May 3, 1932. A. S. BLATTERMAN 1,856,310

REMOTE CONTROL SYSTEM FOR RADIORECEIVERS

Filed March 31, 1930 4 Sheets-Sheet 1

Fig. 1.

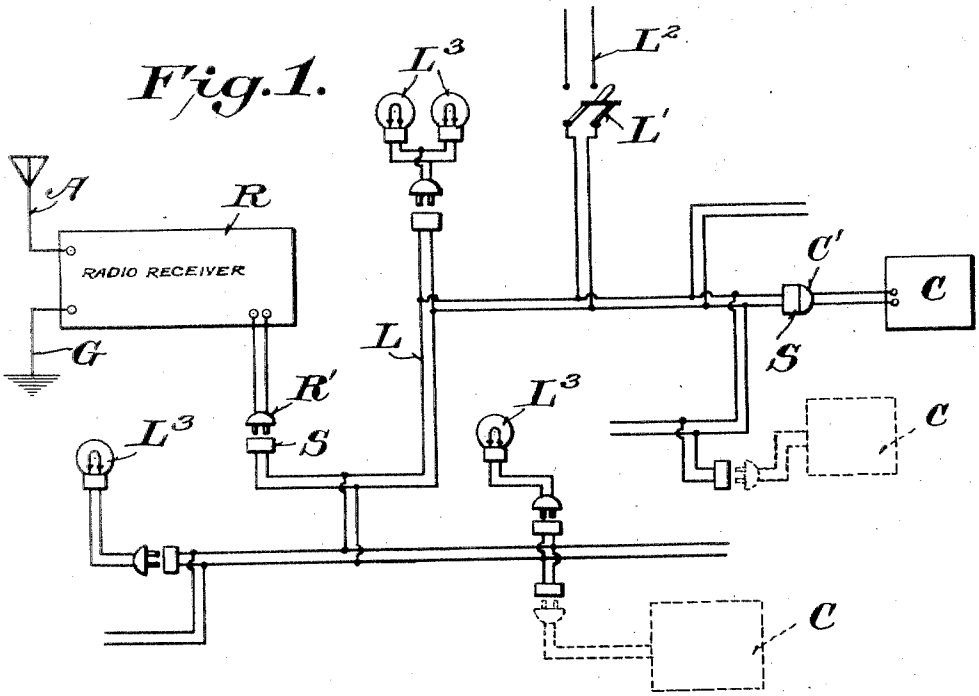
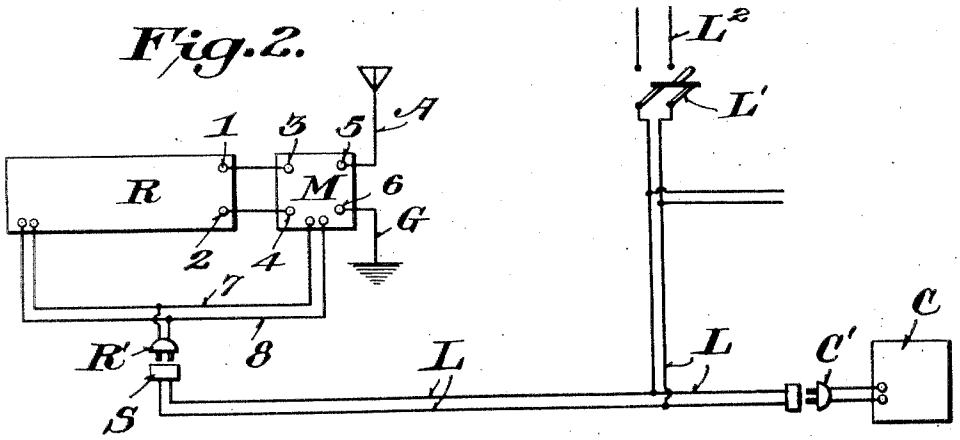


Fig. 2.



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REMOTE CONTROL SYSTEM FOR RADIORECEIVERS

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Fig. 3.

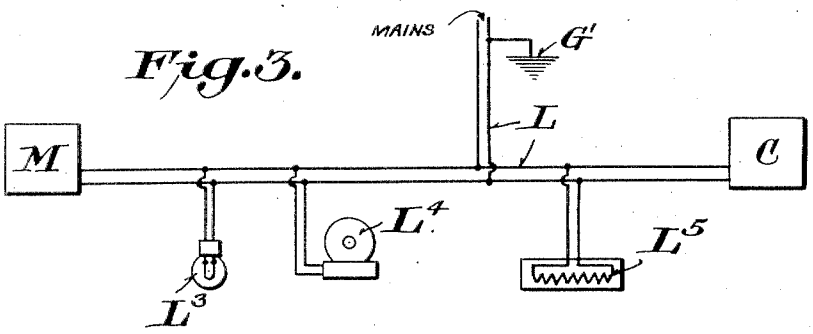


Fig. 3a

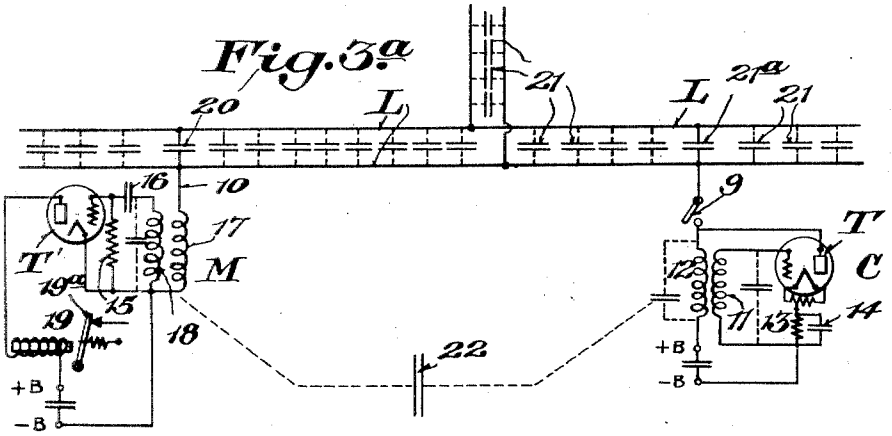
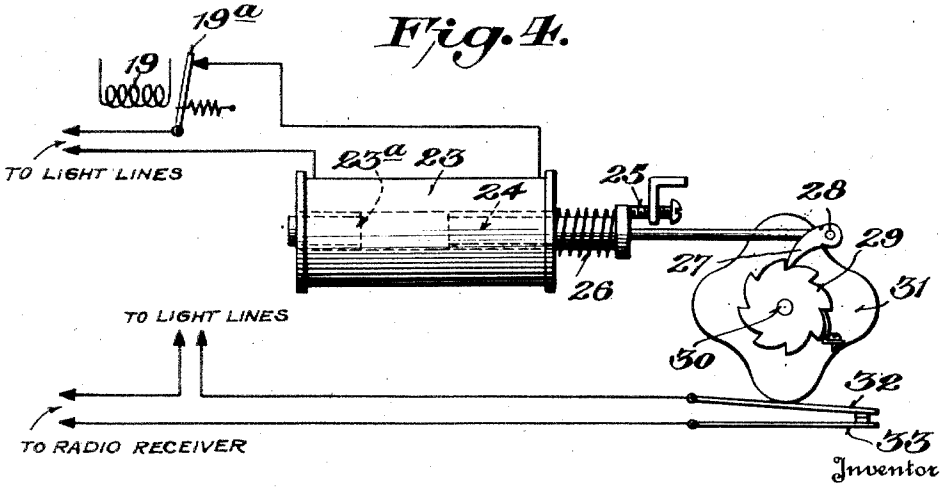


Fig. 4.



