March 21, 1944. J. T. POTTER 2,344,562

MULTIPLE UNIT RADIO RECORDER

Filed May 18, 1940 2 Sheets-Sheet 1

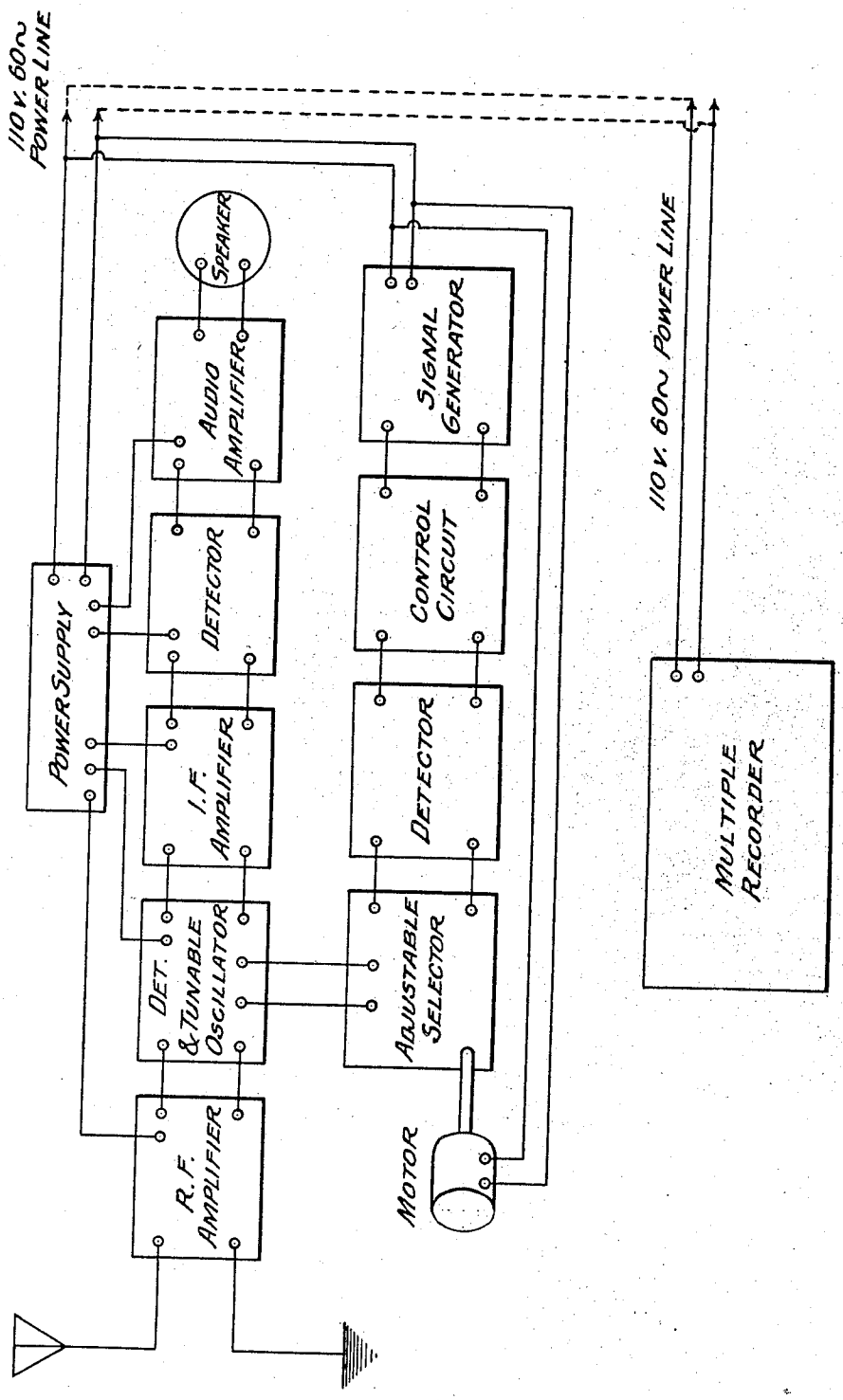


Fig. 1.

