July 18, 1933. W. AULL, JR 1,918,683

REMOTELY CONTROLLED RADIORECEIVER

Filed Dec. 23, 1930 3 Sheets-Sheet 1

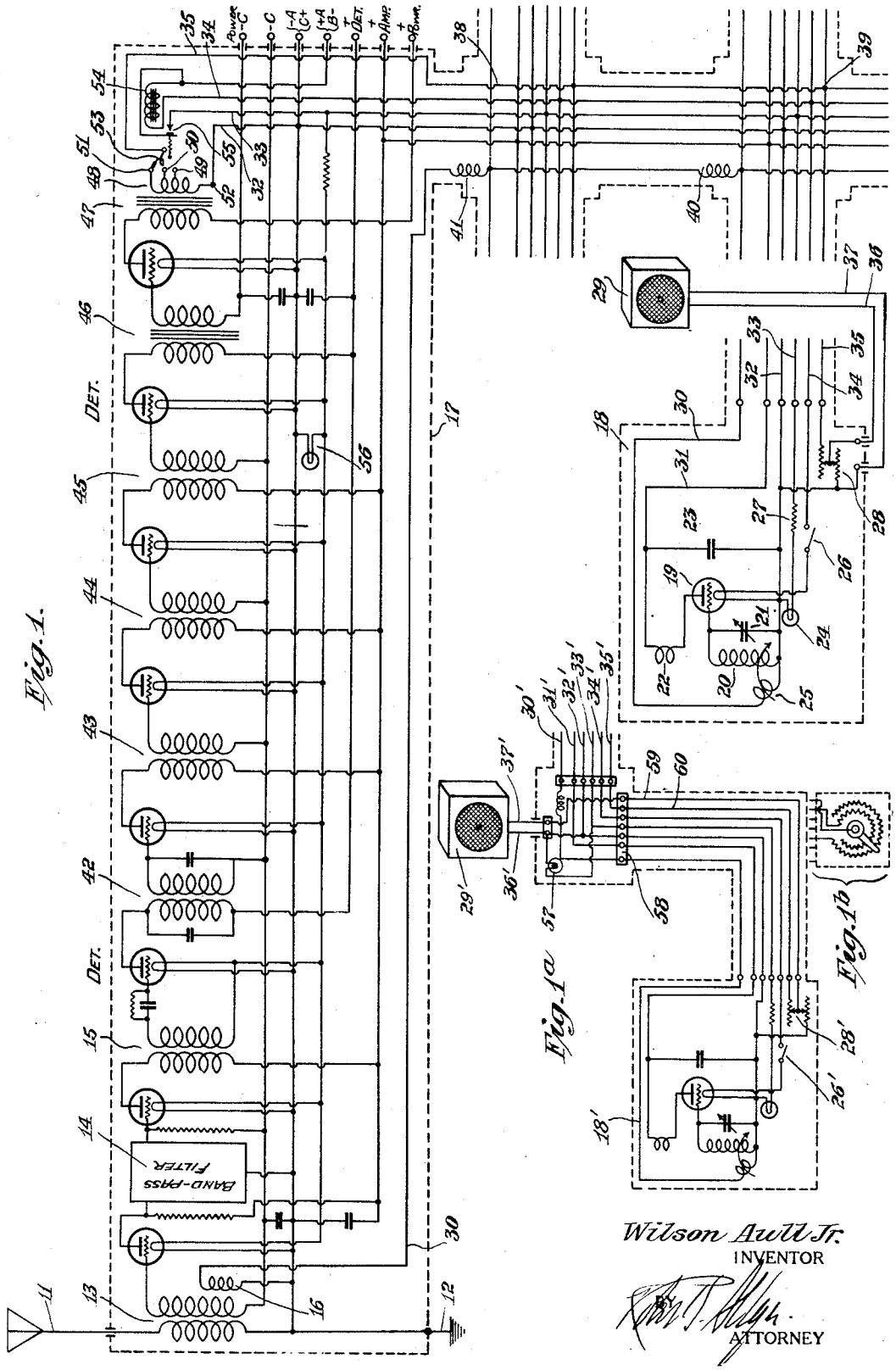


Fig. 1.

Fig. 1a

Fig. 1b

Wilson Aull Jr.
INVENTOR

ATTORNEY

July 18, 1933. W. AULL, JR 1,918,683

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Filed Dec. 23, 1930 3 Sheets-Sheet 2

