June 4, 1935. A. S. BLATTERMAN 2,003,877

REMOTE CONTROL SYSTEM FOR RADIO BROADCAST RECEIVERS

Original Filed Aug. 15, 1930 2 Sheets-Sheet 1

Fig. 1.

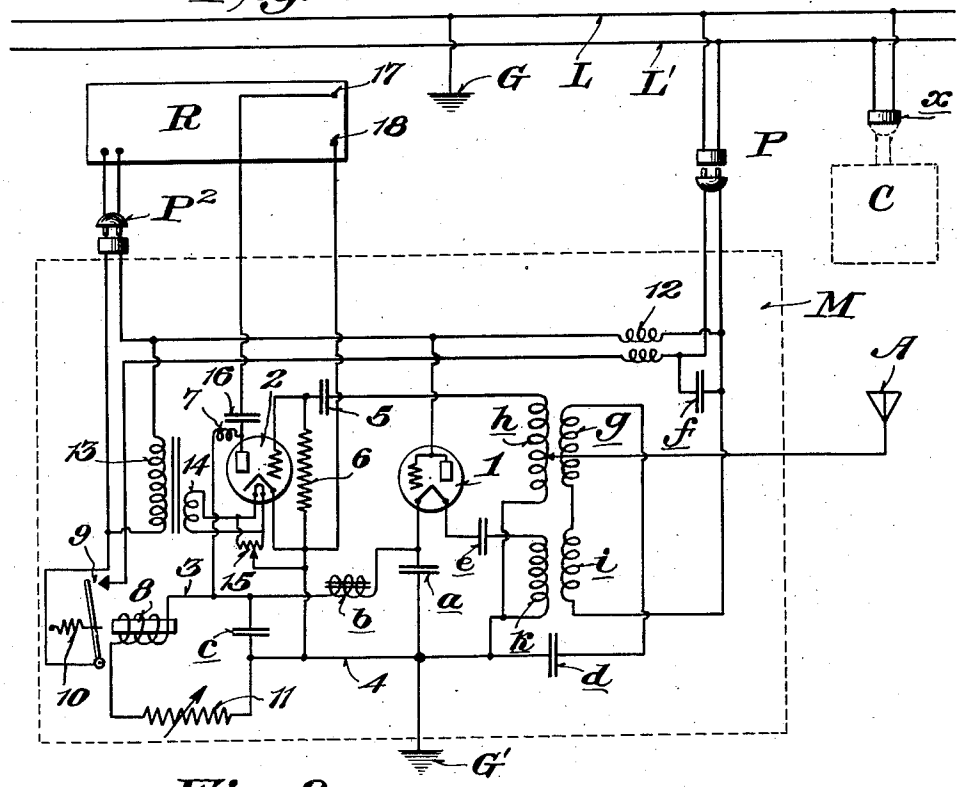
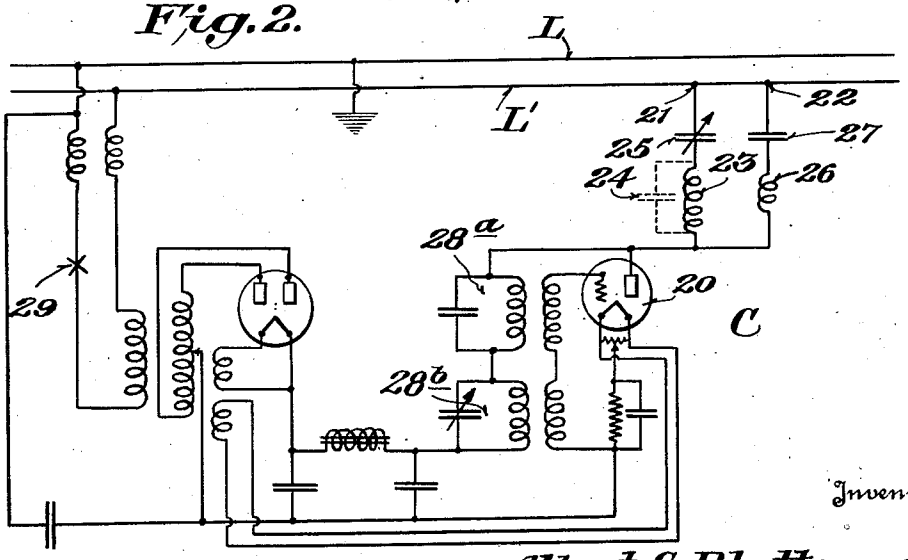


Fig. 2.