INVENTOR.
John T. Potter

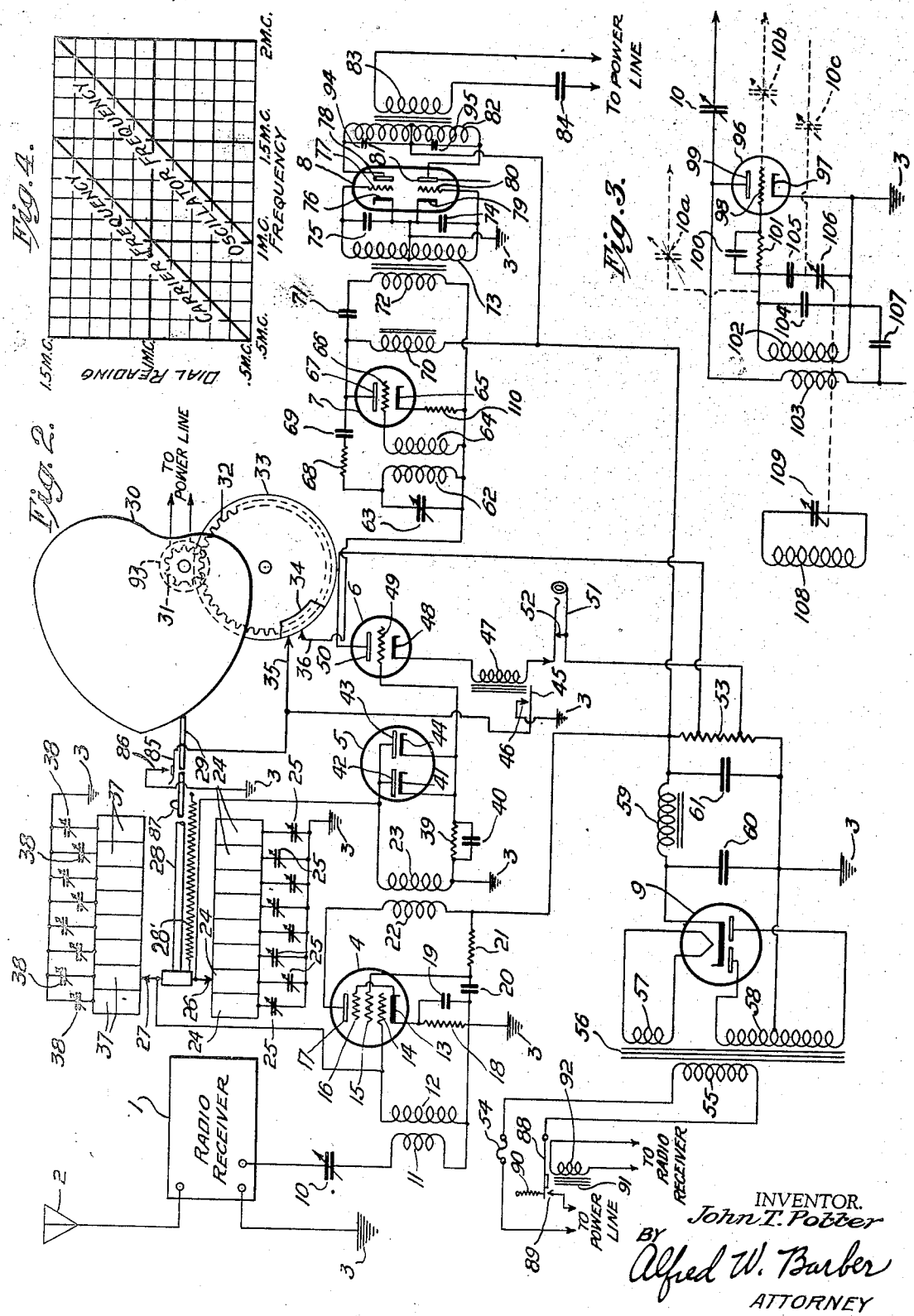
BY Alfred W. Barber

ATTORNEY

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INVENTOR.
John T. Potter
BY
Alfred W. Barber
ATTORNEY

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MULTIPLE UNIT RADIO RECORDER

John T. Potter, Brooklyn, N. Y.