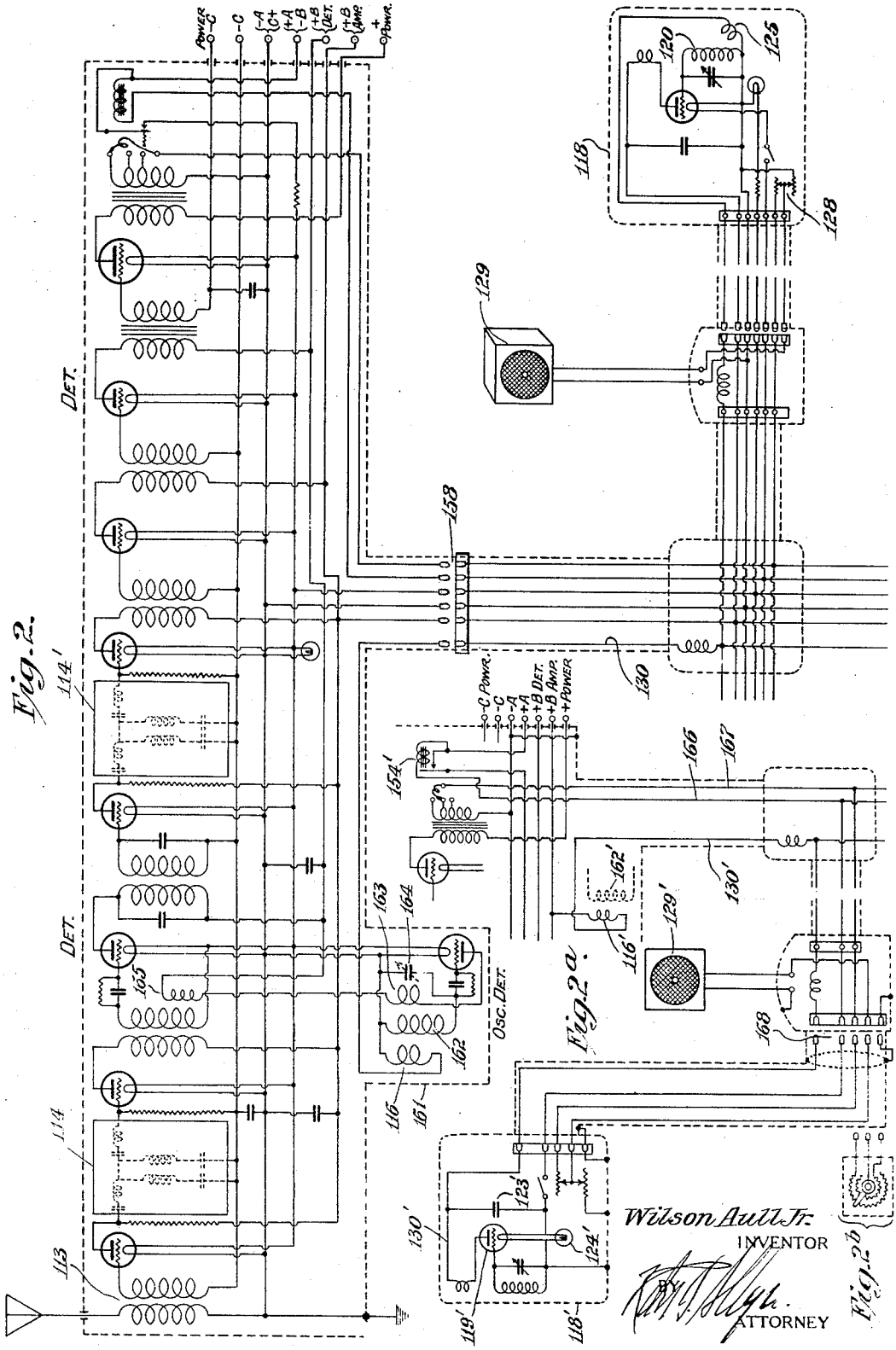


Fig. 2.

Fig. 2a.

Fig. 2b.

July 18, 1933. W. AULL, JR 1,918,683

REMOTELY CONTROLLED RADIORECEIVER

Filed Dec. 23, 1930 3 Sheets-Sheet 3

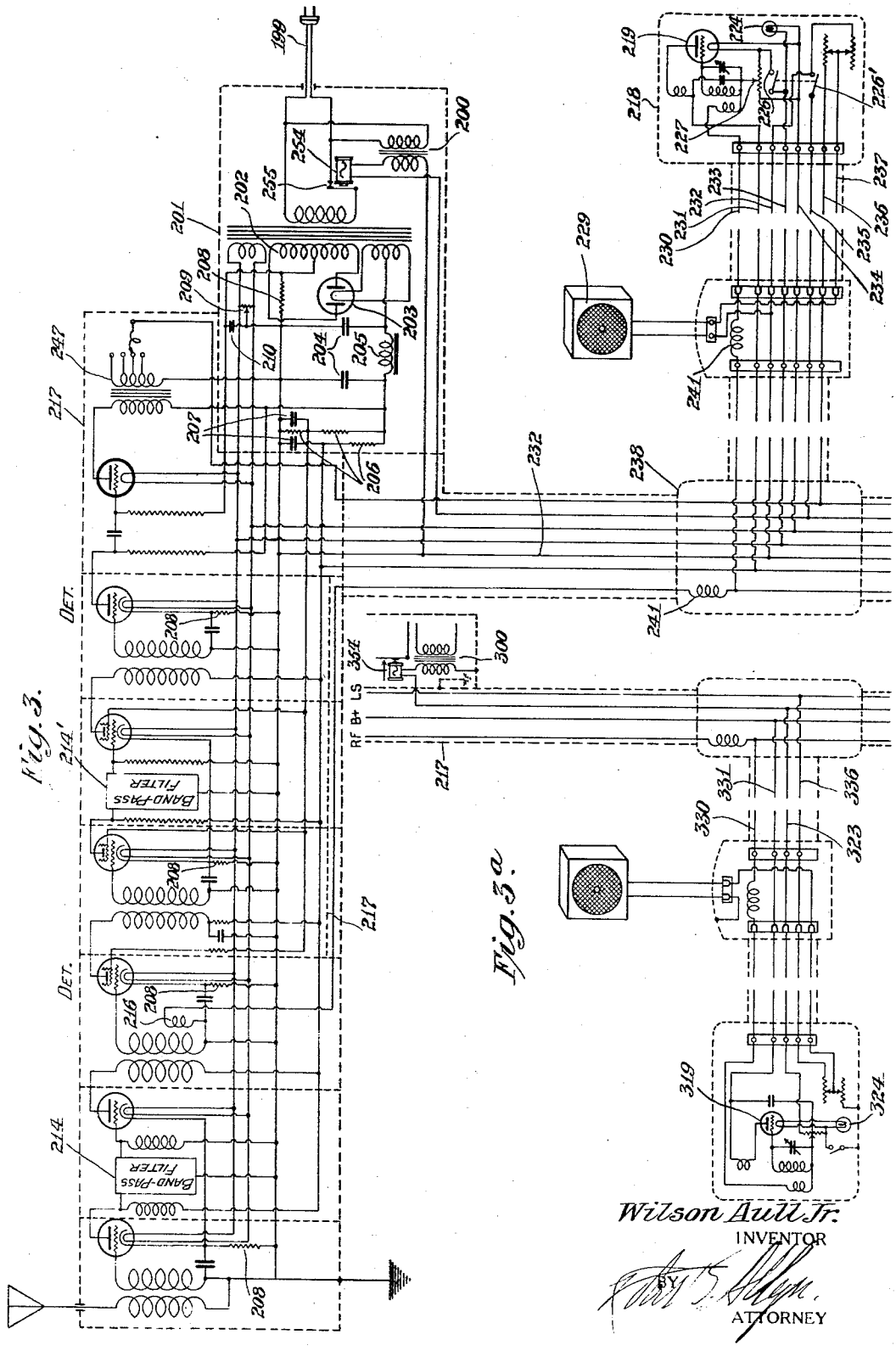


Fig. 3.

Fig. 3a.

Wilson Aull Jr.
INVENTOR

BY

ATTORNEY

Patented July 18, 1933 1,918,683

UNITED STATES PATENT OFFICE

WILSON AULL, JR., OF JACKSON HEIGHTS, NEW YORK

REMOTELY CONTROLLED RADIORECEIVER

Application filed December 23, 1930. Serial No. 504,253.

This invention relates to systems and apparatus for the remote control of radio receivers.

This invention utilizes certain of the methods and means disclosed in United States Patent 1,746,688, issued February 11, 1930 to Bowden Washington, and in pending application Serial No. 217,707 (patented March 3, 1931, No. 1,794,936) of Bowden Washington.

Many broadcast receivers have an output of sufficient undistorted volume and quality to be satisfactory, but the user is compelled either to remain close to the receiver or else to visit it at intervals whenever a change of program or volume is desired.