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REMOTE CONTROL SYSTEM FOR RADIORECEIVERS

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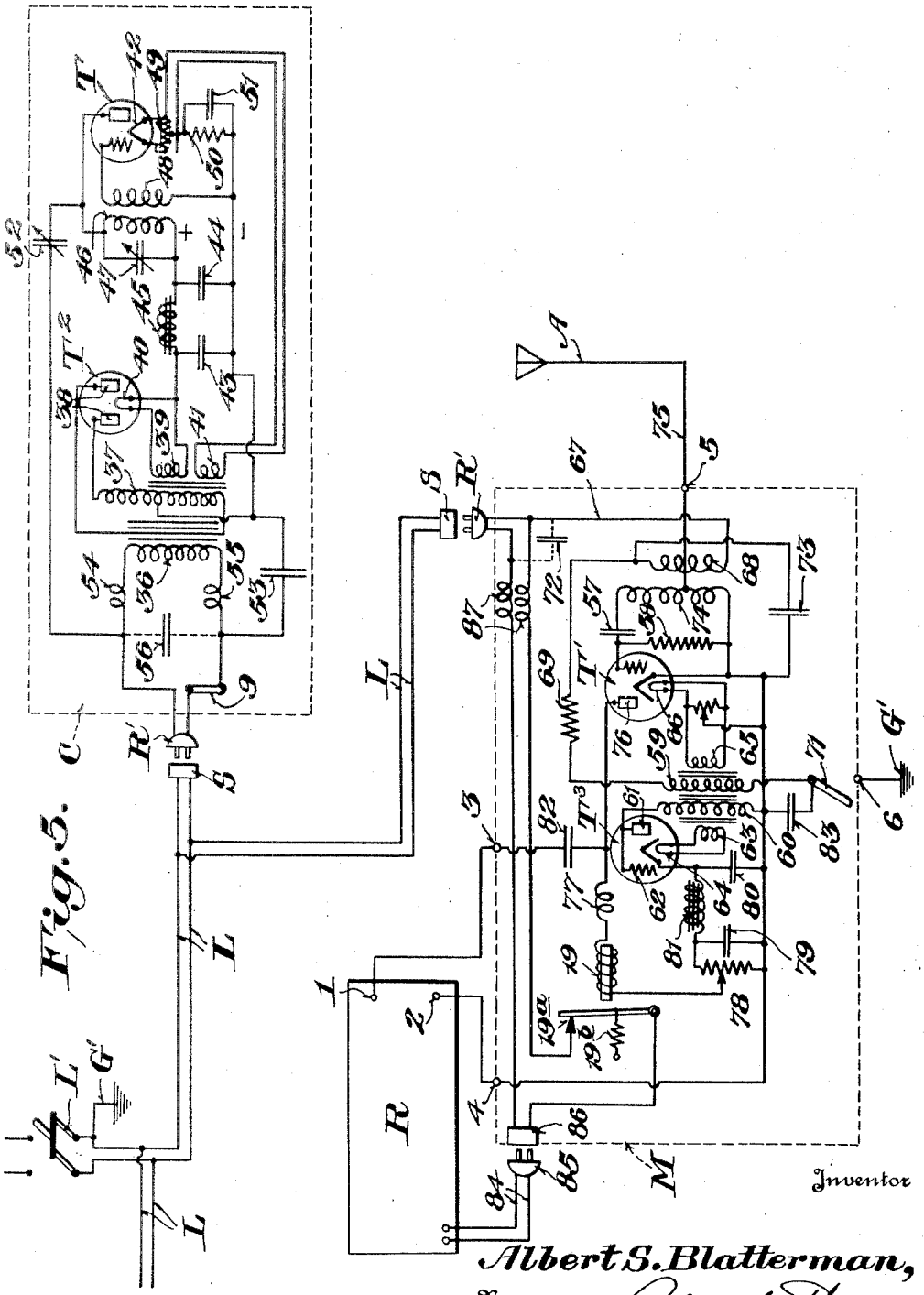


Fig. 5.

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REMOTE CONTROL SYSTEM FOR RADIORECEIVERS

Filed March 31, 1930 4 Sheets-Sheet 4

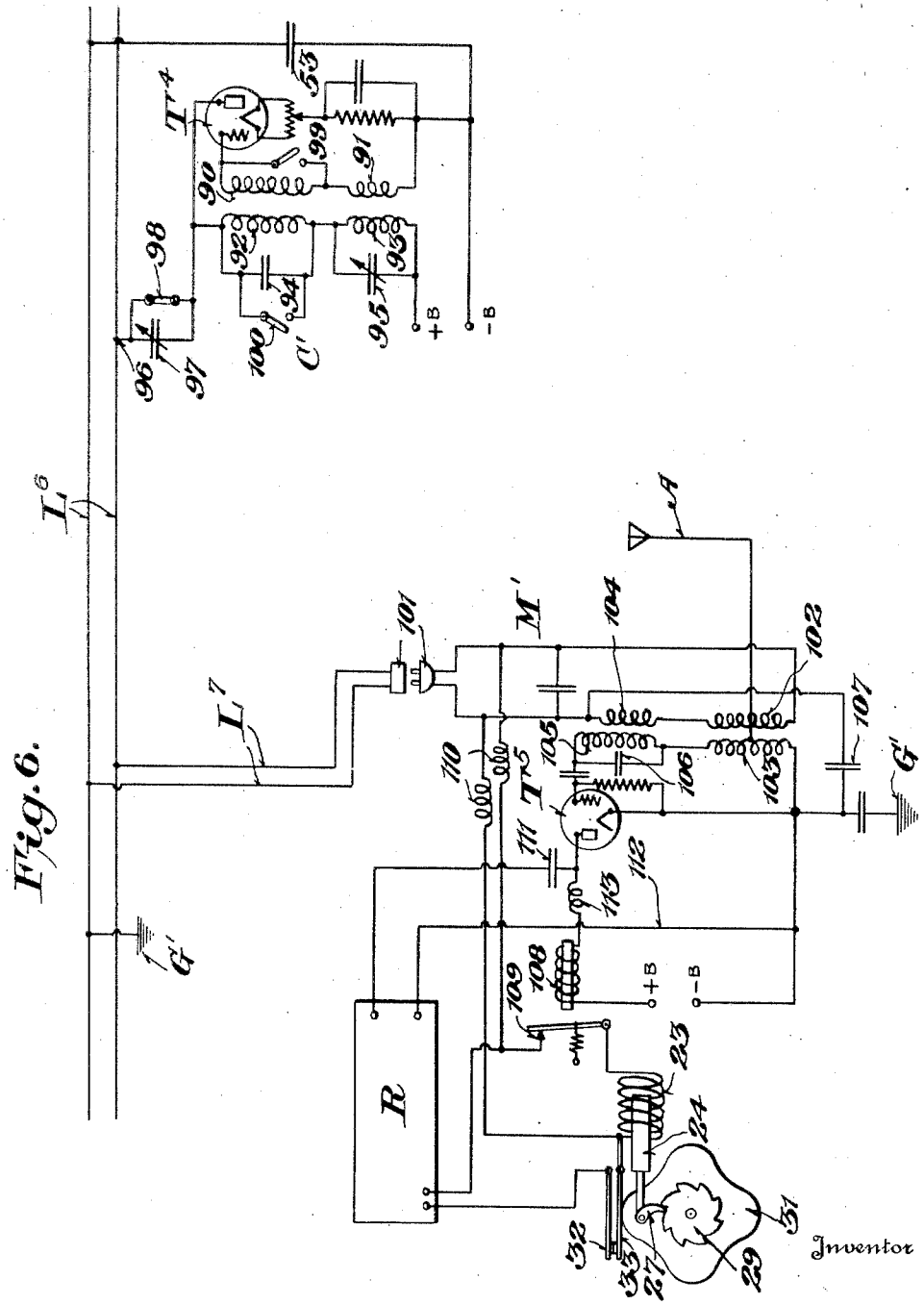


Fig. 6.

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UNITED STATES PATENT OFFICE

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REMOTE CONTROL SYSTEM FOR RADIORECEIVERS

Application filed March 31, 1930. Serial No. 440,594.

This invention relates to a system for the remote control operation of radio receivers without the use of auxiliary wires between the radio receiver and the remote control point.

A primary object of the invention is to provide a novel system of remote control operation of broadcast receivers furnished with power from the usual house service lighting lines, without in any way altering the receiving set itself, thus rendering the invention adaptable for use in connection with any standard light socket power operated receiving set. That is to say, the operator of the set can, without in any way altering or changing the mechanical or electrical construction of the receiver operate the same from any point in the house or building whose service lines supply power for operating the vacuum tubes. In that connection the invention provides means by which radio signals which it may be desired to reproduce through the usual radio receiving set can be "tuned in" from a point other than at the set and without manipulating the tuning apparatus of the set or mechanically operating the tuning apparatus.

More specifically the invention provides a system for the remote control tuning of a radio receiver to any wave length, even though the wave length be outside the normal wave length range of the receiver.

Another object of the invention is to provide a method and means for regulating the signal strength or so-called volume of the signals reproduced on the receiving set from a point remote from the set itself.

A further object of the invention is to provide a method and means by which the radio receiver may be turned "on" or "off" from the remote control point without manual operation of the "on" and "off" switch of the set.

A still further and general object of the invention is to provide a method and means by which the remote control operation of the radio receiver may be accomplished by the use of the power available in the electric light or power lines which furnish current to the usual service outlets.

With the foregoing and other objects in view, the invention consists in the novel features of construction, combination and arrangement of parts as will be hereinafter more fully described, illustrated in the accompanying drawings and defined in the appended claims.

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

Figure 1 is a diagram illustrating the essential elements and purpose of the invention.

Figure 2 is a view diagrammatically illustrating a standard broadcast receiver and the remote control means associated therewith.

Figure 3 is a view illustrating diagrammatically one expedient utilized for the purpose of avoiding the undesirable effects of the usual ground connections in house lighting circuits which will permit the proper functioning of the present remote control means.

Figure 3*a* illustrates diagrammatically the apparatus contained within the mixing box and the remote control box and an expedient utilized for the purpose of avoiding the undesirable effects of the usual lamps and other appliances commonly connected to the house lighting circuits.

Figure 4 is a view illustrating a form of mechanical relay or switch which may be used in the mixing box for opening and closing the circuit to the radio receiver.

