore described are supplied with energy whenever the radio receiver is energized through the rectifier 56. This is preferably of the full-wave type, and since it may be of conventional construction, it has not been shown and will not be described in detail. The rectifier is energized through a transformer 132, the primary winding of which is connected to a suitable source of alternating current whenever the receiver is energized by the power supply control 30, which will now be described.

The power supply control 30 includes an electromagnet 134 which is energized whenever the receiver is placed into operation and which, when energized, serves to close a switch 136 to connect the primary winding 138 of transformer 132 to the power supply through conductors 140 and 142. The motor 28 is energized simultaneously with the transformer, it being connected in parallel with the primary winding of the transformer through a normally closed manually operable switch 144.

In accordance with one of the features of the present invention, the control is so constructed and arranged that it does not rob the radio set of any substantial power and yet will be energized only when the radio receiver is energized. The electromagnet 134 is also supplied with rectified current from a rectifier which is rendered operative in a novel manner only when the receiver is energized. The electromagnet is connected across the power lines 140 and 142 through a rectifier tube 146, which may be of the 7Y4 type and which is rendered conductive only when the receiver is turned on. The electromagnet 134 is connected across the conductor 140 and the plates of the rectifier tube through conductor 148, an electromagnet 150 (provided for a purpose to be described shortly), and conductors 152 and 154. The cathode of tube 146 is connected to the other power supply conductor 142 through a conductor 156. The two electromagnets 134 and 150 are shunted by a smoothing condenser 158.

The rectifier is rendered conductive when a radio receiver is turned on by energization of its cathode heater 160. The heater is connected across a resistor 162 placed in series with the radio receiver power supply. Power is supplied to the receiver through the conductors 164 and 166, a circuit across which is adapted to be closed by operation of the radio power switch, indicated schematically by reference character 168. When the power switch is closed, the radio is connected across the power lines through the resistor 162 and another resistor 170 provided for the purpose of applying a voltage to energize a short-wave indicator to be described shortly.

The record tape, indicated by reference character 172 in Fig. 2, is moved continuously at a constant rate of speed by a self-starting, synchronous, electric clock 174 of the type provided with a mechanical stand-by drive capable of driving the tape during power outages. The clock motor is connected directly across the power leads 140 and 142 through a normally closed manually operable switch 176, as best illustrated in Fig. 1.

The program stylus 35 is secured to a pivotally movable arm 180 mounted upon suitable supporting structure secured to the program stylus carrying arm 34 heretofore referred to. The stylus arm

180 has an armature 182 at the end opposite the stylus and adapted to be attracted by the electromagnet 150 which, it will be recalled, is energized simultaneously with the electromagnet 134 when the radio receiver is turned on. The stylus 35 is normally out of engagement with the record tape, it being biased away from the tape by the weight of the armature 182. However, when the radio is turned on, the stylus is brought into contact with the tape by energization of electromagnet 150.

Many radio receivers are designed to receive also short-wave stations. Ordinarily, short-wave reception may be had upon operation of a band selector switch and one of the features of the present invention resides in providing an improved arrangement for recording short-wave reception. This arrangement includes a stylus 190 adapted to be brought into contact with the record tape when the band selector switch is operated for short-wave reception. This band selector switch is indicated diagrammatically by reference character 192 in Fig. 1 and when it is operated to condition the receiver for short-wave reception, the stylus 190 is brought into contact with the tape. The stylus is carried by bimetallic support 194, having associated therewith a heating coil 196 energized upon operation of the band selector switch 192, thereby to heat the support 194 and bring the stylus into contact with the tape. The heater is connected to the band selector switch through a conductor 198, and the switch is connected through conductor 200 to one end of the previously referred to resistor 170. The other end of heater 196 is connected by conductor 202 to the other end of resistor 170. Thus, when the radio receiver is energized and the band selector switch operated, the heater 196 is energized and a record made of the short-wave reception.

In Fig. 3 a portion of the record tape 172 is shown to illustrate a representative record indication thereon. The traces 173 and 175 are representative of those produced by the stylus 35, while the trace 177 is representative of the record indication produced by the stylus 190 when the band selector switch 192 is actuated for short wave reception. The portion of the trace 175 produced simultaneously with the trace 177 is indicative of tuning to short wave transmitters and in taking the recorded information from the tape 172 this must be considered. Thus all ambiguity as to whether the receiver is tuned to short wave reception or reception in one of the other frequency bands is eliminated.

The short-wave indication may also be utilized as an indication of the operation of the main program stylus. It may be that the program stylus will stick or otherwise fail to contact the tape when the receiver is energized. This gives a false indication, as it indicates non-energization of the receiver. However, by connecting the heater 196 directly across the resistor 170, as between the pair of terminals 204, the stylus 190 will contact the tape whenever the receiver is energized.