One object of my invention is to produce a remote control radio receiver in which the wave length to which it best responds and the volume of the output may be controlled from one or more distant points.

Another object is to produce attachments for existing receivers in order to attain the above mentioned results.

One object of my invention is to allow the operator of a receiver to enjoy such programs as he may desire with the wanted volume, without the necessity of leaving the position in which he finds himself when a change of program or volume is desired.

By means of my invention the control of the broadcast receiver, both as to program and volume, as well as the turning on and off of the same, can readily be accomplished from any desired number of points within a moderate radius from the receiver. These points are usually located within a single dwelling house or apartment, but may be separated from one another or from the set by any moderate distance desired.

The average broadcast receiver of good quality and volume is too bulky and heavy to be conveniently moved from room to room, and there is the necessity of supplying antenna, earth and power connections at each point where it is desired to use the same. There is also the annoyance of being compelled to transport the receiver and make these necessary connections whenever the listener desires the program to be delivered at and controlled from a different point.

By means of my invention the receiver proper can be permanently installed at any convenient point, such as closets, attics or other out-of-the-way spots, wherever power supply, antenna and earth leads are available. The control of this receiver can then be made from any point where a control station is established and the sound output of the receiver be located at such points, or at any other points desired.

My invention contemplates the permanent installation of a series of conductors leading from the radio receiver to one or more points where a remote control station may be desired. Such wiring may be conveniently installed in a dwelling during the process of erection or subsequently. This wiring may be conveniently concealed within the walls and utilize conductors, protective sheaths and fixtures such as conduit, BX cable, junction boxes, wall boxes and other wiring fixtures similar to those employed in systems for the distribution of power or for telephone communication.

My remote control stations embody a small amount of apparatus, light in weight and easily constructed within a small compass. In this fashion these remote control stations can be connected by flexible conductors of suitable length to wall boxes which are a portion of the permanent wiring installation.

Referring to the drawings:

Fig. 1 is a representation, principally schematic, of a super heterodyne system embodying my invention and illustrating one remote control station.

Fig. 1*a* is an alternative form of remote control station to be used with the circuits and distribution wiring of Fig. 1.

Fig. 1*b* is an alternative form of volume control designed to operate in conjunction with the form of station shown in Fig. 1*a*.

Fig. 2 illustrates another form of super heterodyne receiver with one distant control station, wherein a plurality of locally generated oscillations are employed.

Fig. 2*a* shows a modification of Fig. 2 wherein the number of conductors necessary

between the receiver and the remote control stations is reduced.

Fig. 2*b* shows a separate volume control box for use with the form of wiring of Fig. 2*a*.

Fig. 3 illustrates a modification of the system of Fig. 1, wherein the power supply is obtained from an alternating current source.

Fig. 3*a* shows a modification of the system of Fig. 3, allowing the employment of a smaller number of distribution conductors.

Referring to Fig. 1, 11 is a signal collecting means such as an antenna, 12 is a ground connection and 13 is a transformer capable of passing a suitably wide band of frequencies. 14 is a band pass filter and 15 is a transformer also passing a sufficiently wide band of frequencies. 16 is a coil carrying a control frequency and coupled to transformer 13. Dotted lines 17 represent grounded shielding which may well enclose the entire receiver, the distribution conductors, and the remote control unit.

Remote control unit 18 comprises tube 19 with its grid connected to inductance 20 and variable condenser 21. 20 and 21 constitute a circuit of variable frequency under control of the operator, which circuit is maintained in oscillation by tube 19 and tickler coil 22. The by-pass condenser 23 aids in maintaining the oscillation of the assembly by keeping the inductance of the plate circuit of the tube 19 practically constant for radio frequencies, regardless of the distance from the receiver proper. 24 is a pilot lamp to furnish visible indication of the functioning of the filament circuit of the receiver proper. 25 is a radio frequency pick-up coil variably coupled to inductance 20 of oscillating system 20, 21, 22. 26 is a switch which turns on and off both its own remote control unit and the receiver proper. 27 is a resistance for control of the filament of pilot light 24. 28 is a volume control of the constant impedance type serving to control the output of a loud speaker 29.

The remote control unit feeds the receiver proper through the transmission line 30 and receives the energy for its operation through conductors 31, 32, 33 and 34. Conductor 34 also indirectly serves to put the receiver proper into operation or shut it off when so desired but a separate conductor may be used for this function if desired. Conductor 35 serves to bring the output of the receiver to the remote control unit for purposes of regulation and delivery to loud speaker 29 through conductors 36 and 37.

Conductors 30, 31, 32, 33, 34 and 35 constitute the general distributing system of this embodiment of my invention, and in accordance with usual general wiring practices, may pass through various junction boxes as shown at 38 and 39, where branch circuits may be taken off to extend to other points.

Conductors 32 and 34 supply energy to actuate the filament of tube 19 while 32 and 33 supply the pilot-light 24. 32 also serves as a common return for the anode supply circuit, the distant on and off control, the loud speaker circuit and to some extent for the radio frequency transmission conductor 30.

Pilot-lamp 24 serves to indicate that voltage is applied to the filaments of the tubes in the receiving set proper.

Pick-up coil 25 may be mounted movably with respect to coil 20 so that its energy pick-up therefrom can be modified by the operator, thus providing a volume control by determining the strength of signal supplied to the intermediate frequency amplifier of the receiver proper.

Load coils 40 and 41 are in series with radio frequency distribution line 30 in order to improve its transmission characteristics. These coils can be located at frequent intervals, for example at every junction box.

Referring again to the receiver proper, the radio frequency control oscillations arriving at coil 16 via conductor 30 interact with the incoming oscillations in transformer 13 to produce, inter alia, a band of frequencies to which band pass filter 14 is attuned. This amplified band passes through transformer 15, and after rectification is delivered to tuned transformer 42, which serves to pass the lower frequency modulated bands present in its input. This filtered band, bearing the modulations corresponding to that of the broadcast signals received by antenna 11, is amplified several times, passing through suitable transformers 43, 44 and 45. The output of transformer 45, after detection, is delivered to low frequency transformers 46 and after further amplification to 47. Transformer 47 has a secondary winding 48 supplied with taps 49, 50 and 51, and a common low potential terminal 52. An adjustable contact 53 serves to connect transmission line 35 to any one of these taps for purposes of adjusting the transformer output impedance to a value suitable for the transmission line and loud speaker input characteristics.