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Original Filed Aug. 15, 1930 2 Sheets-Sheet 2

Fig. 3.

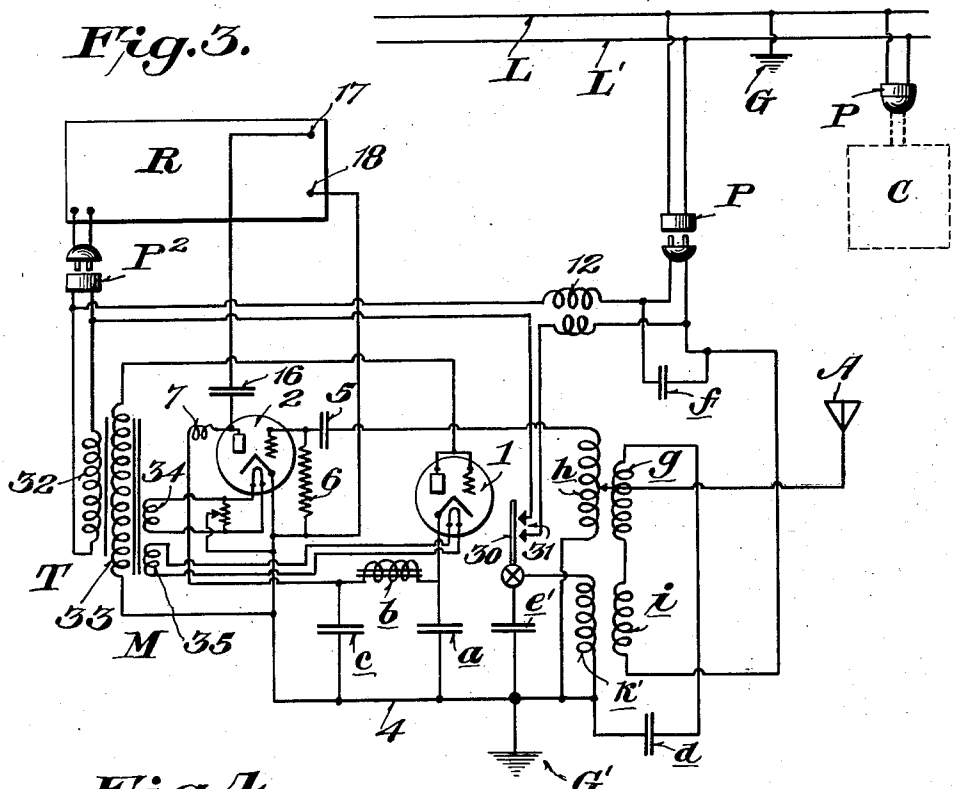


Fig. 4.

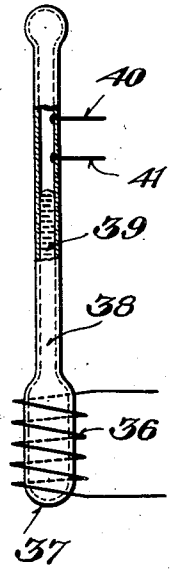
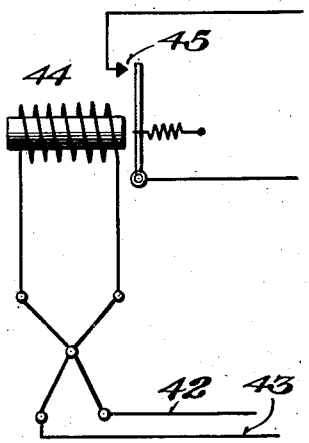


Fig. 5.



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Patented June 4, 1935

2,003,877

UNITED STATES PATENT OFFICE

2,003,877

REMOTE CONTROL SYSTEM FOR RADIO BROADCAST RECEIVERS

Albert S. Blatterman, Asbury Park, N. J.