Figure 5 is a diagrammatic view fully illustrating in diagrammatic form the apparatus and circuit involved in the practice of the present invention.

Figure 6 is a diagrammatic view illustrating a modificatoin of the apparatus and circuits shown in Fig. 5.

Before proceeding to a detailed description of the functioning of the various parts of the apparatus comprising the present remote control system, reference will first be made, by way of explanation, to the theory and principles involved.

Referring to Figure 1, the usual radio receiver which may be of any standard type receiving power from alternating house cur-

rent service lines is designated as R having the usual antenna connection A and ground connection G. The receiver R is adapted to be connected in the conventional manner by a cord and plug R′ with a service outlet S of the power lines L of the house lighting circuit which are connected in the usual manner through the switch L′ with the main power lines L^2 which supply the usual current to the house for lighting the lamps L^3 or other devices which may be connected in the usual manner with the service lines L for house service. In other words, Figure 1 of the drawings illustrates diagrammatically a building lighting circuit having a plurality of outlets or service plugs, to one of which the radio receiver is connected for the purpose of receiving power.

According to the present invention, when it is desired to operate the radio receiver R from a distant point, as for example another room in the house, the control unit C having a cord and plug connection is adapted to be "plugged in" any of the service outlets or plugs so that the turning on and off of the radio receiver R as well as its tuning may be effected at will by the operator of unit C at any point in the house.

Thus, it would be apparent that the present invention contemplates no other connection between the remote control unit C and the radio receiver R, than that incidentally afforded by the connection of both the set and the remote control unit to the common electric lighting circuit, and whereby the radio receiver may be turned "on" or "off", and may be caused to reproduce radio signals of any wave length arriving on its antenna and also the operator may regulate the volume or strength of such signals, at will, from the remote control point.

Heretofore it has been necessary to use special auxiliary connecting wires between the remote control unit and the receiver for the purpose of (1) switching on and off, (2) tuning, and (3) the regulation of signal strength. This arrangement, however, requires that the radio receiver be specially built, or at least partially rebuilt in order to permit of the use of the remote control feature of operation. Furthermore, the present so-called remote control systems permit of the remote control reception of only a certain few predetermined or preselected transmitting stations and all other systems fail in providing an exact tuning of the radio receiver by remote control because such tuning is obtained by mechanical means in which there is always lost motion, friction and wear of the moving parts.

According to the present invention, however, since there are no auxiliary connecting wires between the remote control unit and the receiver, the latter does not have to be rebuilt, or especially built, but on the contrary may be a receiver of any standard or conventional design while the tuning is exact and continuous through all wave lengths not depending on the mechanical movement of the tuning apparatus of the receiver in any way.

As previously stated, there are three functions of complete remote control operation of a radio receiver, viz, (1) tuning the receiver, (2) regulating the strength of the signal, and (3) switching the receiver on and off.

Method of tuning

Referring first to the principle utilized in the present invention for performing the remote control tuning function, it may be pointed out that this is accomplished by a unique use of the well-known phenomenon of beats produced by two different frequencies of electric vibration being simultaneously impressed on a given circuit. A general understanding of the manner in which this is accomplished according to the present invention may be had by reference to Figure 2 wherein the receiving set R, is shown as being connected to conductor cord and plug R′ with the electric light line service outlet S. The receiver R is as usual, provided with the antenna binding post 1 and the ground binding post 2. These binding posts are connected to a small auxiliary apparatus box designated generally as M at the binding posts 3 and 4, the antenna A and the ground G being removed from the radio set and connected to a pair of binding posts 5 and 6 on the box M. The auxiliary apparatus box M is also connected to the service lines L by means of the wires 7 and 8. The remote control unit C is also connected to the house lighting circuit L by means of its two-conductor cord and standard plug C′.

The remote control unit C contains a high frequency oscillating vacuum tube to be later referred to more in detail. The frequency of oscillation of this tube is controllable or adjustable by means of a variable condenser or inductance operated by a knob or dial on the control box. The power required for the operation of the oscillating tube is drawn from the electric light line to which the remote control box is connected, as heretofore stated. The high frequency energy generated by the said oscillating tube in the control box C is impressed, in a way to be described later, upon the electric light lines through their cord connected to the control box.

I have discovered that the electric light lines referred to herein have certain electrical characteristics, and it will be sufficient at this point to say that I have found that, with proper circuit arrangements, also to be described more in detail later, the high frequency energy impressed upon the lines by the oscillating tube in the control box will travel over the lines to all points in the house

and thus reach the auxiliary apparatus box M through its line cord 7—8.

At the same time, the apparatus box M will have impressed upon it the high frequency energy of the incoming radio waves impinging upon the antenna-ground system A—G. Thus the radio wave frequency, arriving from the antenna, and the remote control box frequency arriving over the electric light lines, may be superposed one upon the other in the auxiliary apparatus box M. If these two frequencies are thus superposed in a suitable way, one secures the well known phenomenon of electrical beats, the beat frequency being equal to the difference between the two independent superposed frequencies. Thus, if a radio telephone or telegraph program or massage impinges upon the antenna A and has a frequency of say 1,000,000 cycles per second, it will pass into the auxiliary apparatus box M. Then if the remote control box frequency at C is adjusted to 1,500,000 cycles the beat frequency at M will be 1,500,000 minus 1,000,000 or 500,000 cycles. On the other hand, if the remote control box frequency fed to M over the light lines is, say, 1,800,000 cycles, then the beat frequency will be 1,800,000 minus 1,000,000 cycles, the latter being the frequency arriving over the antenna A, or 800,000 cycles. By changing the frequency generated at the remote control point C, therefore, any signal frequency coming in on the antenna A can be changed in the apparatus box M to some other frequency equal to the difference between the antenna signal frequency and the control box frequency.

Now if the difference frequency or beat frequency is one to which the radio receiver R is responsive, the said beat frequently will be amplified by the receiver which is connected to the box M, and the antenna signal now changed to a different frequency, will be reproduced by the receiver through its loud speaker or other indicating device. The box M will be hereinafter referred to as the "mixing box" because at least one of its functions is to mix the antenna signal frequency with the light line control box frequency to produce a beat frequency of suitable value for amplication by the radio receiving set.

If the receiving set R is once tuned to a certain wave length (or frequency) and left fixed at that tuning point, any signal arriving on the antenna can be caused to be amplified and reproduced by the radio set by simply adjusting the remote control frequency to a value such that the difference between it and the antenna signal frequency produces a beat frequency equal to the frequency to which the radio receiver has been left tuned. Thus, all signals arriving on the antenna may be tuned automatically from the remote control point so as to be reproduced on the receiver itself by manipulation of the variable condenser or inductance in the remote control box which regulates the frequency generated therein. As this condenser is rotated, one station after the other is heard on the radio set. The tuning is exact since it is electrically accomplished rather than mechanically. In the practical application of the above described method of remote control tuning, there is a precautionary measure which must be taken and this is most important when the signals which it is desired to receive are on closely adjacent wave lengths or frequencies and occupy a relatively wide band of wave lengths. This is the condition that exists in the reception of usual American broadcast programs which at present utilize ninety-seven different frequencies for transmission spaced 10,000 cycles apart from 1,500,000 cycles to 540,000 cycles. The precaution referred to is that the receiving set itself must not be left tuned for the purpose of remote control operation at or near to a frequency which it may be desired to receive. For example, if the receiver is left tuned to a frequency of 750,000 cycles, then a 750,000 cycle broadcasting station signal will be passed directly through the mixing box M, Figure 2, and be amplified by the receiver. At the same time, the beat frequency produced by adjustment of the remote control box frequency to a value suitable for receiving this frequency would be the same as the station frequency itself, viz. 750,000 cycles, and there will therefore be interference between the beat frequency and the direct antenna signal frequency which will be manifested by sqeals and howls on the receiver as this particular 750,000 cycle transmitting station is being tuned in by manipulation of the remote control box frequency changing element.

Therefore, the receiver R must be tuned and left tuned to a frequency either above the broadcast range or else below it.

A further precaution that must be taken in practice is to either design the circuits of the oscillating tube in the remote control box C in such a way as to provide an oscillating current in the light lines of pure sine wave form devoid of harmonics, or on the other hand utilize the entire automatic electrical beat tuning principle in such a way that if the remote control box C does generate harmonic frequencies of its fundamental oscillation that these harmonics will not produce beat frequencies with any other antenna signal equal to that frequency to which the radio receiving set has been left tuned. For, obviously, if this occurs two or more signals or programs would be heard at the same time, one being the beat frequency of the control box tube's fundamental against the frequency of one station on the antenna, and others resulting from the production of the same beat frequency through the intermixing of the harmonics from the control box with stations using higher frequencies.