Relay 54, when actuated by closure of remote control switch 26, serves to close contacts 55, which supply voltage to the filament circuits of the receiver proper and the pilot light of the remote control unit. Oscillator 19 has its filament lighted by the current arriving thereat through the winding of relay 54, whose resistance should be so proportioned to the voltage supply and the characteristics of the filament of tube 19 as to supply proper current to the latter.

The receiver proper is in general of the well-known double detection type and is supplied with power through the terminals indicated and suitably labeled at the extreme right of the figure. The precise values for the various voltages and currents to be supplied are de-

pendent upon the design and characteristics of the apparatus employed. A suitable pilot lamp 56 may be incorporated in the receiver to denote when the latter is in operation. By-pass condensers, filter-tuning condensers, grid-condensers, grid-leaks, filament resistors, and other well-known ancillary portions of such a receiver are indicated at suitable points, but can by appropriate modification be omitted or varied, according to the design of the receiver. These devices are well-known in the art and accordingly are not herein described in detail. Likewise tubes suitable for high frequency, intermediate frequency, and low frequency amplification, as well as detection at various frequencies, are employed in the manner well-known in the art as suitable transfer media along the signal path above described.

The connection between the remote control unit and the receiver per se may be effected in any well known manner as, for instance, by the usual flexible cable and plug and socket devices of types such as the one indicated at 168 in Figure 2*a*, thus allowing the remote control unit to be readily moved over a radius determined by the length of this flexible conductor.

This mode of connection allows, for example, the operator of my invention to walk about over such a radius centering at the point of connection to the permanent wiring, or to remain at any point within said radius, without relinquishing his control over the operation of the radio receiver. However, it is often desirable to leave the remote control box at such locations as are most conveniently accessible, such as at the bedside, within reach of an armchair, beside a desk, etc.

In order to facilitate removal of the receiver proper from the permanent wiring system for purposes of repairs or adjustments, the connection between the receiver and such permanent wiring may be by means of a similar plug and jack system. The extreme flexibility of such modes of interconnection between receiver proper, remote control unit and permanent wiring installation, allows the interchanging of receiver and remote control unit if so desired.

Furthermore, by providing a plurality of such output boxes with plug and jack systems, the remote control unit 18 may be readily shifted from one location to another, or other remote control units may be plugged in at other points.

It can be seen that several units can be permanently wired into such a system, or plugged in at the same time without interference with one another, provided that the control switch at only one such station is closed at any one instant. Every pilot light in every control station which is connected to the distributing system will be turned on when the receiver proper is being operated. This will serve to warn any person at any station that such is the case. He will then have knowledge that he should not close his control switch, although he can avail himself of any signals present upon the output wires of the system, by adjustment of the volume control connected into the speaker circuit at his station. It is also possible to use automatically operated cut-out relays as well known in the telephone art to give exclusive control of the receiver to the remote control unit first plugged in.

Owing to the volume controls in the speaker circuits being of the constant impedance type, it will be seen that changes made at any station will not react upon the output of any other station, but the volume control by means of the variable coupling of the radio frequency pick-up coil will function only at the station which has its oscillator in operation. Accordingly although it is possible to operate this system with only the volume control in the radio frequency circuit, it will be seen that the presence of volume controls in the circuit of each loud speaker will make the system more flexible, by allowing the simultaneous control and operation of a plurality of speakers. It is possible to omit entirely the volume control by means of the movement of the radio frequency coil, although its presence increases the flexibility of the system by allowing compensation for changes of power output of individual control units or changes in the strength of incoming signals. However since adjustments of this control will affect all speakers in operation upon the system, an automatic volume control of a type familiar to those skilled in the art may well be substituted in the receiver proper in place of this manual control.

The general principle of operation of the double detection or super heterodyne type of receiver is well-known and the details of the theory involved will not be herein described.

In the practical operation of my invention, the closure of switch 26 completes the circuit of relay 54, deriving its energy from the A battery. This relay when energized closes contacts 55. These operations energize all filament and pilot lamps for the receiver proper, the filament of the remote control unit, and the pilot lamps of all units connected to the system at that instant.

The operator then adjusts volume control 28 so that any signals arriving at the loud speaker will be perceived, suitably couples coil 25 to coil 20, and manipulates variable condenser 21, until the desired signals are obtained. The volume of these signals may be adjusted by variation of the coupling between coils 20 and 25, by adjustment of the volume control 28, or by both methods. If so desired, volume control 28 may be omitted and the entire volume control be obtained through the adjustment of coils 20 and 25.

On the other hand these coils may have a fixed degree of coupling and the volume be adjusted solely by means of control 28. Certain advantages inhere to both these modes of volume control and it is possible to make suitable mechanical connection between these two movements so that both will operate simultaneously.

The adjustment of condenser 21 causes radio frequency oscillations arising from the interconnection of coils 20, 22 and tube 19 to vary over a predetermined range. Movement of coil 25 allows these oscillations to appear to an adjustable degree in transmission line 30. Coil 16 transfers these control oscillations to transformer 13, and the resulting bands of frequencies are amplified and filtered before reaching the first detector.

After detection, the so-called intermediate frequency signal is further amplified and filtered, being finally fed to the second detector, which demodulates it and delivers the audio frequency component to the final amplifier stage. Impedance adjusting transformer 47, with its associated system of variable taps, forms a means of more efficiently delivering the output of the receiver to the transmission line. Volume controls such as 28 serve to maintain the load impedance of the entire system substantially constant without reference to the number of speakers actually in use at any one instant, while shunting undesired or excess signal energy away from speaker 29.

In Fig. 1*a* there is shown a remote control unit similar in principle with that of Fig. 1 and connected by transmission lines 30′, 31′, 32′, 33′, 34′ and 35′ to corresponding numbers on the transmission system of Fig. 1.

The variant form of Fig. 1*a* has the loud speaker connected directly to the wall box where the control unit plugs in. This obviates the necessity for incorporating one of the wires 36 and 37 of Fig. 1 into the flexible cord which may be employed between the remote control unit of the permanent wiring system. In fact conductors 36′ and 37′ in this figure may be extended for a considerable distance from the wall box, or a plurality of outlets may be provided for the plugging in of these conductors, thus allowing speaker 29 to be moved about relative to the location of distant control unit 18′.

In this form it may be desirable to incorporate at the wall box another pilot lamp 57. This lamp will serve to show whether or not the system is being operated, so that the operator at control unit 18′ may not inappropriately close his switch 26′ which may cause interference with other control units then being operated.

In case that it is desired to operate loud speaker 29′ from the system when it is controlled from a point other than this wall box, a separate volume control shown in Fig. 1*b* may be employed. This volume control will allow speaker 29′ to be controlled in volume, without disturbing the operation of the set and any speakers which may then be operating at other points.