Application August 15, 1930, Serial No. 475,524
Renewed November 16, 1934

13 Claims. (Cl. 250—20)

This invention relates to a system for the remote control operation of radio receivers of the type operated from house current without the use of auxiliary wires between the radio receiver and the remote control point and carries forward the basic and fundamental principles of my Patent No. 1,856,310 dated May 3, 1932.

One of the objects of the invention is to provide a method and means for tuning a given radio receiver of any type or character so as to reproduce radio telephone or telegraph signals of any wave length impinging upon its antenna system from a control point other than at the receiver; for regulating the strength of said signals as reproduced by the receiver from said control point, and then switching the receiver on or off from said control point, all without the mechanical movement of any of the tuning controls, volume controls, or switches with which the receiver may be provided, during the said remote control operation.

Another object of the invention is to provide a means for the complete remote control operation of a radio receiver whereby all of the power required for the said remote control operation of the receiver is supplied from the ordinary house lighting circuit, and the said remote control operation of the receiver is accomplished solely over the said electric light circuit.

With the above and other objects in view which will more readily appear as the nature of the invention is better understood, the same consists in the novel construction, combination and arrangement of parts hereinafter more fully described, illustrated and claimed.

A preferred and practical embodiment of the invention is illustrated in the accompanying drawings in which:—

Figure 1 is a diagrammatic view illustrating one embodiment of the invention.

Figure 2 is a diagrammatic view further illustrating the circuits involved.

Figure 3 is a diagrammatic view illustrating a modification of the circuit arrangement shown in Figure 1.

Figure 4 is a detail view illustrating one type of heat operated switching element; and

Figure 5 is a detail diagrammatic view illustrating a further type of switching element.

Similar reference characters designate corresponding parts throughout the several figures of the drawings.

The present invention involves the basic principles set forth in my copending application referred to but utilizes such principles in a different manner to accomplish the same results. In the present case, as in my former case, the difficulty of separately dealing with the three essential functions of complete remote control, viz., (1) tuning; (2) switching; (3) volume regulation due to the fact that in a single set of apparatus or single installation, the method and means provided for the accomplishment of one of these functions may seriously affect the successful accomplishment of one or both of the other functions, have been carefully considered, and the present invention also adequately provides for accomplishing all three of said functions of remote control operation.

My Patent No. 1,856,310, above referred to, involves a system wherein one or more vacuum tubes remains energized at all times in an auxiliary mixing box adjacent the radio receiver. According to the present embodiment of the invention, however, this circumstance is unnecessary, the said vacuum tubes being only energized during the period of remote control operation of the receiver.

Referring to the drawings, it will be observed from Figure 1 that the power required for the operation of the radio receiver R and the remote control means is obtained from the power lines L and L', the said lines being grounded as indicated at G. Since the present invention particularly concerns improvements in the so-called mixing box M, the circuits of this apparatus are shown in detail in Figure 1, and the point to which the remote control box C may be connected to the power lines is diagrammatically indicated at *x*.

Referring more particularly to the mixing box M it will be observed that the same includes in its organization a vacuum tube **1** and a second vacuum tube **2**. The vacuum tube **1** is a three electrode radio tube requiring relatively little power to operate its filament, and has its grid and plate electrodes connected together. This tube serves as a rectifier to furnish current to the plate circuit of the vacuum tube **2**, which current is smoothed out by the conventional filter system *a*, *b* and *c*, the lead wire **3** thereby assuming a steady positive potential with respect to the negative lead wire **4**. The condensers *a* and *c* are of large capacity, 1 or 2 microfarads or so, in accordance with the requirements of filtration and the rectification characteristic of the tube **1**. I have found that the present day commercial type "199" tube is suitable for use as the tube **1** since its filament heats very quickly and requires a maximum filament current of only 60 milliamperes