I have discovered, however, as regards the reception of broadcast programs (200 to 550 meters wave length) wherein the problem as above stated, is particularly difficult on account of the relatively wide band of frequencies employed and their close spacing, that this possibility of harmonic interference with its consequent reception of more than one program at the same time is avoidable. This circumstance arises out of the fact that for the usual American broadcast reception, the ratio of the highest frequency required from the control box C to the lowest frequency so required is substantially less than two; and further that broadcasting receivers are commonly designed to be responsive or tunable to frequencies slightly below and slightly above the extreme frequencies employed for broadcast transmission.

In applying the tuning feature of the invention to the reception of wave lengths commonly used for broadcast transmissions, viz. 200 to 550 meters, I am able to use any ordinary broadcast receiver without making any change therein whatever. In fact, such receivers are ideally suited for the application of the methods of my invention, since, as just stated, they are tunable to frequencies slightly above or slightly below the spectrum of broadcast frequencies. Thus, a typical receiver primarily designed to operate on wave lengths from 200 meters up to 550 meters will be found to tune to 200 meters at for instance "10" on the dial or dials and to 550 meters at say "95" on the dial or dials. This leaves from "0" to "10" at the lower end of the dial scale and "95" to "100" at the upper end of the scale in which regions no broadcasting is normally heard. In using such a receiver, according to the methods of the present invention, therefore, the operator tunes his receiver either to a dial setting at the top of the scale, for instance, "100" or to the bottom of the scale, for example "0" since at neither of these settings will he hear broadcast signals direct from the antenna through the mixing box M, Figure 2. The frequency to which he thus tunes his receiver will be the beat frequency that will be employed in the remote control tuning operation as above described.

For example, suppose the dial or dials of the receiver are turned to the extreme top of the scale, viz. 100. The receiver then may be tuned to say 600 meters or 500,000 cycles which is 60,000 cycles below the longest broadcast wave length used. In order to tune in the longest broadcast wave length used that is, a 540,000 cycle station by the remote control method of my invention, the operator merely rotates the variable condenser in the control box C, Figure 2, until the frequency generated by the oscillating tube in the control box is 1,040,000 cycles. The beat frequency then produced will be 1,040,000 cycles minus the station frequency of 540,000 cycles or 500,000 cycles which is the frequency to which the receiver has already been tuned. If it is desired to tune in a station of 400 meters wave length equivalent to 750,000 cycles, this station will be heard on the receiver when the remote control box frequency is adjusted to generate a frequency of 1,250,000 cycles whereby the beat frequency produced is again 500,000 cycles which will, of course, be amplified by the receiver since the latter is still tuned to these 500,000 cycles at "100" on its dial. Similarly if it is desired to hear a 200 meter station (1,500,000 cycles) which is the shortest wave length commonly used for broadcasting in this country, the remote control frequency is set to 2,000,000 cycles and again the beat frequency will be 2,000,000 minus 1,500,000 or 500,000.

Therefore, it will be noted that for broadcast reception, as above described, the control box circuits need only be designed to produce frequencies from 1,040,000 up to 2,000,000 cycles, a ratio less than 2 to 1. This condition prevents the previously mentioned difficulty of multiple program reception which may arise from harmonics generated in the remote control unit, since the first harmonic of the latter has twice the frequency of the fundamental and the next harmonic three times the frequency of the fundamental whereas, as just shown, 1,040,000 is the lowest control box fundamental required and its first harmonic, namely 2,080,000 cycles is 80,000 above the highest control box frequency needed and cannot produce a beat frequency of 500,000 cycles to which the radio receiver is left tuned with any broadcast station since these only use frequencies up to 1,500,000 which extereme frequency would produce a beat of 580,000 cycles with the control box harmonic just referred to and this will not pass through the receiver.

If the receiver dials are turned down to "0" instead of up to "100" then the receiver will be tuned below the broadcast range, say to 1,600,000 cycles, and the control box frequencies required to cover the broadcast band will range from 3,100,000 to hear a 200 meter (1,500,000 cycle) program up to 2,140,000 to hear the longest wave stations using a transmitting frequency of 540,000 cycles. This again is a variation in control box frequency of less than two to one so that harmonic interference is easily avoided.

A unique feature of the method of electrical tuning of the receiver R according to the present invention, is that radio telephone and telegraph stations may be received even though these stations are transmitting on frequencies far different from those for which the receiver that is being employed is primarily designed. Thus, if an ordinary broadcast receiver suitable for from 200 to 550 meter

reception is uesd, its wave length range may be extended to practically any degree without making any changes in it if the present method of remote control tuning is employed. All that is required is to arrange the remote control tuning circuits of the oscillating tube at C to cover the wider band of frequencies. That is, a 50 meter station (6,000,000 cycles) can be heard on the regular receiver if the control box frequency is adjusted to say 6,500,000 cycles because the beat frequency would then be 500,000 cycles which corresponds to the receiver tuning when its dials are set at "100" on the scale or scales.

The same principle obviously applies to the reception of longer wave stations such as 2,000 or 3,000 meters. When thus extending the range of frequency reception, due consideration must be taken of the possible interference difficulties hereinbefore described. The prevention of such interference will be readily accomplished by any one skilled in the art through an understanding of the causes of such interference as hereinabove explained.

Method of regulating signal strength or volume

Referring now in a general way to the feature of the invention which deals with the regulation of signal strength or volume, this is accomplished by the simple expedient of regulating the intensity of the oscillations impressed upon the electric light lines at the remote control point.

If the oscillating energy from the remote control box C is strong, the beat frequency produced in the mixing box M by the combination of the control box frequency with the antenna signal frequency will be of large amplitude and produce loud response through the radio receiver, whereas, if the oscillation delivered from the control box to the lighting lines is weak, the beat frequency produced in the mixing box will be correspondingly weak and hence the signal strength from the radio set diminished.

The regulation of the amplitude of oscillations impressed upon the lines from the remote control box may be accomplished in various ways which will be described later in detail.

Method of switching receiver on and off

The third function of the remote control operation namely that of switching the radio receiver on or off, necessarily involves more or less difficult problems since there are no connecting wires between the remote control point and the radio receiver other than the wires of the house lighting circuit. However, it is very desirable to use these light lines for the purpose of remote control because in the first place they are already installed in the house and, therefore, make for simplicity and convenience, and secondly by confining all of the operating and control currents within these wires it is possible to prevent disturbances in radio receivers in other houses in the neighborhood or in other apartments in the same apartment building. The practical handicaps to remote control switching of the radio receiver under these conditions are as follows:—

I. The most important circumstance is that switching actually requires the throwing of a switch. This requires many times the power required for the beat frequency tuning even though a very delicate relay with movable armature is employed to open and close the circuit. The tuning principle described can be effectively utilized with a few hundredths of a volt delivered from the control box to the mixing box because the tuning phenomenon is entirely electrical in character whereas the operation of a relay switch which is a mechanical device with weight and friction may require several hundred times as much voltage.

II. It is not difficult to send enough power over the two light wires from the control box C to the mixing box M when there are no lights or other electrical appliances connected across the lines but when lamps as at nighttime, or when electric refrigerators, oil burners, electric stoves, etc. are turned on they are in fact connected between the two lighting or power lines in the house and constitute a virtual short circuit on the line to any current which one might ordinarily attempt to send over the lines from the control box C. This short circuiting effect ordinarily would prevent the delivery of enough power from the remote control unit C to the radio receiver R and the mixing box M to accomplish the desired switching. It is necessary, therefore, to employ methods and means which will accomplish the switching of the radio set without any effect from the turning on or off of lamps or other electrical devices in the house.

III. The fact that the electric light lines are grounded in nearly every building in accordance with the fire underwriter's requirements also presents difficulties from the switching standpoint because such ground connections may also produce short circuiting effects when certain arrangements for remote switching are attempted.

According to the present invention, one of the methods and means for overcoming the difficulties to be noted may be explained by reference to Figures 3 and 3*a* of the drawings.

By reference to Figure 3 it will be observed that the remote control box C and the mixing box M are shown as being connected with the various house service lines L which include various branch circuits for lamps, motors, etc. across them, the lamps being des-

ignated as L^3, the motor as L^4 and an electric stove or the like being designated as L^5. The grounding on the electric circuit system is shown at G', such grounding generally existing at the main switch and service meter of all buildings. In Figure 3*a* I have shown diagrammatically certain apparatus that is contained within the mixing box and the remote control box which apparatus is connected to the electric light lines L at 9 and 10. At the remote control point, that is, within the remote control box C, there is shown an oscillating vacuum tube T associated with circuits comprising a grid inductance 11 inductively coupled to plate inductance 12 and with bias resistor 13 by-passed as usual by the condenser 14. The tube T is supplied with power for its filament and plate circuits from the light lines according to methods well known in the art. At the point where the radio set and mixing box M are located I employ and have shown in Figure 3*a* a vacuum tube detector T' with its conventional grid-leak 15 and condenser 16. The grid-leak condenser vacuum tube method of detection is used because it is one of the most sensitive known methods of detection. The detector tube T' is connected on its grid or input side to the electric light line L as indicated at 10 through a transformer having a primary winding 17 and a secondary winding 18. In the plate circuit of the detector there is shown a relay 19. The filament and plate power required for operating the detector is supplied from the electric light lines in accordance with known methods. The plate current of the detector tube will pass through the windings of the relay 19 whose armature will therefore be subjected to an attracting magnetic force whose value depends upon the magnitude of the detector tube plate current.