The separate volume control of Fig. 1*b* may be provided to plug directly in the terminal strip 58 by a suitable plug and jack system when remote control unit 18′ is not connected thereto, or it may be provided with a suitable flexible connecting cord, so as to operate within a limited radius centering at the wall box. The electrical construction of this volume control is to secure constant impedance and corresponds precisely with that of 28 in Fig. 1.

As to the impedance adjusting output transformer 47, this transformer would ordinarily be adjusted when an installation is first made and not be changed thereafter except when a change of tubes or loud speakers might render it desirable.

Ordinarily such a transformer may well step-down to a line impedance of say 200/500 ohms, and suitable step-up or step-down transformers (not shown), fitting to the electrical impedance of the windings, may be provided within the loud speaker assembly. As shown, the loud speakers are supposed to "look into" the line with a suitable impedance. This may or may not require impedance adjusting transformers.

In case the speakers are of a type demanding a separate power supply for energizing a field magnet, such energy may be drawn from conductors 32 and 33, or may be derived by a separate connection to another power supply such as the household lighting circuit, with the use of such conversion apparatus between the two as may be necessary and is well known in the art.

While I have shown an L-section type attenuator as a volume control at 28, other types can readily be employed.

While the radio frequency transmission line is shown as loaded by impedances 40 and 41, which makes it of a series inductance type, I do not limit my system to such a type of transmission line. For example, the shunt element type can be used, as is well known in the art. Whatever type of transmission line be employed such inductances as 40 and 41 should be placed every few feet, for example, one in every junction box and one in every wall box. There should be an appropriate number introduced at additional points in the case of long distribution lines.

I do not limit myself to the specific type or location of band pass filter indicated at 14 in Fig. 1. There are many forms of band pass filters and many possible locations therefor. For instance one design might place the band pass filter ahead of all amplifying apparatus, or it might use a single section filter for coupling each stage.

In Fig. 1, oscillator coupling coil 16 may

be placed so as to feed energy to the input of the first detector, rather than the first radio frequency amplifier. This mode of connection may simplify the design or construction of band pass filter 14 and reduce to negligible proportions the amount of locally generated oscillations radiated through the antenna.

Other auxiliary devices well known in the art may be used in connection with the receiver. For example, automatic volume control preceding audio frequency amplifications may be employed, as previously mentioned.

It is possible to supply the receiver with a long flexible cable replacing the permanent wiring system shown in Fig. 1. Such a cable can be provided with plug-in sockets along its length allowing divers remote control units to be plugged therein at suitable intervals.

It is understood that my system is very flexible and will allow other permanent or temporary installation of a plurality of remote control units and/or plugs at many points, all controlling and/or fed by a single receiver.

It is preferable with my invention to adequately shield all the units and connecting lines as indicated by the dotted lines. This is to prevent the radiation of energy from the system or the absorption of undesired energy from extraneous sources. The mode of such shielding can be any suitable one such as "Belden Braid" in the case of a flexible cable, or condulet in the case of a permanent installation, or by other means. This shielding, however, may be dispensed with under certain conditions and is not a fundamental part of my system, although its use is preferred when several systems according to my invention are operated in proximity to one another.

It is to be noted that the pilot lamp at the distant control unit "repeats back" and thus indicates the proper functioning of the relay 54 located at the receiver proper.

Pilot lamps at other remote control boxes such as 57 of Fig. 1*a* serve to warn a prospective operator that the system is already in use, thus preventing him from setting into operation a second remote control unit which might give rise to undesired disturbances in the system. Pilot lamps might also be provided at any suitable point along the entire system to serve as appropriate monitors, thus preventing a person from unnecessarily going to a wall box, only to find upon his arrival that the system is already in operation.

It is assumed that when one leaves a remote control or speaker control station he will turn the speaker circuit volume control of the unit which he has been using to zero. Otherwise it is possible for loud speakers to suddenly operate at undesired and/or inopportune moments, by virtue of the manipulation of some other remote control unit.

In connection with the choice of appropriate frequencies for the control unit oscillators and the intermediate frequency chosen for the amplifier system in the receiver proper, it is to be noted that by making this intermediate frequency a sufficiently high one, the frequency of the oscillator will not come within the broadcast band. This tends to still further avoid unwanted results due to undesired oscillations escaping from the system and possibly interfering with the operation of other nearby receivers.

In Fig. 2 a further modification of my invention is shown. Here the principle of operation is that of triple demodulation and is fully set forth in United States Patent No. 1,746,688 of Bowden Washington.

In general the system consists in generating a high frequency control oscillation which interacts with another fixed high frequency oscillation to produce a variable lower frequency which corresponds in frequency to the output of the oscillator of the ordinary superheterodyne.

This system includes a remote control unit 118 generating a frequency much higher than that of the broadcast frequency band. The design of this unit and its component parts are substantially as shown in Fig. 1*a* except that coupling coil 125 is not here shown variable with respect to coil 120, although it may be so constructed. The entire volume control is thus left for constant impedance attenuator 128, unless automatic volume control devices are incorporated in the receiver proper. Loud speaker 129 is shown directly connected to the wall box, and no pilot light is indicated in this figure. It is to be understood, however, that these variant details are not an essential of this particular system.

At 161 is shown an oscillating high frequency detector or demodulator which forms an essential part of this system. The action of this device is described in detail in the above mentioned United States Patent 1,746,688 and it is unnecessary to enter into the detailed theory of its operation.

Radio frequency transmission line 130 transfers energy by means of coil 116 to the oscillating system of this second detector comprising coils 162, 163 and condenser 164. This latter condenser is shown as semi-variable, but it is to be understood that when once installed it will be set at a certain value which will not cause interference with neighboring receivers of similar type, and not necessarily changed thereafter. The mixed output of remote control unit 118 and oscillating detector 161 is fed by means of energy transfer coil 165 to the input of the first non-oscillating detector of the superheterodyne receiver.

The superheterodyne receiver proper is of

the same general type as shown in Fig. 1. However, I have shown at 114 and 114′ two separate band pass filters, one in the radio frequency channel and the other in the intermediate frequency channel. These are shown as a combination of low-pass and high-pass filters. However, as remarked supra in connection with Fig. 1, I am not limiting myself to any particular form or location of band pass filter. The receiver may connect to the distribution system by a separable connection strip device, as indicated at 158.

Coupling coil 165 may be coupled to transformer 113, according to the arrangement of Fig. 1, by suitable design of filter 114 although the coupling shown in Fig. 2 is the preferred one. The remainder of the devices not specifically pointed out in Fig. 2 have functions corresponding to the similar ones in Fig. 1.