while for the tube 2, I have found the present day commercial type "227" with four elements well suited for the intended purpose, namely primarily that of detection as commonly understood in the art. This detector tube 2 is provided with a grid condenser 5 and a grid leak 6 in the conventional way. Its plate electrode receives direct current voltage through radio frequency choke coil 7 from the positive filter lead 3. Across the filter output, that is across the condenser *c*, between the positive lead 3, and the negative lead 4 is connected an electromagnetic relay 8 with armature contacts 9 held open by a tension spring 10, said relay being in series with a resistor 11 by means of which the magnitude of the current flowing through the relay windings may be adjusted to a suitable value under operating conditions. It will be seen that when the relay contacts 9 are closed, operating power is supplied from the light line L, L' through connection plug P and radio frequency choke coils 12 to the receiving set R and also simultaneously to the transformer comprising the primary winding 13 and secondary winding 14 which latter lights the filament of the detector tube 2. Resistance 15 across the filament of this tube is connected at its middle point to the cathode of the detector tube and to negative lead 4 in the usual way.

It will also be seen from Figure 1 that the filament of the rectifier tube 1 and the grid of the detector tube 2 are connected to a plurality of circuits and circuit elements including condensers *d*, *e* and *f* and coils *g*, *h*, *i*, *k* and through these coils by inductive couplings to the light lines L and L' by means of the plug and receptacle P. The coils referred to are designed to be responsive to currents of frequencies many times greater than that of the power or lighting system (assumed 25 to 60 cycles) and hence do not permit the passing of these low frequency currents either to the grid of detector tube 2 or the filament of rectifier tube 1. The entire system is connected to ground as at G' ordinarily used with the radio receiver.

At the remote control point C, I employ means to be hereinafter described which provide for the generation of currents of high frequencies. The frequency of one such current generated at the control point is fixed and predetermined and this current is used for switching the radio receiver on or off through its operation of the relay in the mixing box in a manner to be described. Currents of other high frequencies generated at the remote control point are utilized for the tuning and volume control of the radio receiver, generally in accordance with the system of remote tuning described in my aforesaid patent.

In accordance with the basic methods of my Patent No. 1,856,310, it will be seen that in the present invention I utilize the light lines as a single one-way or unilateral conductor for the high frequency control currents generated and impressed upon the lighting lines at the control point C and passed therefrom over the lines to the mixing box. This is done chiefly by utilizing the inherent capacity between the light lines themselves in conjunction with condenser *f* across the lines at the mixing box, condenser *d* and ground connection G', all as described and claimed in the patent referred to.

The said high frequency control currents entering the mixing box M through the plug and receptacle P reach the ground connection G' by passing through coils *g* and *i* in series and through condenser *d*. In passing through these coils the said high frequency currents induce high frequency voltages in their respectively associated coils *h* and *k*. The coil *k* is connected in series with the condenser *e*, the filament of the rectifier tube 1 and the larger filter condenser *a*; and the double capacity of this circuit is adjusted by means of the condenser *e* so that in combination with the inductance *k* this circuit is in tune or in resonance with the fixed predetermined frequency aforementioned as generated at the control point C for switching the radio receiver on or off. Since condensers *d* and *e* are relatively small (about 200 micro-microfarads or so), no current of power line frequency (such for instance as 60 cycle current as commonly used) passes through the filament of tube 1. However, when the high frequency switching current is impressed on the lines from the control point C, current of this latter high frequency does pass readily through said filament since the circuit of which said filament is a serial part is tuned, as just explained, to the high frequency used for the switching operation. This high frequency current causes the said filament to heat up, permitting the tube 1 to function as a rectifier for the power line (60 cycle) voltage through its plate-grid connection to said power line as shown and large condenser *a* to ground at G'. (Note that plug P must be properly poled as shown). Smooth d.-c. voltage is hereupon supplied through the filter system *a*, *b*, *c* to the plate of the detector tube 2 and to the relay circuits 8 and 11. The direct current thus produced through the relay causes its armature to be drawn up and its contacts to close, as will be clear from the drawings, and switches the line power (60 cycles) on to the radio receiver and simultaneously similarly energizes the transformer 13, 14 from the lines to light the filament of the detector tube 2. The radio receiver R and the detector tube 2 are both thus made ready to function, and will obviously remain turned on as long as the rectifier filament tube 1, remains lighted, that is as long as it receives high frequency current of the fixed predetermined switching frequency over the lines from the control point as described.