Now in the method of remote switching which is illustrated in Figure 3*a*, the circuits of the remote control oscillating tube T are so designed that oscillating current is generated having a certain predetermined and fixed frequency and the circuit of the detector tube T' in the mixing box M is designed to be resonant with the frequency generated in the remote control box C. Thus the circuits of the control box C are in tune with those of the mixing box and if these two tuned circuits are coupled together, current oscillating in the control box circuit will readily produce a similar oscillating current in the mixing box M. I have discovered that by a proper choice of frequency and with certain circuit arrangements to be described more in detail later, the coupling just referred to between the control box circuit and the mixing box may be suitably provided by the lighting circuit itself to which both the control unit and the mixing box are connected and I provide this coupling in such a way that the two wires of the lighting circuit are made to act substantially as a single conductor. The entire switching system thus comprises essentially an oscillating circuit having so-called unilateral connection to a distant resonant circuit responsive to it through the unilateral connection provided. The two lighting wires L—L are caused to act as a single conductor for the control frequencies used by means of the condensers 20 and 21*a*, Figure 3*a*, connected across them, these condensers being located respectively in the mixing box and in the remote control box. The inherent capacity indicated at 21 between the lines also contributes to this effect, especially if the wires are closed together as in the "BX" type house wire or run for considerable distances in the house, since both proximity of the two wires to each other and a great length of double conductor conspire to increase the inherent line to line capacity referred to.

It will now be clear that lamps or other electrical appliances connected across the lines thereby causing more or less of a short circuiting effect between the lines as already explained, will produce no deleterious effect whatever upon the oscillating current passing over the lines from the control box, since these two lines now act as a single conductor for the high frequencies used for the remote control operation. Another concomitant feature of importance in thus utilizing both sides of the line as a single one-way conductor resides in the fact that through the condition described two wires are virtually placed in parallel to carry the control current. This reduces the resistance of the unilateral connection as well as its inductance, which circumstances, in lines commonly met with in practice contribute to lessen the attenuation of the control currents and hence to the development of greater voltage delivered from the control box over the line to the mixing box detector tube T'.

Of course, physically there cannot be a transfer of energy from the oscillating control tube to the mixing box over one wire alone. There must be a return circuit. In the present invention this return circuit is provided, at least in part by the stray capacity between the two sets of apparatus. This capacity is indicated at 22 in Figure 3*a* and arises through the proximity of both the apparatus at the control point and the radio set and associated mixing box to other wires in the building, steam or water pipes, walls, floors, gas pipes, etc. It may be increased, if desired, by the use of small condensers connected between the circuits of the mixing box and the water pipe or other ground connection regularly used at the radio set.

With the switch 9 at the remote control box open no oscillating voltage is impressed on the light lines and the plate current in the de-

tector tube T′ of the mixing box M is relatively large, for example three milliamperes. Now when the switch 9 at the remote control point is closed, an oscillating voltage is impressed on the light lines, and hence upon the circuits of the detector tube which will respond readily to this oscillation since they will have been previously designed to be resonant to the switching frequency used. Immediately this happens, the detector tube plate current is reduced in accordance with well known laws of such detector action. In practical designs of apparatus embodying my invention, the plate current drops from about three milliamperes to 0.2 or 0.3 milliamperes. If the spring on the armature of relay 19 is adjusted so that a current of say 1.5 or 2.0 milliamperes will cause the armature to be drawn up against the pole face of the relay magnet, then before the switching voltage comes on and the plate current is three milliamperes the relay contacts 19*a* will be open; but when the switching voltage is applied and the detector plate current drops to say 0.3 milliamperes the magnet of the relay will release the relay armature whose spring will cause the contacts 19*a* to close. Thus, the contacts 19 may be used to turn the radio set on or off.

In using the particular method of switching and tuning so far described, it will now be understood that the radio set will remain turned on as long as the relay contacts 19*a* in the mixing box are closed and that this requires the oscillating switching voltage from the control box to be continuously impressed on the line as long as it is desired to tune and operate the set from the control point. The necessity thus arising of simultaneously impressing the switching frequency on the lines together with the various frequencies required for tuning sometimes causes difficulties, some of which are a serious overloading of the detector tube in the mixing box by the strong switching frequency, the presence of harmonics in the switching frequency oscillation which may cause interference with the tuning frequencies, and the fact that since the switching frequency and the tuning frequencies are both simultaneously being transmitted and received with the same apparatus, difficulties of circuit design are encountered. None of these difficulties are insurmountable, however, as apparatus already built and operated has shown. Nevertheless, I have found it generally more satisfactory, when using a selected fixed switching frequency as hereinbefore described, to impress this frequency momentarily on the line to switch the radio set on and then impress it on the line again for an instant to switch the set off. Inasmuch as impressing the switching frequency on the line always causes the relay contacts to close and thereby turn the set on, an auxiliary device must be used at the mixing box which will operate by the closing of the relay contacts 19*a* in such a way that successive closures of these contacts will successively turn the radio set on and off. Such an auxiliary device is diagrammatically illustrated in Figure 4.

Referring to Figure 4, the relay windings 19 and relay contacts 19*a* are shown in connection with an electromagnet 23 having a movable iron core plunger 24 held back against the stop 25 by the compressed spiral spring 26. The pawl 27 hinged at 28 operates the ratchet 29 which is fixed to a shaft 30 which is also fixed to a cam 31. This cam operates to open and close the spring contacts 32 and 33. When the relay contacts 19*a* are closed the electromagnet 23 is energized from the lighting lines causing the plunger 24 to be drawn into the magnet against the stop 23*a*. In this movement of the plunger it will be seen that the pawl 27 turns the ratchet 29 and the cam 31 ⅛ of a revolution and thus operates the contacts 32 and 33. When the relay contacts 19*a* are open, the spring 26 pushes the plunger 24 and pawl 27 back to their original positions leaving the ratchet and cam, however, and hence the contacts 32 and 33 in the position they took up on the forward stroke of the plunger. Thus, successive forward strokes of the plunger caused by successive closures of the relay contacts 19*a* results in the alternate opening and closing of the contacts 32 and 33 which, as will be apparent from the drawings, results in alternately turning the radio receiver off and on. Briefly, therefore, successive closures of the remote control box switch 9 successively impresses the switching oscillation on the lines, successively causing the relay contacts 19*a* to close which in turn successively causes forward strokes of the plunger in the electromagnetically operated switch with its attendant pawl-ratchet cam operation on the main contacts 32 and 33 for turning the radio set alternately on and off.

While the foregoing method of remote control switching has been found to be entirely practical and feasible, an alternative method possessing the advantage of great simplicity will now be described. In practice I have found that it is not quite so universally usable as the method just described, but I have discovered that for all ordinary homes or even rather large ones, or for apartments, the characteristics of the lighting lines in the building are sufficiently near alike and have such electrical properties that this alternative method of switching is almost universally practical. When using it in very large factory buildings difficulty is sometimes experienced on account of the great length of the wiring circuits or the use of two or three phase supply systems or three wire systems with grounded center. In such cases the previously described switching sys-

tem is better because the switching oscillation current sent over the lines is more powerful than in the system about to be described and, furthermore, the frequency can and will be selected to be such as to avoid absorption in the long lines due to resonance effects therein.

In the alternative method of switching now to be described generally, the circuits of the mixing box and those of the remote control box are designed to be substantially responsive to the same degree to all the frequencies to be generated in the control box for the purpose of tuning. This design is carried out with due regard to the electrical characteristics of the average house lighting system. Prior to making a more detailed description of this method of switching it may be pointed out that a relay is used in the plate circuit of a detector tube as previously described but no special or preselected or particular frequency is used for switching. The switching is accomplished by the high frequency tuning currents themselves when they pass over the lines from the control box to the mixing box at the receiver. The moment the control box is put in operation as by turning on the current from the light line, this tube begins to oscillate, and by the use of suitable circuits these oscillations are immediately impressed upon the light line, and, no matter what their frequency, are impressed with substantially equal magnitude upon the detector in the mixing box causing the relay contacts therein to close. This in turn instantly connects the radio set to the line so that it begins to operate. On account of the fact that the design is such that the detector circuits are substantially equally responsive to all the tuning frequencies sent over the line from the remote control box, the relay contacts referred to remain closed and hence the radio set is turned on throughout all the tuning operations conducted at the remote control point by adjusting the frequencies required for the reception of various stations.

Having now described in a general way the various elements of the apparatus and method employed in the invention to accomplish, (1) remote tuning of a radio receiver; (2) remote controlling of volume; (3) remote control switching of a radio set, the methods and means by which these various objects are consolidated into practical and useful form will be described.

Figure 5 shows one practical form of the invention in detail, the same embodying the alternative method of switching and tuning last described.