Fig. 2*a* shows one method of reducing the number of conductors required for my remote control system. The grounded sheath of the entire system is employed as a common return for several circuits including the filament, anode, volume control and high frequency transmission circuits. This system is preferably, although not necessarily, limited to receivers having a small number of remote control stations.

In this simplified form conductor 130′ serves both to convey the anode voltage to tube 119′ of remote control unit 118′ and also to transfer the oscillating energy from this remote control unit back to the receiver proper.

In the form of Fig. 2*a* it is to be noted that pick-up coil 116′ has one side connected to radio frequency transmission line 130′ and the other end to the supply of direct current anode voltage of the receiver proper, whereas coil 116 of Fig. 2 has its other end connected to the filament circuit. This change of connection is due to the above mentioned dual function played by transmission line 130′. Coil 162′ corresponds in function and connection with coil 162 of Fig. 2.

It is to be noted in this simplified form of Fig. 2*a* that conductor 166 serves not only to excite relay 154′ but also carries the filament heating current for the tube 119′ and pilot lamp 124′ to the remote control unit 118′.

This means that relay 154′ must be suitably designed to carry such current continuously, and without undue voltage drop. Conductor 167 serves to supply the output of the receiver to the loud speaker 129′. The remote control unit is shown with a separable plug-in system at 168 as described in connection with previous figures. Pilot lamp 124′ does not "repeat back" the condition of the set. It indicates only that the control unit where it is located is turned on, and it may be omitted if desired.

Fig. 2*b* shows a separate volume control unit adapted to be plugged in at 168 when remote control unit 118′ is not employed at that point. This will allow control of the volume of speaker 129′ while the receiver is being controlled from another point, in a fashion similar to that explained in connection with Fig. 1*b*.

It is also to be noted that no separate pick-up coil corresponding to coil 125 of Fig. 2 is needed in this remote control unit 118′ since by-pass condenser 123′ is adjusted to allow the desired amount of oscillating energy to travel back over the anode feed wire 130′ which thus becomes the radio frequency transmission line.

All parts not definitely referred to in Figs. 2, 2*a* and 2*b* correspond to similar parts shown in Figs. 1, 1*a* and 1*b* and their functions will be evident to one skilled in the art.

Referring now to Fig. 3 a remote control superheterodyne system falling under the same general electrical category as the system of Fig. 1 is disclosed. This system is designed to derive its entire power supply from a commercial alternating current supply such as a household lighting circuit. The general circuit is of the single oscillator type which oscillator is shown at 218 as being incorporated into a remote control unit. The essential portions of this unit are substantially the same as those of the corresponding unit of Fig. 1. It is to be noted, however, that switch 226 which functions to control the filament of tube 219 is mechanically coupled as indicated by dotted lines to switch 226′ which latter switch functions solely to control the relay at the receiver proper. It is considered preferable to partially isolate these two circuits from one another when alternating current is employed, as is here the case.

Loud speaker 229 is here shown as coupled to the wall box, as in the case of Fig. 1*a*. This necessitates one more conductor 237 between the remote control unit and the wall box to furnish controlled energy to this loud speaker.

A junction box is indicated at 238 which may be employed for convenience in wiring. Load coils such as shown at 241 are employed in the radio frequency transmission line 230 for the reasons set forth in connection with Fig. 1.

Referring now to the receiver proper, cord and plug 199 serve to introduce energy from the source of alternating current. Transformer 200 is maintained continuously "alive", as long as plug 199 is connected to an active source of current. The secondary of transformer 200 has one side connected to conductor 232 which serves as a common return for several of the circuits. The other side of the secondary passes through the winding of relay 254 and by conductor 235 to relay control switch 226′.

Power supply transformer 201 receives its primary energy only when the relay closes

contacts 255. The secondary of this transformer consists of the usual windings customarily employed with alternating current receivers, such as anode supply winding 202, etc. The rectifying tube 203 delivers its output through a filter system comprising condensers 204 and impedance 205 to a voltage divider and filter system including resistance 206 and condensers 207.

The output of this voltage divider system, together with the various voltage dropping resistors, serves to supply the divers potentials for the operation of the vacuum tubes which link the several circuits of the receiver. These tubes are indicated as of various types, some directly, and others indirectly heated. Some tubes have three electrodes and others four. The interchangeability of various types of tubes will be familiar to one versed in the art and I am not claming any special choice or arrangement of tubes.

Resistance 208 are indicated at several points as serving to allow appropriate static potentials to appear upon the grids of the several tubes in this receiver. The alternating current cathode heating leads are shunted at 209 and 210 with a resistor condenser combination, which may conveniently be made variable in order to allow adjustment to the point of minimum hum.

The entire receiver, as well as the distributing lines, junction boxes, wall boxes, and remote control units, can well be enclosed in a grounded shield 217, made continuous throughout the entire system. This shield may well enclose also radio frequency transmission line 230 where it passes through the intermediate amplifier section of the receiver as indicated by dotted lines. Band pass filters are indicated at 214 and 214′. These filters may be of various types and may be employed at points other than those indicated, as stated in connection with Fig. 1.

Transformer 247 has its secondary tapped for purposes of adjusting the impedance to an optimum value for the distribution lines and loud speakers employed.

In the operation of this form of my invention, closure of switch 226′ allows relay 254 to function, closing contacts 255 which allows energization of transformer 201. The cathode heating current will now be applied to the tubes in the set proper, and due to switch 226 being mechanically coupled to switch 226′, this current will also heat the cathode of oscillator tube 219.

It will be noted that at any other remote control unit where the switch is not closed the pilot lamp 224 will light, as well as at the unit in use. This arises from the fact that the pilot lamps are tapped on to the cathode heating line antecedent to the switch 226. This serves to give a general warning throughout the system when it is being operated. The radio frequency output of remote control unit 218 passes back over radio frequency transmission line 230 to pick up coil 216 whose location may be varied as described in connection with Fig. 1.

Line 231 serves to supply anode current to the remote control. Line 232 serves as a common return for the relay controlling circuit and the signal output circuit. Lines 233 and 234 carry the cathode heating current. Line 235 carries the relay control circuit to the remote control boxes and line 236 the output signal energy. Conductor 237 is needed only when loud speaker 229 connects to the wall box and can be omitted if this speaker be connected directly to the remote control unit as in the case of Fig. 1. Resistor 227 may be variably or fixedly tapped for reducing the hum by affording a point of connection for the grid which will give minimum unwanted modulation thereunto.

The operation of the receiver proper is analagous to that described for Fig. 1 and is not here repeated in detail. By-pass condensers, coupling condensers and various resistors, as well-known in the art, are indicated at appropriate points in this receiver although their values and positions may vary with the design of the same.