The grid of the detector tube 2 is connected as usual through its grid condenser 5, and then to coil *h* which returns to the cathode element of the tube as shown. Said coil *h* is made so as to be particularly responsive to both the frequencies which it may be desired to receive from the antenna A, and to the tuning frequencies arriving over the light lines L, L' from the control point c all as explained in my previously referred to patent. The coil *h* derives high frequency currents from the light lines by means of its inductively coupled primary coil *g*, and from the antenna signals by means of the connection of the antenna A to the said coil *h* at a suitable point along it as shown; and the combination of the antenna currents with the high frequency light line currents induced by the control box circuits acting on the grid or input circuit of the detector tube 2 produce beat frequency currents utilized in the tuning of the receiver, all as described in my aforesaid patent.

In the manner above described it will be understood that I rely upon the coil system *i*, to effect the switching process by lighting the filament of the rectifier tube 1 through the use of a preselected high frequency switching current from a control point *c* while I rely upon the coil system *g*, for tuning purposes through the use of frequencies of a different order of magnitude

from the fixed and predetermined switching frequency.

The rectified beat frequency tuning current here produced and described more in detail in my aforesaid patent is, as therein described passed to the radio receiver R through condenser **16** at the binding post **17** of the receiver ordinarily used for connection to the antenna and back to the cathode of the detector tube **2** and ground G' from the binding post **18** on the receiver ordinarily used for the ground connection.

In the operation of the system it will now be clear that the high frequency switching current from the remote control point C is passed over the light lines to the mixing box continuously and simultaneously with the high frequency tuning currents as long as it is desired to have the receiver in operation, and that upon turning off the control apparatus at C, or at least by turning off the high frequency switching current the filaments of all tubes in the receiver and the mixing box will be extinguished and the entire reception apparatus effectively turned off.

I have found that for the reception of broadcast programs of the usual American wave lengths, viz., 200 to 550 meters, a suitable switching frequency is one of either substantially longer wave length such as 2,000 meters or so, or of substantially shorter wave length such as 50 meters or so, it being necessary, of course, that this frequency differ considerably from the frequencies used for tuning in order to avoid squealing and interference.

As regards the circuits and apparatus used at the remote control point *c* these may be identical with similar circuits and apparatus described in my aforesaid patent with reference to the modification utilizing the generation of separate and different frequencies for switching and tuning, except in my present invention certain differences are to be noted regarding the coupling of the oscillating tube to the light lines. These will be understood by reference to Figure 2 of the drawings.

Referring now to Figure 2 the plate of the oscillating tube **20** is connected through two paths to the line at the points **21** and **22**. One of these paths contains choke coil **23** with its inherent self-capacity as shown in dotted lines at **24**, and a small variable condenser **25**. The other path contains choke coil **26** and fixed condenser **27**. Both of these paths to the line are subjected to high frequency voltages developed at the plate electrode of the oscillating tube, one such frequency being the previously mentioned fixed and predetermined frequency used for switching, and other frequencies of relatively different frequency than said switching frequency, and used for tuning in accordance with the method of beats hereinbefore referred to. By the design and structure of the elements of the two paths just referred to, these two sets of frequencies are constrained to separately follow one each of the two said paths. This is necessary for the reason that variation in the amplitude of the currents used for tuning is desired for the purpose of volume control, while a steady invariable current is required for switching through the lighting of the rectifier tube filament in the mixing box. I accomplish this in the following way:—

Referring to Figure 2, and assuming for example that the tuning frequencies are much higher than the switching frequency, the choke coil **26** of path **26—27** is designed to choke back the relatively high tuning frequencies but allow the relatively lower switching frequency to pass on to the line at point **22** through condenser **27**, while the larger choke coil **23** of path **23—24** is so designed as to choke back the lower frequency switching current, but by virtue of its inherent self-capacity **24**, allows the higher frequency tuning currents to pass to the line at point **21** through the small variable condenser **25** which is used for volume control as described in my previously referred to patent. The circuit **28a** containing inductance coil and fixed condenser generates the oscillating switching current. The circuit **28b** containing inductance coil and variable condenser generates the variable high frequency tuning currents. The switch **29** turns the control circuits on or off, since through it is supplied the operating power from the line. The remaining circuits and apparatus of this figure are identical in nature and use to the similar circuits of my former patent at this point of the system.