The remote control box C is shown in dotted lines and contains the remote control circuits and apparatus while the radio receiver is diagrammatically indicated at R and the mixing box and its enclosed apparatus are indicated at M. The house lighting lines L are shown as being respectively connected with the remote control box C and the mixing box M, and as previously described the house lighting line L shown at the left hand side of the switch L′ may run to various other branch circuits in the house. One side of the line is shown grounded as indicated at G′ which is in accordance with standard fire underwriter's requirements.

Referring first to the apparatus contained within the remote control box C, it is pointed out that the same includes the vacuum tubes T and T^2, the first of which is arranged to generate high frequency oscillations, and the second of which functions as a rectifier tube to supply rectified alternating current to energize the plate circuit of the tube T. The power required to operate both of these tubes (in this case assumed to be alternating current) is obtained from the light lines L through the receptacle S and plug R′. The switch 9 serves to turn the current on or off in the remote control box. The line current passes through the transformer comprising the primary winding 36, energizing the secondary winding 37 which energizes the plates 38 of the rectifier tube T^2. Another secondary winding 39 energizes the filament 40 of the tube T^2, and a still further secondary winding 41 energizes the filament 42 of the oscillating tube T. The condensers 43 and 44 together with an iron core choke coil 45 constitute a filter system to smooth out the rectified current from tube T^2 so that the plate current supplied to the oscillator tube T will be substantially non-fluctuating. The circuit of the tube T comprises an inductance coil 46 with associated variable condenser 47 by the adjustment of which the frequency of oscillation of the tube is varied. The coil 46 is inductively coupled to the grid coil 48 to provide the proper feed-back for producing oscillation. The resistor 49 is tapped at its center and connected as shown and in the conventional way to the bias resistor 50 and by-pass condenser 51. The oscillating energy in the circuit consisting of the coil 46 and condenser 47 is fed over into the light line circuit through the small adjustable or variable condenser 52 and also through the relatively larger fixed condenser 53. The air core choke coils 54 and 55 prevent the radio frequency oscillating currents fed over into the light line from entering the transformer primary 36. The fixed condenser 56 is not always required, but in certain cases is advantageous to at least partially remove high frequency polarity effects at the plug R′. The amount of oscillating energy fed into the light lines depends upon the value of capacity used in the condenser 52. This condenser, therefore, serves as a volume control, reducing the volume when its capacity is decreased and raising the volume

when its capacity is increased. An additional control of volume is secured by slight adjustments of the variable condenser 47 since this changes the beat frequency at the mixing box to a value slightly away from the frequency to which the receiver is left tuned.

Referring to the mixing box M it will be observed that the same contains the vacuum tube T′ previously referred to which functions as a detector and a second vacuum tube T^3 which functions as a rectifier. The detector tube T′ is provided with a grid condenser 57 and a grid leak 58. Both of these tubes, in the illustration shown, are standard three electrode tubes such as the present day standard "227" type detector tubes which are well suited to the purpose they serve from the standpoint of rectifying ability, detection, sensitivity and freedom from alternating current hum. These tubes are furnished with power for the operation of their plate and filament circuits from the light lines L (here assumed to be carrying commercial alternating current) through the receptacle S and plug R′. The power is supplied through a transformer comprising a primary winding 59, and secondary winding 60 furnishing power to the jointly connected plate 61 and grid 62 of the rectifier tube T^3 which serves to supply rectified alternating current to the plate circuit of the detector tube T′; another secondary winding 63 furnishes power to light the filament 64 of the rectifier tube, and another secondary 65 furnishes power to light the filament 66 of the detector tube T′. Thus, it will be seen that the light circuit current passing through the primary winding 59 of the transformer just mentioned flows from only one wire 67 coming to the mixing box from the plug R′, thence through coil 68 to and through the automatic voltage regulator 69 and the primary winding 59 of the transformer. After passing through the primary of the transformer the current then passes to the binding post 6 on the mixing box assuming, of course, the switch 71 is closed, and then passes to ground G′ which is customarily a steam or water pipe. The current then passes through the electric system ground G′—G′, Figure 5, the latter ground being located at the main house switch L′ and thereby completing the circuit to the other side of the line. This circuit arrangement is a feature involving the unilateral connection hereinbefore referred to in connection with the transmission of oscillating high frequency currents from the control box to the mixing box. It provides a path of low impedance for the light line low frequency current but, except for the portion of the circuit comprising the copper line conductors L between the plug R′ on the control apparatus C and the plug R′ at the mixing box, it provides a path of very high impedance for the high oscillation frequencies generated in the control box which upon their arrival at the mixing box are thus prevented from shorting themselves to ground. They reach the coil 68 in the mixing box over the line conductors L acting jointly as a single conductor as hereinbefore explained, the latter effect being enhanced by use of the condenser 72 in the mixing box to increase the capacity between these lines. They then return to the control box circuits partly by virtue of stray capacity as previously explained but more particularly by passing through the coil 68, thence through the condenser 73, thence to the mixing box ground G′ and back to the control box circuits through the light circuit ground G′ at the switch L′ and the light line circuits L.

In thus passing through the coil 68, the high frequency currents from the control box induce a voltage in the coil 74 which is inductively coupled to the coil 68, and thus actuate the grid of the detector tube. The design of the coils 68 and 74, together with the adjustment of the capacity 73, must be given special attention depending upon the range of frequencies to which it is desired to have the mixing box circuits responsive. Thus for the remote control operation of this system to cover the usual broadcast range of 200 to 550 meters, I construct the coil 68 by winding sixty-five turns of #32 gauge wire on a one and one-eighth inch diameter bakelite tube, and I place the coil 74 inside this tube. I wind the coil 74 on a ¾″ diameter rubber rod in which are turned nine grooves spaced 5/64″ apart each groove containing eighty turns of #34 gauge wire. The antenna connection 75 is tapped into this coil 74, as shown, at its center turn. In connection with this coil system and the other circuit elements which have been used in practical forms of the apparatus for broadcast reception, the size of the condenser 73 has been found to be best at a capacity of 250 micro-microfarads.

The plate 76 of the detector tube T′ is connected, as shown, to the radio frequency choke coil 77, thence to the relay magnet winding 19, and thence to a point on the resistor 78 from which point a suitable value of direct current voltage is taken to operate the plate of the detector tube and relay. The condensers 79 and 80 in combination with the iron core choke coil 81 comprises a filter for smoothing out the rectified alternating current impulses delivered from the rectifier tube T^3 all according to present day practice in the art. It will be seen that the plate of the detector tube is also connected to a condenser 82, which from the binding post 3 on the mixing box leads to the binding post 1 on the radio set R, this binding post 1 being the post ordinarily used for connecting the antenna A to the set. The ground binding post 2 of the radio set R connects to the binding post

4 on the mixing box which in turn leads back to the cathode of the detector tube T′ in the mixing box and to ground G′ through the fixed condenser 83. The power supply cord 84 customarily attached to the radio set and ordinarily plugged into a wall socket or other socket on the electric light system of the house is here plugged into the mixing box by means of the plug connector 85 and receptacle 86. The only connection to the electric light system, therefore, is through the mixing box plug R′, the power circuit to the radio set running from this point through the two radio frequency choke coils 87 and then through the relay contacts 19*a* which are held closed by the spring 19*b* unless sufficient detector tube (T′) plate current flows through the relay windings to pull the armature of the relay up and thus open the contacts at 19*a*, and hence open the power supply to the set, turning it off.

As previously stated, the coils 68 and 74 and the condenser 73 must be proportioned with some care and due regard to the various radio frequencies that are to be handled in the entire radio system. In this respect the aim of the constructor or designer will be to so arrange the coils and condenser referred to that substantially equal radio frequency voltages will be impressed upon the grid of the detector tube T′ for all of the frequencies generated in the remote control box as well as all the frequencies which it is desired to receive from the antenna A. It will be clear to those skilled in the art that this result will also be effected to some extent by suitable design of the oscillating circuits and the couplings in the control box.

Operation of system

In practice the mixing box M is placed at a convenient location adjacent or near to the radio set R and the power cord 84—85 is plugged into the receptacle 86 of the mixing box. The antenna binding post 1 of the set is connected to the binding post 3 of the mixing box, and the ground binding post 2 of the receiving set is connected to the binding post 4 of the mixing box. The plug R′ of the mixing box is then plugged into the socket or outlet convenient to the radio set and the mixing box is then ready to function in connection with the control box C. The control box C is then carried to any point in the house or building and its plug R′ plugged into any convenient socket or outlet. Thus the control box C may be moved from point to point in the house or building for controlling the radio receiver R from any desired point over the light lines L.

When the mixing box M is connected with the receiving set R in the manner referred to, the power switch on the set itself is turned on and the switch 71 in the mixing box is closed. The latter immediately supplies light line power to the tubes T′ and T³. (The mixing box plug R′ must be properly poled by trial. That is, if the tubes T′ and T³ do not light up when switch 71 is closed the plug R′ must be reversed.) As these tubes heat up to operating temperature, the plate current of the detector tube T′ flowing through relay magnet winding 19, will attract the relay armature and break the relay contacts at 19*a* so that the radio set is turned off.