Application May 18, 1940, Serial No. 335,886

3 Claims. (Cl. 234—1.5)

The present invention concerns recorders and in particular recorders for recording the tuning and operating conditions of a plurality of radio receivers.

This general type of recorder has been shown in my Patent Number 2,249,324 issued July 15, 1941. Some features of the method of coupling to the radio receiver are shown in Patent Number 2,213,886 issued on September 3, 1940.

One object of the present invention is to simplify the method of and means for recording the operation of a plurality of radio receivers on a single record sheet.

Another object is to simplify the installation of a remote unit at a radio receiver.

Still another object is to simplify and improve the operation of the signal generating unit of the remote unit.

A further object is to provide more reliable operation of the remote unit especially over a long period of time without attention.

A still further object is to provide a remote unit capable of transmitting a signal to the recorder over a longer distance than has hitherto been obtainable.

These and other objects of the invention will be evident from the detailed description of the invention given in connection with the various figures of the drawings.

Radio broadcasting in this country is largely paid for by advertisers. The effectiveness of this form of advertising is most accurately measured by measuring the size of the listening audience. The determination of the size of this audience has become very important to the whole broadcasting structure. Previously, audience measurements have been made by telephone calls or house to house visiting. This is an inaccurate, slow and expensive method of determining the audience. Much desired information becomes almost impossible to obtain by this method. Machine recording of the operation of radio receivers has been found to be quick, accurate and cheap. One machine can more than replace hundreds of telephone or house to house calls.

Two general types of machine recorders have been disclosed in the above referred to patent applications. One type has been called a "single unit" since each recorder records the operation of a single radio receiver. The second type has been called a "multiple unit" since each recorder records the operation of a number of radio receivers. The present invention particularly concerns "multiple unit" recorders.

Briefly, the multiple recorder of the type with which the present invention is concerned comprises a number of remote units each attached to a radio receiver and a central recorder unit. Each remote unit transmits by means of timed impulses information indicating the mode of operation of its connected radio receiver to a central point where a recorder is located. This multiple recorder system has the advantages that the mode of operation of a number of radio receivers may be recorded on a single record sheet. These records are conveniently collected every twenty-four hours, giving a daily record of the operation of a large number of radio receivers. The present invention concerns an electronic coupling unit which greatly simplifies the attachment of remote units to the radio receivers; means for increasing the power output of the remote units permitting a greater radius of operation from the recorder; and various other features which cheapen, simplify and improve the operation of the multiple type recorder.

In the drawings:

Fig. 1 shows a block diagram of one embodiment of the present invention.

Fig. 2 shows a circuit diagram of a particular form of the present invention.

Fig. 3 shows a detail of modes of connection of the signal generator to a radio receiver.

Fig. 4 shows the relation between carrier and oscillator frequencies in a typical superheterodyne radio receiver.

The block diagram of Fig. 1 shows the general layout of one form of the present invention. It shows a superheterodyne radio receiver, the signal generator controlled by the oscillator of the radio receiver, and the multiple recorder. The radio receiver may be any conventional radio receiver and in the form shown in Fig. 1 includes a radio frequency amplifier marked "R. F. amplifier" for selecting and amplifying the received signals. It includes a first detector which receives signals from the radio frequency amplifier and mixes them with signals from a tunable variable frequency oscillator to produce an intermediate frequency signal which is passed on to an intermediate frequency amplifier. The first detector and tunable oscillator are represented by the block marked "Det. & tunable oscillator" and the intermediate frequency amplifier by the block marked "I. F. amplifier." The amplified intermediate frequency signals are passed along to a second detector marked "Detector." The detected signals are applied to an audio frequency amplifier marked "Audio amplifier" the output of

which is connected to a loud speaker marked "Speaker." Power to operate the various units of the receiver is derived from a power line as, for instance, a 110 volt, 60 cycle line and is passed through suitable rectifiers and filters marked "Power supply."