I shall now describe a second modification of the invention which also utilizes the heating effect of a high frequency switching current generated at the control point and passed over the light lines to the mixing box for the purpose of switching the radio receiver and auxiliary mixing box tubes on or off. The method of tuning and regulating the volume or strength of signal are the same. In this modification, however, instead of causing the said high frequency switching current to heat the filament of a rectifying vacuum tube, thereby making it operative as such, I cause said current to directly actuate a heat operated switch to turn the radio receiver and tubes in the mixing box on or off. Figure 3 shows the method, circuits, and apparatus used in this modification of my invention.

Referring particularly to Figure 3 it will be observed that the general circuit arrangement is substantially the same as that shown in Figure 1 with the exception that a switching device **30** is used, and the relay **8** of Figure 1 and its associated elements are not used.

The switching element **30** is connected in a circuit comprising the inductance *k'* and the condenser *e'* in series, said circuit being tuned to the switching frequency delivered to the same over the light lines from the control point. The element **30** is of such a character that it heats up by the passage of the high frequency switching current passing through it, and as a result of such heating causes the movement of an expansion element or the generation of another current within it, which expansion element or current is used to close the contacts **31**. Upon the closing of the contacts **31** line current power is supplied through said contacts to the radio receiver and to the transformer T having primary winding **32** and secondary windings **33**, **34** and **35**, the latter energizing the rectifier tube **1** and the detector tube **2**. In this way the closing or opening of the contacts **31** turn the entire apparatus on or off.

In the practical use of this modification of the invention, I have used various constructions of heat operated element **30**. Two examples of these elements are shown in Figures 4 and 5.

In Figure 4, the high frequency switching current from coil K' to condenser *e'*, Figure 3, passes through a coil **36**, said coil being made of an extremely fine resistance wire so that it heats up substantially when the said switching current passes through it. I have found that a coil of about 11 ohms resistance made of 0.0015 inch

diameter constantan wire is suitable. This coil is wound on an enlarged section 37 of a glass tube 38 containing a fine column of mercury 39 closely resembling an ordinary thermometer. Two contact wires 40 and 41 are sealed into this tube and lead to the power line, radio receiver, and transformer circuits of the mixing box, as do contacts 31 of Figure 3. When the coil 36 heats up by the passage through it of the aforesaid high frequency switching current, it in turn causes the heating of the mercury within the bulb 1 which it surrounds, causing expansion of said mercury and a rise of the mercury column 39 in the glass tube 38. When the column of mercury thus rises high enough to touch both the sealed contacts 40 and 41, the radio receiver and tubes of the mixing box will be turned on. Conversely when the high frequency switching current through the coil 67 is removed, the mercury column 39 falls due to the cooling off of the mercury in the bulb 37, thus opening contacts 40 and 41 and the radio receiver and tubes of the mixing box will be turned off.

Figure 5 illustrates a thermoelement of the usual type, having a resistance on the order of 50 or 100 ohms, through which the high frequency switching current passes over the wires 42 and 43, these wires being connected in series between coil K' and condenser e', Figure 3. The heating of the thermojunction due to this current causes the generation of a direct current, in a manner well known in the art, which direct current I utilize to actuate a sensitive electromagnetic relay 44 which closes or opens its armature contacts 45 (corresponding to contacts 31 of Figure 3) and thus turns the radio receiver and mixing box tubes on or off.

It will be understood that the heat operated element 30 must be insulated electrically from the contacts 31, a necessity which is met by the construction of the apparatus of both Figure 4 and Figure 5.

I desire to point out that in this invention as was also pointed out in my related invention described in my Patent No. 1,856,310, it is necessary to make sure that the mixing box detector tube as well as the receiver itself do not generate oscillations since if this occurs interfering squeals will be produced in the reception of signals of certain frequencies due to heterodyne interference between these oscillations and the oscillations generated at the remote control box. In practice I have found that there is very little, in fact practically no tendency toward this effect with the circuits and apparatus shown in this and my previously referred to patent.