The tuning dial or dials on the radio set are tuned or turned to some suitable setting such as "100" or to zero scale reading. The receiver is left at this setting. The remote control unit C may now, as previously indicated, be plugged into any socket in the house, and by turning the switch 9 of the control box the circuit from the plug R′ is closed to the rectifier tube T². This starts the delivery of the plate current to the tube T and the latter starts to oscillate. The oscillating current thus produced passes over into the light line through condenser 52, arrives at the mixing box through plug R′ and in passing through coil 68 induces a voltage in coil 74 which is impressed upon the grid of the detector tube T′. Immediately this happens, the plate current of the detector drops, and since this current passes through the relay windings 19, the relay is de-energized permitting the spring 19*b* to pull the relay armature back and close the contacts at 19*a*. These contacts in closing complete the power line circuit to the radio set, thus turning the latter on. Since the coil system 68, 74 and condenser 73 are so designed as to be responsive to all frequencies generated in the control box, the radio set will remain turned on as long as the remote control unit is in operation.

At all times signals are arriving on the antenna A but they are made audible on the receiver only when the frequency generated in the remote control box is such that the difference between this frequency and an antenna signal frequency produces a beat or different frequency equal to that to which the radio set has previously been left tuned. The frequency of the remote control unit oscillation is, of course, regulated by the variable condenser 47 therein so that manipulation of this condenser results in the tuning in of various stations on the receiver all as hereinbefore explained.

When the remote control unit is turned off by means of its line switch 9, the plate current of the detector tube T′ in the mixing box M and hence the relay current increases promptly to its normal value, breaking the relay contacts 19*a* which turns the radio set "off".

In the practical operation of this system there is delivered to the mixing box M from the remote control box C an oscillating volt-

age many times greater than that produced in the mixing box by an incoming signal from the antenna. This has the effect of sensitizing the detector in the mixing box and permits tube and relay adjustments to be made therein which will not permit the turning on or off of the radio set by the lesser energy of the antenna signal alone. Loud crashes of static will occasionally cause the relay contacts to open or close but this effect is sporadic and of momentary duration so that the effects produced are no more deleterious to the operation of the radio set than are commonly experienced under heavy static conditions. I have found that the sensitiveness of the entire receiving equipment to weak signals is not impaired by the interposition of the mixing box between the set and the antenna when using the present remote control system of operation. I have also found that the selectivity of the receiving system is not impaired. The reasons for these two circumstances will be clear to those skilled in the art from an understanding of the method of operation of the system as described. The practical form of the circuits and apparatus herein described is especially typified by its simplicity, ruggedness, ease of manufacture, use and portability.

The detector tube T′ in the mixing box M serves not only to operate the relay but also rectifies the combined antenna signal current and remote control light line tuning currents to produce the beat frequency current hereinbefore referred to, which beat frequency current is passed to the radio receiver through the condenser 82 since it is prevented from passing through the relay circuit by the high frequency choke coil 77.

A modification of the invention is shown in Figure 6 of the drawings. The form of invention shown in this figure involves the use of a selected, fixed, and predetermined frequency generated at the control box and used for the switching of the radio receiver on or off, in combination with the use of other high frequency currents also generated at the control box and used for the tuning of the receiver. Referring to Figure 6, it is pointed out that only the essential elements of the invention are shown. That is to say, such conventional elements, accessory thereto, such as power transformers, rectifiers, filters, etc. for energizing the essential elements are for sake of clearness, omitted, since such accessory elements are similar to those shown in Figure 5 and fully described in connection therewith.

The circuit and apparatus elements of the remote control box are indicated generally at C′, and those of the mixing box are designated generally at M′ while the radio receiver is designated at R. The control box C′ contains an oscillating vacuum tube T^4 with grid circuit coils 90 and 91 in series and inductively coupled respectively to the plate circuit coils 92 and 93 thus providing the necessary feed-back for producing or generating oscillations. The coil 92 is shunted by a fixed condenser 94 and the coil 93 is shunted by the variable condenser 95. The plate voltage required for the oscillation of the tube is conventionally supplied at the points "+B" and "−B" and the filament of the tube is also lighted in the conventional way. The tube T^4 is used to generate various frequencies. One such frequency is determined by the constants of the circuit comprising the condenser 94, coil 92, and coil 90. This frequency is selected and produced by suitable design of said circuits for the purpose of switching the radio receiver R on or off. Other frequencies are generated by the same tube T^4 by means of the associated circuits comprising variable condenser 95, coil 93 and coil 91. Such latter frequencies are used for tuning the radio receiver in accordance with the principles heretofore described. The entire apparatus at the control point is connected to the electric light circuit L^6, the point of connection involved in the operation of the control box elements here under discussion being shown at 96 through the small variable volume control condenser 97 and switch 98. Besides the switch 98, there are two other switches 99 and 100 located in the circuits as shown. All three of these switches are mounted on a single shaft so that they operate simultaneously. The arrangement is such, however, that switches 99 and 100 open when the switch 98 closes. It will be seen that when switches 99 and 100 are closed (and hence switch 98 opens) the tube T^4 in combination with the circuit elements 91, 93 and 95 generates high frequency currents suitable for carrying on the tuning of the receiver and regulating its volume through condenser 97, and that the circuits comprising the elements 90, 92 and 94 will not then be oscillating because they are short circuited by the switches 99 and 100. When the last mentioned switches are opened, however, and switch 98 closed, the short circuits are removed from the circuits of 90, 92 and 94, and they will generate the particular frequency for which they are designed, which frequency will be impressed directly on the light line through the switch 98 which now shorts out the small variable condenser 97. Thus, the switching frequency current can be momentarily thrown on the light line and then withdrawn by momentarily throwing the switches refered to and as long as the control box tube T^4 is in operation, the high frequency tuning currents will be generated by the tube and the elements 91, 93 and 95 during the intervals between the switching operations, and impressed upon the line through the condenser 97.

The mixing box M′ contains the detector

tube T^5 and other elements as described in connection with Figure 5. All the high frequency currents generated in the control box, including both the switching current and the tuning currents, are delivered to the mixing box through the receptacle and plug 101 by the one-way or unilateral operation of the interconnecting light lines L^6 and L^7 as hereinabove explained. In this method of using the invention, however, the input circuits to the grid of the detector tube in the mixing box are differently arranged. As shown, these circuits now comprise the inductively coupled coils 102 and 103, both respectively connected in series with the inductively coupled coils 104 and 105. By suitable design all these coil systems, in connection with the capacities 106 and 107, in accordance with known principles and methods, are made resonant or tuned, definitely to the frequency generated in the control box for the purpose of switching the radio receiver on or off, while the coil system 102, 103 is made responsive to all frequencies which are picked up on the antenna A or which are generated in the control box for the purpose of tuning. The switching frequency is selected to be different from any of the last mentioned antenna or tuning frequencies. It will now be seen that when the switching frequency is impressed on the line at the control box in the manner previously explained, the circuits 104 and 105 at the mixing box being tuned to this switching frequency will respond with great strength and strongly affect the detector tube T^5 in the control box, causing a sharp and pronounced decrease in its plate current which flows through the relay 108 thus allowing its contacts to close. The closure of these relay contacts 109 energizes the solenoid plunger magnet 23—24 from the light line source at 101 through high frequency choke coils 110 as shown, which in turn operates the pawl-ratchet-cam device 27—29—31 in the manner described in connection with Figure 4, and hence turns the radio set on or off as will be obvious from the drawings.

On the other hand, when the switching current from the control box is removed from the light line by the switching operation at that point hereinabove described, the tuning currents then generated at the control point and passed over the light lines to the mixing box will affect the circuits 102—103 and produce the beat frequency tuning phenomenon previously described, said heat frequency being passed to the radio receiver for amplification and/or detection and reproduction through the condenser 111 and back to the detector tube T^5 through the wire connection 112. The choke coil 113 prevents high frequency currents from passing through the relay windings and forces them to pass to the radio receiver.

In the operation of this modification of the invention, therefore, the switching frequency current is caused to be generated and impressed on the lines for a moment by means of the triple switch 98—99—100 at the control box, thus operating the relay 108 which in turn operates the plunger magnet switch 23—24 and switches the radio set on. Tuning of the radio receiver is then accomplished by adjusting the variable condenser 95 in the control box which varies the tuning frequencies delivered over the lines to the mixing box. The radio receiver may then be turned off by again impressing the switching frequency from the control box upon the lines by manipulation of the triple switch 98—99—100.

While the attached drawings and the above description have referred generally to the use of commercial alternating current house light or power service, it will be understood that the novel features of the invention are not at all restricted to alternating current supply systems, but are equally useful and readily adaptable by anyone skilled in the art to direct current lighting or power systems and the claims following have been drawn accordingly.