While I have shown certain tubes as being indirectly heated and other as having four elements, it is to be understood that directly heated types of tubes or those having a greater or lesser number of elements can be substituted without changes other than those familiar to one versed in the art and without altering the substance of my invention.

For greater aid in reduction of unwanted pick-up of alternating current with consequent hum, it may be desirable to eliminate or reduce the use of common return conductors and to supply the circuits of the remote control unit and/or the loud speaker through separate twisted pairs of leads. This will increase the number of conductors necessary in the permanent wiring and may be desirable or necessary only in the case of long transmission lines.

In Fig. 3*a* a further modification of the system of Fig. 3 is shown, in which the number of conductors in the transmission line is reduced to four by the employment of the grounded sheath of the system as a common return for all circuits. In this form pilot light 324 and oscillator tube 319 operate simultaneously and only at the remote control box which is in use.

Lead 323 carries the current for lighting the oscillator tube and the pilot lamp. In this case this current is derived from transformer 300 through relay 354. The winding of this relay should be appropriately designed for such series connection.

Conductor 330 is the radio frequency

transmission line conductor, 331 the anode voltage supply conductor, and 336 the output signal conductor. Other parts of this system correspond to similar parts in Fig. 3.

This system is especially adapted where but few remote control stations are employed, located not far distant from one another, although its use is not limited to such installation.

Referring to all the systems herein disclosed, it is to be noted that no especial effort has been made to cut down the conductors employed in my system to an irreducible minimum. Means will be apparent to one skilled in the art whereby certain conductors may be dispensed with by allowing others to perform a plurality of functions. For example, the common return conductor of Figs. 1, 1*a*, 2 and 3 may be dispensed with and the grounded sheath employed as a substitute therefor. While it is possible to make such changes, other consideration, such as quality of reproduction render extreme economy or parsimony in this direction inadvisable in most cases.

It is possible to produce the receiver proper of my invention with a long flexible cable attached thereunto. This cable may bear, at intervals along its length, plug-in sockets suitable for connection of comparatively short remote control box cables thereunto.

In the case of permanent installations, certain control boxes may be permanently wired into the system, while other boxes can be plugged in when so desired.

In order to reduce the number of remote control boxes necessary, the devices of Fig. 1*b* and Fig. 2*b* can be employed or a number of spring clip connection devices can be provided, one at each station in order merely to close the loud speaker circuit when they are plugged in, since it may sometimes be desirable from a viewpoint of simplicity to obtain signals at a certain point without it being necessary to control them thereat.

Volume control units such as those of Figs. 1*b* and 2*b* can be permanently or semi-permanently installed at each loud speaker station, and automatic connection devices can operate so that these volume controls will be operative when the remote control unit has been disconnected and will be inoperative when the remote control unit is again plugged in.

Two forms of volume control have been shown, and the use of automatic volume control devices in the set proper has been mentioned. It is to be understood that any or all of such devices may be used in any desired combination.

Pilot lamps have been provided throughout my system for the sake of convenience but in many cases they may be omitted and the number of conductors necessary reduced by one. For example, in Fig. 1 the omission of pilot lamp 24 will allow the corresponding omission of conductor 33.

In my various figures detection has been shown both of the grid rectification and the plate rectification type, but it is to be understood that I do not limit myself to either of these types, as any other type of rectification, such as that employing a two electrode tube or solid or liquid rectifying elements may be employed.

From a manufacturing or economic viewpoint it may be desired to employ already existing receivers in connection with my circuit. One method of doing this is to utilize such a receiver of the tuned radio frequency type as the intermediate frequency amplifier, detector and audio amplifier of my system. In this case an adapter might be separately manufactured and sold, which adapter would incorporate the radio frequency amplifier, band pass filters, power supply for itself and the remote control box circuits, as well as necessary cable, wall boxes, remote control boxes, and so forth.

In this case the existing broadcast receiver, if of the alternating current type, might plug into the adapter power supply in order that the relay of the latter may conrol the receiver as well as the adapter.

Electrical circuits and apparatus for the ready conversion of an existing receiver of this type as outlined in the preceding paragraph are disclosed in the pending application, Serial No. 217,707, of Bowden Washington. The general principles of operation therein disclosed are applicable to my invention with the substitution of a radio frequency transmission channel, material and confined in nature, for the general unconfined transmission channel of the pending application above referred to.

My invention has many advantages, some of which are set forth in the first portion of this specification, and others which will be apparent to those skilled in the art.

Contrasting my invention with prior disclosures employing a general, immaterial and wide-spreading transmission channel, it is to be noted that my invention tends to keep the high frequency oscillating energy within a material and confined channel where its possible interference with adjoining apparatus will be reduced to a minimum. In this connection, it is to be noted that the configuration of my radio frequency loop circuits ensures minimum radiation, even if not shielded.

Another advantage of my invention is that my apparatus may be readily appended to many existing installations, without extensive alteration thereof.

Another advantage of my invention is that it can not only be readily applied to existing receivers, but can be installed as a complete

assemblage where no receivers already exist, thus ensuring flexibility of application.

Another advantage of my invention is that any station within range of the receiver can be tuned in with equal efficiency and facility from the remote control point, whereas many existing remote control systems either limit the operator to a certain fixed number of stations, which must be "pre-selected" or else render the control of the receiver extremely difficult when "fine tuning" is to be attempted in connection with a weak or distant station.

My invention furthermore avoids all difficulties and errors due to the mechanical or electrical lag of moving parts at the receiver proper which is a serious difficulty with remote control systems which incorporate such moving parts.

Due to the fact that I incorporate my power supply entirely in the set proper rather than in my remote control unit, I am enabled to reduce the apparatus needed in this unit to a minimum both in respect to size and weight. A small condenser and coil may be used, especially in the circuit of Figs. 2 and 2*a*, due to the high frequencies generated by the oscillator of this unit.

However, if it is not desired to reduce the size or weight of the remote control unit to an absolute minimum, it is possible to incorporate within this unit the power supply thereof. In this case the number of conductors necessary in my transmission cable can be reduced. For example, a tube of the 199 type may be employed with small flash light cells furnishing the necessary power for operating both its cathode and anode circuits. Such construction will not materially increase the size or weight of my remote control unit, although from a viewpoint of upkeep trouble I prefer to localize all my power supply at the main receiver unit.

Likewise a filter unit can be incorporated within the remote control unit to allow its power to be directly derived from direct current mains, or from alternating current by the addition of a rectifier.

In order to allow minimum cost, the first installation may consist of a set together with an extension cord carrying a single remote control unit at its extremity. This cord can be extended to other stations, as the installation grows. Such a cord may have along its length different points adapted for the plugging-in of one or more remote control units. When such an installation reaches the point where the long cords are awkward or unsightly, a permanent wiring system may take their place.