In order to generate signals characteristic of the operation of the above described radio receiver, signals from the oscillator of the receiver are applied to a selective system including an amplifier stage and two tuned circuits. The circuits are tuned in timed sequence to a plurality of oscillator frequencies, the presence of any one of which indicates that the radio receiver is tuned to one of a plurality of predetermined radio stations which fact it is desired to record. One way to tune the circuits thru the desired sequence is to operate a step selector by means of a synchronous motor connected to the 110 volt, 60 cycle source. The selector is shown as "Adjustable selector" and the synchronous driving motor as "Motor." The selected signal is fed to a detector marked "Detector" which generates an impulse which in turn is fed to a signal control circuit marked "Control circuit." The signal control circuit when it receives an impulse from the detector energizes a signal generator as, for instance, a 20 kilocycle oscillator and output amplifier marked "Signal generator." The 20 kilocycle signal is applied to the power line over which it travels to a recorder at some remote point marked "Multiple recorder." This recorder is called a "Multiple recorder" since the signals from a large number of signal generators as described above may be recorded by a single recorder. A suitable recorder is shown and described in the copending application entitled "Multiple recorder" Patent Number 2,249,324 issued July 15, 1941.

In Fig. 2 is shown a preferred form of the present invention attached to a radio receiver and sending signals over the power line although it is not so limited since the signals may evidently be sent thru the ether or over other wires such as telephone or telegraph lines. A radio receiver 1 is shown connected to antenna 2 and ground 3. The signal generating system includes an input signal amplifier tube 4, a detector tube 5, an oscillator control tube 6, a signal oscillator 7, an output signal amplifier 8, and a rectifier 9 for supplying power to the signal generator. Input amplifier tube 4 is a pentode having a cathode 13, control grid 14, screen grid 15, suppressor grid 16 and plate 17. Cathode 13 receives a bias from cathode current drop in resistor 18 which is by-passed by condenser 19. Screen grid 15 receives a bias thru dropping resistor 21 and is by-passed by condenser 20. Suppressor grid 16 is connected to cathode 13. Control grid 14 is connected to the secondary 12 of input transformer 11—12. Primary 11 is connected to the oscillator of the radio receiver 1 by means of coupling condenser 10. It has been found that condenser 10 may be a very small capacity of the order of 1 micro-microfarad if it is connected to a point in the oscillator circuit having a substantial radio frequency voltage to ground. This capacity may be varied to suit the particular receiver or the particular point of connection and in each case is made small enough not to disturb the calibration or tuning point of the receiver. This is particularly important in the case of push-button receivers where it is desirable to connect the unit without retuning the push-button adjustments.

The periodic selecting system shown in Fig. 2 includes two commutators 24 and 37. Each segment of these commutators is insulated from the others and from ground and is connected to individual and adjustable condensers 25 and 38. Contact with the commutators is made by sliding contacts 26 and 27. These contacts are moved over the commutators in a predetermined manner by means of rod 28 biased by a tension spring 28' against cam 30 which is driven by the synchronous motor 93 from the alternating current power line. Cam 30 is thus rotated and moves contactors 26 and 27 over commutators 24 and 37 in a predetermined manner. Condensers 38 are adjusted to tune secondary 12 to a plurality of predetermined oscillator frequencies each corresponding to a carrier frequency, the reception of which by the radio receiver it is desired to record.

Amplifier tube 4 thus receives selected signals and having its plate 17 connected to primary 22 of transformer 22—23 amplifies them and passes them on. Secondary 23 is tuned by one of condensers 25 at any given position of contactors 26 and 27 to the same frequency as that to which secondary 12 is tuned and thus further selects desired signals. The desired signal thus selected and amplified is rectified by diode detector 5 by connecting secondary 23 to plates 42 and 43 tied together and to cathodes 41 and 44 thru load resistor 39 by-passed by condenser 40. The system thus far described generates voltage impulses across resistor 39 corresponding to selected desired oscillator signals. The cathode end of resistor 39 is positive and is connected to control grid 49 of control tube 6. Cathode 48 is connected thru relay coil 47 and jack 51 to a suitable bias point on voltage divider 53. Relay 45—46—47 is normally open at contact 46 and the impulses on grid 49 cause it to close partially completing a circuit between the return circuit of oscillator 7 and ground 3. Relay 47 operates each time contactors 26—27 contact condensers tuning the system to an operating oscillator frequency. It is desired, however, to operate oscillator 7 only when contact is made on the steep part of cam 30 in order that signals may only be generated during short predetermined intervals. In order to make these intervals less frequent the generation of oscillator signals may be limited to every 2nd, 3rd or 4th revolution of cam 30. To accomplish this a conducting segment 34, which covers one-eighth of the circumference of its circle, closes the circuit between contacts 35 and 36 during the desired interval completing the return circuit of oscillator. Segment 34 is carried by an insulating disc 3 geared to motor 93 by means of gears 31 and 3 For instance, if gear 32 has four times the number of teeth of gear 31, the circuit is close throughout one half of every fourth revolutio of cam 30.