The operation of the apparatus will now be reviewed. It is illustrated in the condition obtaining when the radio receiver is not energized. Under these conditions, assuming that power lines 140 and 142 are connected to a suitable source of alternating current, which may be 60-cycle 110-volt alternating current, the clock 174 is energized and drives the tape 172 at a constant rate of speed. The styli 35 and 190 are out of contact with the tape.

When the radio set is turned on by operation of the power switch 168, a circuit is closed connecting the radio and resistors 170 and 162 in series across the power lines 140 and 142. The cathode heater 160 is energized by the voltage drop across resistor 162 and the rectifier tube 146 is rendered conductive. When this occurs, electromagnets 134 and 150 are energized by direct current. Electromagnet 150 moves stylus 35 into contact with the tape and electromagnet 134 closes switch 136 so power is supplied to the condenser driving motor 28 and to the transformer 132. The motor 28 rotates the condenser to "hunt" the station to which the radio receiver may be tuned; in the instant embodiment the "hunting" is done when the capacity of condenser 26 varies from its minimum to its maximum value. At the same time the motor drives the stylus 180 through the crank 36 and the stylus supporting arm 34.

Assuming that the station tuned in by the receiver corresponds to some position of condenser 26 counterclockwise of the position in which it is indicated, then the motor continues to rotate until this position is reached. During this rotation the crank arm 36 is also rotated in a counterclockwise direction as is the cam 124. The grids of the mixer and control tubes 16 and 20, respectively, are ungrounded so that the relay 22 is energized and may be de-energized to brake the motor when the apparatus "finds" the station.

A voltage from the local oscillator of the radio receiver, having a frequency bearing a certain definite relation to the frequency of the station tuned in by the receiver, is applied to the amplifier and thence to grid 57 of the mixer tube 16. A variable frequency is applied to the grid 80 of the mixer tube 16 by the oscillator 18. As the condenser 26 is rotated by the motor, the frequency of oscillator 18 is changed until the difference between the two oscillator frequencies is about 3000 cycles. Current of this frequency flows through the choke coil 24 in the mixer output, and it is rectified by one of the diode rectifier sections of tube 20, namely, that including plate 88 and cathode 70. The rectified current produces a voltage drop across resistor 102 which is applied to grid 86 of tube 20 to render the tube less conductive and to decrease the flow of current through the relay 22 to a value such that the brake arm 120 is released and engages the brake disc 118, thereby to stop further travel of the condenser driving motor and of the condenser. Stoppage of the motor also stops the crank and stylus 35, whereby the stylus makes a straight line longitudinally of the tape to indicate the particular station to which the radio receiver is tuned.

If another station is tuned in, the heterodyne frequency increases above the 3000 cycle minimum and the grid 86 consequently becomes more positive and relay 22 lifts up the brake arm 120 to permit the condenser driving motor again to "hunt" the new station. As the condenser is rotated, the oscillator frequency is again changed. Should the frequency of the station tuned in be such that it corresponds to an increase in capacity of condenser 26 from the position in which it was last stopped, then the motor is again stopped before it completes a full rotation. However, should it correspond to some frequency less than that at which the condenser last stopped, then the motor will continue to rotate through that half revolution during which cam 124 grounds the grids of the mixer and control tubes. This, as previously described, corresponds to the return of the stylus 35 from the far side of the tape to its initial position, thereby to prevent inaccuracies

which might result from backlash in the stylus moving system. When the condenser 26 reaches the position corresponding to the station tuned in, the motor again stops in the manner described above.

Should the radio receiver be conditioned for short-wave reception by operation of the band selector switch 192, then the heater 196 is energized and, in turn, effects movement of the bimetallic stylus supporting arm 194 to bring the stylus 190 into contact with the tape. Thus, when a short-wave station is tuned in, there is provided a dual indication of short-wave reception. During short-wave reception the motor 28 rotates continuously because the oscillator 18 is not designed to generate the proper frequency for heterodyning with the receiver local oscillator when the latter is conditioned for short-wave reception.

While but a single embodiment of the invention has been illustrated and described in detail, it should be understood that the specific details thereof are intended to be illustrative and not limitative of the invention.

What I claim as new and desire to secure by United States Letter Patent is:

1. Apparatus for recording the radio stations to which a radio receiver is selectively tuned, comprising an amplifier excited by a signal voltage derived from said receiver having a fundamental frequency indicative of the station to which the receiver is tuned and operative to deliver an output voltage having the same fundamental frequency and harmonics of said fundamental frequency, a recorder including means controlled by the output voltage of said amplifier and responsive to changes in the fundamental frequency thereof for producing record indications of the stations to which said receiver is tuned, and means responsive to the output of said amplifier when harmonics of said fundamental frequency are present in said output for disabling said last-named means whereby said last named means is prevented from spuriously responding to a harmonic of said fundamental frequency to produce a false record indication.