It will of course be understood that I do not wish to limit myself to the particular detection methods, type of oscillating circuits, type of power supply and smoothing out or filtering, or to the type of coupling between the remote control oscillating circuits, and the light lines or the type of coupling between the light lines, antenna and mixing box circuit elements, the examples herein set forth being merely by way of illustration.

I claim:—

1. The method of controlling the energization and operation of a radio receiver over power lines with which said receiver is connected which consists in generating at a point on the power lines remote from said receiver high frequency oscillating currents, of a predetermined fixed frequency and also other relatively different variable frequencies, and then transmitting the said fixed and variable frequencies over the power lines to the said receiver for the purpose of turning the said receiver off or on and tuning and regulating the signals received on the said receiver.

2. The method of controlling the energization and operation of a radio receiver by utilizing the power lines with which the receiver is connected as a medium for the transmission of the control energy which consists in generating fixed and variable high frequency currents at a point along said power lines remote from the said receiver, and then transmitting said currents over the power lines to the receiver whereby the said fixed high frequency current will turn the receiver off or on and the said variable high frequency current will regulate the tuning of the signals on the receiver and control their strength or volume.

3. The method of controlling the energization and operation of a radio receiver over power lines with which said receiver is connected which consists in generating a fixed high frequency current at a point on said power lines remote from said receiver, and then transmitting said current over said power lines to a vacuum tube operated relay switch connected to control the power circuit of said receiver whereby the vacuum tube is rendered operative by causing its filament or heater electrode to be heated by the said high frequency current.

4. A system for controlling a radio receiver over the light or power lines to which said receiver is connected comprising in combination, a radio signal receiver included in circuit with the light lines for supplying power thereto, means for selecting the signals to be received by said signal receiver, switch means for connecting said signal receiver to said power lines for supplying power to said receiver, a remote control device connected to said power lines for controlling said selecting means over said lines and means included in said remote control device for generating a fixed predetermined high frequency current for controlling the operation of said switch means whereby the power supply of said receiver is controlled.

5. A system for controlling a signal amplifier and reproducer over the light or power lines to which said signal amplifier and reproducer are connected comprising in combination, a signal amplifier included in circuit with the light lines for supplying power thereto, means connected to the input circuit of said amplifier for selecting the signals to be amplified thereby, switch means for connecting said signal amplifier to said power lines for supplying power thereto, a remote control device for generating a variable high frequency current and for impressing said current on said power lines for controlling said selecting means over said lines, and means included in said remote control device for generating a fixed predetermined high frequency current for controlling the operation of said switch means whereby the power supply of said amplifier is controlled.

6. A system for controlling a radio receiver over the light or power lines to which said receiver is connected comprising in combination, a signal amplifier included in circuit with the light lines for supplying power thereto, means connected between the input circuit of said amplifier and said light lines for selecting the signals to be received by said signal amplifier, switch means for connecting said signal amplifier to said power lines for supplying power to said amplifier, a re-

mote control device connected to said power lines for controlling said selecting means over said lines, and means included in said remote control device for generating a fixed predetermined high frequency current for controlling the operation of said switch means whereby the power supply of said amplifier is controlled.

7. A system for controlling a radio receiver over the light or power lines to which said receiver is connected comprising in combination, a radio signal receiver included in circuit with the light lines for supplying power thereto, means including a detector tube for selecting the signals to be received by said signal receiver, a rectifier tube connected to said light lines for supplying power to said detector tube, switch means for connecting said signal receiver to said power lines for supplying power to said receiver, a remote control device connected to said power lines for controlling the operation of said selecting means over said power lines, and means in said remote control device for generating a fixed predetermined high frequency current for controlling the operation of said rectifier tube.

8. A system for controlling a signal amplifier and reproducer over the light or power lines to which said signal amplifier and reproducer are connected comprising in combination, a signal amplifier included in circuit with the light lines for supplying power thereto, means including a detector tube for selecting the signals to be amplified by said signal receiver, a rectifier tube connected to said light lines and the anode circuit of said detector tube for supplying power thereto, switch means for connecting said signal amplifier to said power lines for supplying power thereto, a remote control device connected to said power lines for controlling the operation of said selecting means over said power lines, and means in said remote control device for generating a fixed predetermined high frequency current for controlling the operation of said rectifier tube and said switch means.