A further economy of my system is due to the fact that the set proper may be housed in a cabinet of very low cost, due to the fact that it can be installed in a location hidden from ordinary view. In fact an installation of my invention with one or two remote control stations may be as economical as the average superheterodyne receiver. This economy arises also from the fact that expensive gang condensers can be eliminated.

Further advantages of my invention are its flexibility, simplicity and adaptability.

I claim:

1. In remote controlled radio receivers, the combination of a stationary unit including a power supply, a signal collector, amplifying means, detection means, relay means and substantially stationary tuning means, a substantially non-radiating poly-functional transmission line unit, including a conductor suitable for transmitting high frequency control oscillations to said receiver, a conductor suitable for transmitting a low frequency power supply, and a conductor suitable for transmitting relay operating current, and a control unit, located at a distance from said stationary unit and including oscillation generating means, frequency variation means and relay control means, all of said units coacting with one another to connect said power supply to all of said units, receive a band of broadcast signals, select signals of a desired frequency from said band, amplify said signals, detect said signals and deliver said signals to a responsive device, substantially without mechanical motions within said stationary unit.

2. A remote controlled radio receiver whose response frequency, volume and connection to its power supply may be controlled from a distance, having a band-pass amplifier, an oscillating detector associated with said amplifier and having a normally fixed frequency, said frequency being well outside the response frequency of said band-pass amplifier, pick-up means associated with said oscillating detector, a separate oscillator of such variable frequency as will produce beats within the frequency range of said band-pass amplifier, substantially non-radiating connective means associated with said separate oscillator and coupling it with said pick-up means, a detector associated with the output of said amplifier, a filter-amplifier resonant to the output of said latter detector and another detector associated with the output of said filter-amplifier and an audio frequency amplifier associated with the output of said last mentioned detector, said separate oscillator being distant from the remainder of the herein described parts of said receiver and adapted to coact therewith within an area embraced by said conductive means, said separate oscillator also including means for controlling the connection of said radio receiver to its power supply.

3. A radio receiver suitable for control by means of locally generated continuous oscillations, said receiver having a separately portable and distant variable control oscillator with substantially non-radiating output

means and means for turning said radio-receiver on and off, an untuned radio frequency amplifier, a first detector associated with the output of said untuned amplifier, an intermediate frequency band-pass filter amplifier associated with the output of said first detector, a local oscillator of fixed frequency associated with said untuned amplifier and having separate pick-up means, a second detector connected to the output of said filter amplifier, substantially non-radiating means connected to said variable control oscillator so as to transmit over a pre-determined and confined channel continuous oscillations of variable frequency, said continuous waves being transmitted to said pick-up means and adapted to interact with said local oscillator so as to produce in conjunction with the received signals a frequency in the output of the first detector equal numerically to a response frequency of the intermediate frequency filter amplifier and a second detector associated with the output of said filter amplifier, said second detector being adapted to produce audio frequency currents.

4. A household receiving set comprising five units, namely a receiving unit, a portable control unit, an amplifying unit, a transmission line unit and a sound reproducing unit all adapted to be located substantially within a single apartment, said control unit being connected to the receiving unit by the transmission line unit and being adapted to be moved in the apartment from place to place with respect to the other units, said receiving unit including a band amplifier having signal energy collecting means and adapted to receive and amplify all signals within a broad band of frequencies, said control unit including high frequency oscillation apparatus, frequency control means, means for controlling the connection of the stationary units to their power supply and volume control means, said amplifying unit including means for amplification at a fixed super-audible frequency, detecting means and audi frequency amplifying means, said sound reproducing unit being located at a distance from said receiving and amplifying units and being connected therewith by said transmission line unit, and said transmission line unit including substantially non-radiating transmission lines suitable for high and low frequency currents.

5. Remote control radio receiving apparatus including a fixed unit, a sound producing unit, a portable control unit, and a transmission line unit connecting all of said units, said fixed unit including substantially stationary means for the reception of broadcast radio signals, and for the conversion of said signals to a frequency determinable by said portable control unit, means for the detection and amplification of said converted signals, means for transferring said detected and amplified signals to said transmission line, relay means for determining the operation of all of said units, and means for connection to suitable power sources, said sound reproducing unit being connected by said transmission line unit to said fixed unit, and said portable control unit containing means for the generation of high frequency control oscillations, means for determining the frequency of said oscillations, means for operating the relay control means within said fixed unit, means for controlling the input of said sound reproducing unit, and means for indicating the operation of said relay control means within said fixed unit.

6. A radio receiver having in combination a remotely located control oscillator and switching control, means for the substantially non-radiative transmission of the output of said control oscillator, means for the simultaneous collection of signals throughout a broad band of frequencies and the collection of at least part of the transmitted output of said control oscillator, means for the amplification of both signals and control oscillations, means for the detection of both signals and control oscillations so as to produce signals of frequencies differing from the frequencies of the component oscillations entering said detecting means, means for selecting a pre-determined differing frequency, means for adjusting the control oscillations so as to transfer the modulation of the desired signal to said pre-determined differing frequency, means for the amplification and demodulation of said pre-determined differing frequency, means for the amplification of the demodulations, substantially non-radiating means for transferring said amplified demodulations to a distant point, and sound reproducing means at this point, said control oscillator being located at a point distant from the previously mentioned collecting, detecting and amplifying means and including means for determining the connection of the radio receiver to its power supply and for determining its disconnection therefrom.

7. The method of selective radio reception controlled from a distance such as within the limits of an ordinary apartment which comprises collecting all available signals in the range of the receiver and within a pre-determined band of frequencies, constituting a plurality of signal channels, producing oscillations of a control frequency, transmitting the same a short distance over a substantially non-radiating and confining channel, collecting said oscillations, amplifying said oscillations and said signals, detecting said oscillations and said signals so as to produce signals of frequencies equal to the differences of frequency between said signals and said control oscillations, selecting one of said

produced frequencies, re-amplifying, demodulating it and further amplifying the demodulated resultants thereof.

8. The method of household selective radio reception by apparatus including a plurality of units, some portable and some fixed, which comprises collecting all available signals in the range of said apparatus within a pre-determined band of frequencies comprising a plurality of signal channels, producing oscillations at said portable units of a control frequency and transmitting the same a short distance in a substantially non-radiating manner, collecting said oscillations, adjusting the frequency of said control oscillations until the desired one of said produced frequencies has a pre-determined value, further amplifying said desired frequency and demodulating it and determining the connections of the stationary units to their power supply from said portable units.

WILSON AULL, JR.