2. Apparatus for recording the radio stations to which a radio receiver is selectively tuned, comprising an amplifier excited by a signal voltage derived from said receiver having a fundamental frequency indicative of the station to which the receiver is tuned and operative to deliver an output voltage having the same fundamental frequency and harmonics of said fundamental frequency, a recorder including means controlled by the output voltage of said amplifier and responsive to changes in the fundamental frequency thereof for producing record indications with respect to time of the stations to which said receiver is tuned, said last-named means being susceptible of spurious response to produce false record indications when the magnitude of one of the harmonic components of said output voltage exceeds a predetermined value, and means responsive to the output of said amplifier when harmonics of said fundamental frequency are present in said output for limiting said one harmonic component of said output voltage to said predetermined value.

3. Apparatus for recording the radio station to which a radio receiver is selectively tuned, comprising an amplifier excited by a signal voltage derived from said receiver having a fundamental frequency indicative of the station to which the receiver is tuned and operative to deliver an output voltage having the same fundamental frequency and harmonics of said fundamental frequency, a tunable oscillator, means for tuning said oscillator to vary the frequency of the oscillator output voltage, a recorder including a recording means for producing a record on a movable recording element and movable in accordance with changes in the tuning of said oscillator, heterodyning means excited by the output voltages of said amplifier and said oscillator and operative to deliver an output voltage having a frequency equaling the difference between its two exciting frequencies, control means responsive to a decrease in the output voltage frequency of said heterodyning means to a predetermined value for arresting tuning of said oscillator and movement of said recording element, thereby to cause said recording means to produce a predetermined trace on said element indicative of the station to which said receiver is tuned, the tuning range of said oscillator being sufficiently broad as to approach or equal the first harmonic component of the amplifier output voltage, whereby said control means is susceptible of false operation if said first harmonic component of said amplifier output voltage is allowed to exceed a predetermined value, and signal responsive automatic gain control means for controlling the gain of said amplifier that said first harmonic component of said amplifier output voltage is not allowed to exceed said predetermined value.

4. In apparatus for recording the transmitting stations in different frequency bands to which a multi-band radio receiver of the type having a band selector switch is selectively tuned, the combination comprising, a recorder including a recording stylus for producing a record on a movable record receiving element, means including a motor for moving said stylus relative to said element, means tending to bias said stylus out of contact with said element, magnet means operable to move said stylus into contact with said element, an energization circuit for said motor including a relay operated switch for closing said energization circuit, means for connecting said relay and magnet means in series, means for operating said relay and magnet means in response to energization of said receiver comprising a rectifier having its plate circuit connected in series with said relay and magnet means, said rectifier including a cathode heater, a pair of resistors connected in series with the energization circuit of said receiver, means connecting said cathode heater across one of said resistors whereby said heater is energized to render the rectifier operative whenever the receiver is turned on, a second recording stylus, a bimetallic support normally holding said second stylus out of contact with said element, a heater for said bimetallic support for causing when energized said second stylus to move into trace producing engagement with said element, and means operable by said band selector switch for connecting said heater for said bimetallic element across the other of said resistors.

5. In apparatus for recording the stations to which a radio receiver is selectively tuned, the combination comprising, a recorder including a recording stylus for producing a record on a continuously movable recording tape, means including a motor for moving said stylus relative to said tape, means tending to move said stylus so as to be ineffective to produce a record on said tape, magnet means operable to render said stylus ef-

fective to produce a record on said tape, an energization circuit for said motor including a relay operated switch operable to close said energization circuit, means for connecting said relay and magnet means in series, means for operating said relay and magnet means in response to energization of said receiver comprising a rectifier having its plate circuit connected in series with said relay and magnet means, said rectifier including a cathode heater, a pair of resistors connected in series with the energization circuit of said receiver, means connecting said cathode heater across one of said resistors whereby said heater is energized to render said rectifier operative whenever the receiver is turned on, a second recording stylus, a bimetallic support normally holding the second stylus out of contact with said tape, a heater for said bimetallic support for causing when energized said second stylus to move into trace producing engagement with said tape, and means for connecting said heater for said bimetallic element across the other of said resistors to provide a check on the accuracy of said first mentioned stylus.

6. Apparatus for recording the radio stations to which a radio receiver is selectively tuned, comprising an amplifier excited by a signal voltage derived from said receiver having a fundamental frequency indicative of the station to which the receiver is tuned and operative to deliver an output voltage having the same fundamental frequency and harmonics of said fundamental frequency, a recorder including means controlled by the output voltage of said amplifier and responsive to changes in the fundamental frequency thereof for producing record indications with respect to time of the stations to which said receiver is tuned, said last-named means being susceptible of spurious response to produce false record indications when the magnitude of one of the harmonic components of said output voltage exceeds a predetermined value, and signal responsive automatic gain control means for controlling the gain of said amplifier that the magnitude of said one harmonic component of said output voltage is prevented from exceeding said predetermined value.

ROBERT A. CLARK, JR.

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