9. A system for controlling a radio receiver over the light or power lines to which said receiver is connected comprising in combination, a signal amplifier included in circuit with the light lines for supplying power thereto, means including a detector tube connected between the input circuit of said amplifier and said light lines for selecting the signals to be received by said signal amplifier, a rectifier tube connected to said light lines for supplying power to said detector tube, switch means for connecting said signal amplifier to said power lines for supplying power to said receiver, a remote control device connected to said power lines for controlling the operation of said selecting means over said power lines, and means in said remote control device for generating a fixed predetermined high frequency current for controlling the operation of said rectifier tube.

10. A system for controlling a radio receiver over the light or power lines to which said receiver is connected comprising in combination, a radio signal receiver included in circuit with the light lines for supplying power thereto, means including a detector tube for selecting the signals to be reproduced by said signal receiver, a rectifier tube connected to said light lines for supplying anode current to said detector tube, switch means for connecting said signal receiver to said power lines for supplying power thereto, a remote control device connected to said power lines for generating a variable high frequency current, connections between the input circuit of said detector tube and said power lines whereby said variable high frequency current is transferred from said remote control device to the input circuit of said detector tube for selecting the signals to be reproduced by said signal receiver, and means in said remote control device for generating a fixed predetermined high frequency current for controlling the operation of said rectifier tube and said switch means.

11. A system for controlling a radio receiver over the light or power lines to which said receiver is connected comprising in combination, a radio signal receiver including a radio frequency amplifier, detector, audio frequency amplifier and sound reproducer connected to be energized from the light lines, means including a detector tube for selecting the signals to be reproduced by said signal receiver, a rectifier tube connected to said light lines for supplying anode current to said detector tube, switch means for connecting said signal receiver to said power lines for supplying power thereto, a remote control device connected to said power lines for generating a variable high frequency current, connections between the input circuit of said detector tube and said power lines whereby said variable high frequency current is transferred from said remote control device to the input circuit of said detector tube for selecting the signal to be reproduced by said signal receiver, and means in said remote control device for generating a fixed predetermined high frequency current for controlling the operation of said rectifier tube and said switch means.

12. A system for controlling a signal amplifier and reproducer over the light or power lines to which said amplifier and reproducer are connected comprising in combination, a signal amplifier and reproducer included in circuit with the light lines for supplying power thereto, means including a detector tube for selecting the signals to be amplified and reproduced by said amplifier and reproducer, a rectifier tube connected to said light lines for supplying anode current to said detector tube, switch means for connecting said signal amplifier and reproducer to said power lines for supplying power thereto, a remote control device connected to said power lines for generating a variable high frequency current, connections between the input circuit of said detector tube and said power lines whereby said variable high frequency current is transferred from said remote control device to the input circuit of said detector tube for selecting the signal to be amplified and reproduced by said signal amplifier and reproducer, and means in said remote control device for generating a fixed predetermined high frequency current for controlling the operation of said rectifier tube and said switch means.

13. A system for controlling a radio receiver over the light or power lines to which said receiver is connected, comprising in combination, a radio signal receiver included in circuit with the light lines for supplying power thereto, a detector tube included in the input circuit of said signal receiver, a rectifier tube connected to said light lines and said detector tube for supplying anode current thereto, a relay connected to control the energization of certain ones of the power circuits of said signal receiver, connections between the winding of said relay and said rectifier tube whereby said relay is controlled in accordance with the energization of said rectifier tube, a remote control device connected to

said light lines at a point remote from said signal receiver, means included in said remote control device for generating a variable high frequency current and for impressing said current upon said light lines, means connected to said detector for receiving said variable high frequency current from said light lines and heterodyning said current with signal currents desired to be received, means included in said remote control device for generating a fixed frequency current and for impressing this current upon the circuit of said light lines, and means connected to said rectifier tube for receiving said fixed frequency current whereby the operation of said rectifier tube is controlled in accordance with said fixed frequency current.

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