I claim:—

1. The method of controlling the entire operation of a radio receiver over the electric light lines from a remote control point along said lines, which includes selectively receiving various desired signals, regulating the strength of said signals, and turning the receiver on or off, which consists in transmitting high frequency currents over the said light lines from said remote control point to the point where the receiver is located, mixing said high frequency currents with said desired signals, rectifying the currents resulting from said mixing, regulating the strength of said high frequency currents and rendering the receiver inoperative by cutting off said high frequency currents.

2. The method of controlling the operation of a radio receiver from a distant point, over a power line to which the receiver is connected, which consists in transmitting over the power line an electrical impulse, supplying operating power to the receiver by actuating a switch by means of said impulse, then transmitting over the power lines current of variable high frequency, mixing said variable high frequency current with desired signal currents, rectifying the currents resulting from said mixing, regulating the strength of the said variable high frequency current, and finally turning off the power supply to the receiver by again transmitting an electrical impulse over the power line.

3. In the art of radio signalling, a system for the entire remote control operation of a radio receiver including the selective reception by said receiver of signals from transmitting stations of any wave length, the regu-

lation of the strength of such signals, and the switching of the receiver on or off, all from a point other than at the receiver itself, comprising in combination, an electric light or power line system, a plurality of interconnected apparatus means adjacent the receiver, a plurality of auxiliary interconnected apparatus remote from the receiver, an antenna, a ground connection, connections between said means adjacent the receiver, and both the light line system and the receiver, connections between the means adjacent the receiver and both the antenna and the ground, and connections between the auxiliary means remote from the receiver to said light or power line system, means at the remote control point constituting a generator of high frequency currents, and other means also located at the remote control point including a switch device which permits impressing the said high frequency currents upon the light lines at the said remote control point.

4. Means for operating radio receiving apparatus from a remote point over electric light or power lines with which said receiver is connected, comprising the combination with the receiving apparatus and the house lighting lines having a plurality of outlets, of a control device located at anyone of said outlets for generating high frequency control currents, the said device having means to cause the receiving apparatus to receive and render intelligible signals intercepted from transmitting stations using various wave lengths, to regulate the strength of such signals, and to switch the operating power to the receiver on or off, the said light or power lines being adapted to furnish operating power to both the receiver and the said control device and also adapted to transmit said high frequency control currents from the control means to said receiving apparatus.

5. The combination with the house lighting lines of a radio receiver and detecting apparatus including an antenna system, said receiver and apparatus being electrically connected with said house lighting lines, and a device for remotely controlling the operation of said receiver and detecting apparatus adapted to be connected to any point in the house lighting lines, said device including means for generating and impressing high frequency currents upon said lines to cause the said receiver to render intelligible signals intercepted from radio transmitting stations using various wave lengths, the said device also including means for regulating the strength of such intercepted signals, and means at the remote control point for switching said high frequency currents on or off to the light lines to turn the operating power from the light lines to the receiver on or off.

3. Means for remotely controlling a radio receiver apparatus having an antenna system, over electric house lighting or power lines with which said apparatus is connected, from a point along said lines, to cause it to selectively respond to various distantly transmitted radio signals which are intercepted by the antenna system; comprising, a device located at the control point along said lines and having a plurality of means for generating variable high frequency currents and impressing said currents upon said lines, means for causing said house lines to carry said high frequency currents as a single unilateral conductor from the point of remote control to the point at which the receiver is located, and means respectively connected to the receiver, to the antenna and to the house lines and responsive to all of the aforesaid variable frequencies transmitted over the house lines from the control device and also responsive to the signal frequencies received by the antenna system.

7. A system for controlling a radio receiver over house lighting or power lines to which said receiver is connected including means associated with the receiver for simultaneously receiving variable high frequency currents transmitted thereto over the power lines and radio signals from the antenna system, apparatus remote from said receiver having means for generating high frequency currents, means for coupling said apparatus to said lighting or power lines for impressing said variable high frequency currents thereon, said variable high frequency currents being transmitted to said first mentioned means for controlling energization of said receiver and heterodyning with the incoming signal for controlling the tuning and regulating the signal strength of said receiver.

8. A method of controlling a radio receiver over the house lighting or power lines which consists in generating variable high frequency currents at a point remote from the receiver, impressing said high frequency currents on said lighting or power lines, whereby said currents heterodyne at the radio receiver with radio signal currents intercepted by the receiver to produce a super-audible beat frequency at the receiver for controlling the energization, tuning, and signal strength of the receiver.

9. A system for controlling a radio receiver over house lighting or power lines to which said receiver is connected, including means associated with the receiver for simultaneously receiving variable high frequency currents transmitted thereto over the power lines and radio signals from the antenna system, and a remote control apparatus having means for generating high frequency currents, means for coupling said apparatus to said lighting or power lines for impressing said variable high frequency currents thereon respectively for switching the power sup-

ply to the receiver on and off and selectively operating the receiver.

10. A system for controlling a radio receiver over house lighting or power lines to which said receiver is connected including means associated with the receiver for receiving variable high frequency currents transmitted thereto over the power lines and radio signals from the antenna system, means for heterodyning the variable high frequency currents and radio signals, and apparatus connected with the said lighting or power lines at a point remote from said receiver for producing high and variable frequency currents which are transmitted over said lighting or power lines from the control point to said first mentioned means.

11. A system for controlling a radio receiver over house lighting or power lines to which said receiver is connected including means associated with the receiver adapted for receiving variable high frequency currents transmitted thereto over the power lines and also receiving radio signals from the antenna system, said means comprising means for mixing said high frequency currents with radiant energy received by the antenna system, and means for rectifying the current resulting from said mixing; and means for producing oscillating high frequency electrical current at a point remote from said receiver and transmitting the same over light or power lines to said first named means to selectively render said receiver operative or inoperative.

12. A system for selectively receiving various radio signals on a receiver connected with house lighting or power lines including means for producing high and variable frequency electrical currents from a control point on said lines remote from the receiver and transmitting the same over said lines to the receiver, means at the receiver for collecting signal energy from the antenna system and high frequency energy from the house lighting or power lines, means for mixing said energy with said high frequency currents, and means for rectifying the energy resulting from said mixing.

13. A system for selectively receiving various radio signals comprising a radio receiver connected to the house lighting or power lines, control apparatus remote from the receiver and having means for generating and impressing high frequency currents on said lines, and means at the receiver for intermixing high and variable frequency currents and signal energy intercepted by said receiver, and means for producing high frequency super-audible beats by rectifying the current resulting from said intermixing, and means for impressing said beats upon the radio receiver to accomplish the selective reception aforesaid.

14. A system for selectively receiving various radio signals comprising a radio receiver connected to the house lighting or power lines, control apparatus adapted to be connected to the said lighting or power lines at a point remote from the receiver and having means for generating and impressing high frequency currents on said lines, means at the receiver for superposing said high frequency currents from the lighting or power lines on the signal currents intercepted by the receiver, means for rectifying both of said currents at the receiver to produce a rectified resultant high frequency current equal in frequency to the difference between the frequencies of the two said superposed currents, and means for impressing said rectified resultant current upon said radio receiver.

15. In a radio receiver control system, means for switching a radio receiver on or off over the electric light lines from a control point along said lines, comprising a plurality of means at said control point for generating and impressing upon said lines high frequency currents, a plurality of means at the receiver, auxiliary and external thereto, connected to said light lines for receiving said high frequency currents over said light lines, and a separate plurality of means at the receiver, auxiliary and external thereto, responsive to said high frequency currents in such manner as to effect the switching on or off of the said radio receiver.

16. In a remote control system for operating radio receivers, means for switching a radio receiver on or off over an electric light line to which said receiver is connected, from a point along said line, comprising means for generating a fixed predetermined high frequency current at the said control point, means for impressing said current upon said line at the control point, means at the receiver, auxiliary and external thereto, also connected to said light line and electrically responsive to said high frequency current received by said auxiliary means over said light lines, and means connected to the said auxiliary means to accomplish the said switching on or off of said radio receiver.

17. A system for the entire remote control operation of a radio receiver including the tuning of said receiver to receive and reproduce signals from transmitting stations of any wave length, the regulation of the strength of such signals, and the switching of the receiver on or off, from a point other than at the receiver itself, comprising in combination an electric light or power line system, a plurality of inter-connected apparatus means adjacent the receiver, a plurality of auxiliary inter-connected apparatus means remote from the receiver, an antenna, a ground connection, connections between said auxiliary means adjacent the receiver and both the light line system and the receiver, connections between the auxiliary means ad-

jacent the receiver and both the antenna and ground, and connections from the auxiliary means remote from the receiver to said light or power line system, wherein a portion of the means remote from the receiver is a generator of a high frequency current of fixed and predetermined frequency used for switching the receiver on or off, means at the remote control point constituting a generator of high frequency currents of adjustable frequency used for tuning said radio receiver and regulating its volume, and other means also located at the remote control point including a switch which permits impressing upon the light lines at said remote control point either the said switching frequency or the said tuning frequencies.

In testimony whereof I hereunto affix my signature.

ALBERT S. BLATTERMAN.