Tube 7 including cathode 65, control grid and plate 67 is the controlled output signal gene ating oscillator tube. Its circuit includes grid c 64 coupled to plate coil 62. Plate coil 62 is tun to 20 kilocycles by means of variable condens 63. Feed-back is obtained by connecting coil to plate 67 thru blocking condenser 69 and fee back control resistor 68. The oscillation wa form may be improved by means of the un-b passed degenerative cathode resistor 110. Pla voltage is supplied thru the parallel-feed cho 70. The circuit will oscillate only if the l side of the circuit is completed to ground 3 th contacts 35—36 and 46.

Oscillator 7 thus generates 20 kilocycle signals in accordance with the receiver tuning and the timing circuits. The 20 kilocycle signals are amplified by output tube 8 which comprises a double triode connected in push-pull. One triode includes cathode 76, control grid 77 and plate 78 while the other triode includes cathode 79, control grid 80 and plate 81. The 20 kilocycle signals are applied to grids 78 and 80 by means of the push-pull input transformer 72—73. Condensers 74 and 75 connected across secondary 73 are used to at least partially tune secondary 73 to improve the waveform of the output and to increase the input to tube 8. Plates 78 and 81 feed primary 82 of the push-pull output transformer 82—83. The primary 82 may be tuned by condensers 94 and 95 also to improve the waveform decreasing the possibility of harmonic interference and to increase the output. Secondary 83 applies signals to the power line or other transmission medium thru blocking condenser 84.

Power is supplied to the unit by means of power transformer 55—57—58, rectifier 9, choke 59, filter condensers 60—61 and voltage divider 53. While motor 93 is operated continuously to maintain its phase relation with other signal generators in the system, the power is turned on to the remaining part of the unit by means of relay 91. Relay 91 is normally held open by means of spring 90 opening contact 89 in series with the power supply. The power line current to the radio receiver is passed through coil 92 and hence whenever the receiver is turned on coil 91 is energized attracting armature 88, closing contact 89 and thus supplying power to the unit.

In case the receiver is operated on a station which is other than those which it is desired to record, it is still desirable to record the operation of the receiver. This is accomplished by means of contacts 85—86 connected across contact 46 and closed once for each revolution of the cam 30 by means of point 87 on rod 28. Thus a signal is generated independently of the tuning of the radio receiver indicating that it is being operated.

Fig. 3 shows one method of connecting the signal generating unit of Fig. 2 to the oscillator of a superheterodyne receiver and suggests three alternative connections. Other modes of connection will be evident to those skilled in the art. Tube 96 represents the oscillator tube of a typical superheterodyne radio receiver such as the one shown in Fig. 1. Oscillator tube 96 is shown as a triode having a plate 99, a grid 98, and a cathode 97 heated by well known means not shown. The oscillatory circuit from grid 98 to cathode 97 includes grid resistor 101 by-passed by grid condenser 100, and grid coil 102 tuned by trimmer condenser 104 and tuning condenser 106 in series with padding condenser 105. Feedback to provide oscillation is furnished by means of plate coil 103 coupled to grid coil 102 connected between plate 99 and by-pass condenser 107. Coupling condenser 10 which couples the oscillator to the signal generating unit is shown connected to plate 99. One of the most convenient methods of connection is to place the connecting wire to condenser 10 around one of the tube base pins carrying oscillator voltage and to replace the tube in the socket.

Also in Fig. 3 is shown a radio frequency coil 108 tuned by variable condenser 109. This may be a part of the R. F. amplifier of the typical superheterodyne radio receiver as shown in Fig. 1. Condenser 109 may be ganged with condenser 106 as represented by the connecting dotted line. Coil 108 is tuned to various desired carrier frequencies by condenser 109 while the oscillator coil 102 is tuned to a frequency which is higher or lower by the desired intermediate frequency. Fig. 4 shows the relation between carrier frequencies and oscillator frequencies in a superheterodyne having an intermediate frequency of 500 kilocycles and a carrier frequency range of 500 to 1500 kilocycles (0.5 to 1.5 mc.). This diagram shows, for example, that when receiving a carrier frequency of 1 mc. that coil 108 is tuned by condenser 109 to 1 mc. while the oscillator tube 96 oscillates at 1.5 mc. as determined by the tuning of coil 102 by condenser 106.

Returning to the operation of the signal generating system of Fig. 2, in order to generate a signal indicating operation of the receiver 1 on this 1 mc. frequency one of condensers 38 and the corresponding condenser 25 are set to tune coils 12 and 23 respectively to 1.5 mc. so that the signal from oscillator tube 96 thru condenser 10 being 1.5 mc. will cause a signal to be generated by oscillator tube 7. Thus the signal generating system is responsive to one frequency while the receiver is tuned to another. The signal generator produces a signal indicating operation of the receiver on a particular carrier when the oscillator of the receiver oscillates at a predetermined frequency difference from the carrier. The same relation holds for generating signals indicating operation on other predetermined carriers. This relation of response frequency of the signal generator to carrier being received by the receiver will be the same for all the signal generators in the system operating on receivers having the same intermediate frequency and in which the oscillator is on the same side of the carrier. The relation will be different for receivers employing the same intermediate frequency but with the oscillator on the other side of the carrier. The relation will also differ for different intermediate frequencies. Thus one multiple recorder may record the operation of a large number of radio receivers on a predetermined selection of stations while the signal generators comprising the system may be responsive to many different frequencies as determined by the intermediate frequencies of the receivers to which they are connected.

It should be noted that the signal generator will operate with any type of superheterodyne radio receiver equally well. Push-button receivers, inductance tuned receivers, automatically tuned receivers, remote control receivers, midgets and in fact any type of superheterodyne may be used in connection with the signal generator shown. An all-wave receiver automatically registers when actually operating on the carriers selected and automatically cuts-off on other wave bands due to the lack of the proper oscillator frequency. Similarly, the device is not limited to the broadcast band or any one band. For instance, three stations in the broadcast band may be recorded, two in the frequency modulation band and two in the television band merely by proper choice of coils 12 and 23 and condensers 25 and 38.

While only a single embodiment of the present invention has been shown and described, many modifications will be apparent to those skilled in the art within the spirit and scope of the invention as set forth in the appended claims.

What is claimed is:

1. In a radio receiving system for recording the operation of a radio receiver, the combination of,

a tunable signal amplifier, means for periodically tuning said amplifier to a number of predetermined signal frequencies including a motor-driven contactor for periodically contacting a plurality of contacts, and a plurality of tuning condensers connected to said contacts, an input circuit connected to the input of said amplifier and adapted to be connected to a signal carrying circuit of said radio receiver, an impulse signal generator for producing a marking signal for a remote recorder in response to selected signals traversing said amplifier, and means for disabling said generator during the cycle of operation of said contactor between the times of selected periods of contacting said contacts.

2. The combination claimed in claim 1, said impulse signal generator comprising an oscillating circuit, the means for disabling said generator including a normally open relay in said oscillating circuit, and means responsive to selected signal output of said amplifier for closing said relay.

3. The combination claimed in claim 1, said impulse signal generator including a control circuit therefor, the means for disabling said generator including a normally open switch in said control circuit, and means driven by the motor driving said contactor for closing said switch only during certain selected periods of contact between said contactor and said contacts.

JOHN T. POTTER.