Nov. 13, 1934. E. F. ANDREWS 1,980,842

RADIO RECEIVING SET

Filed July 31, 1930 5 Sheets-Sheet 1

Fig. 1.

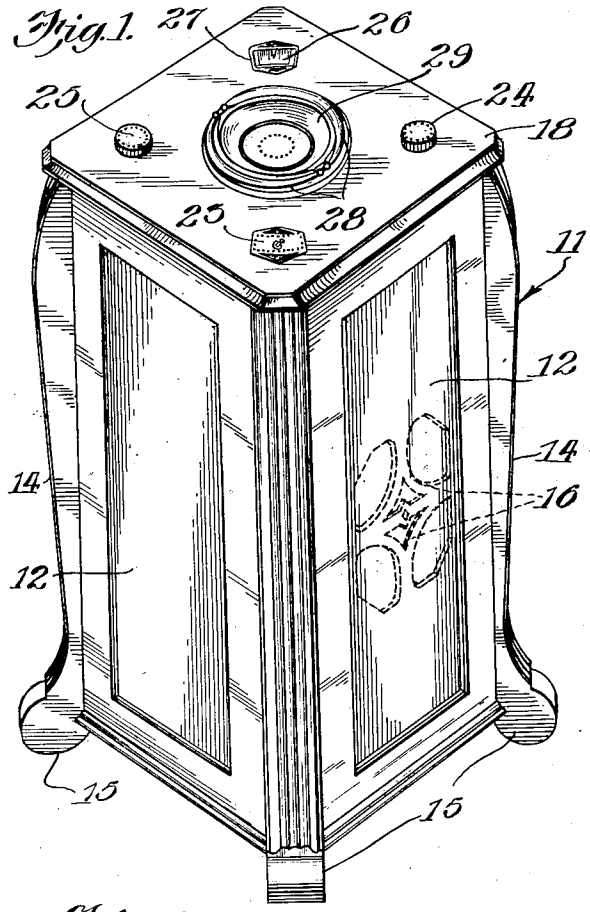


Fig. 7.

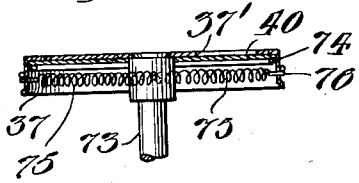
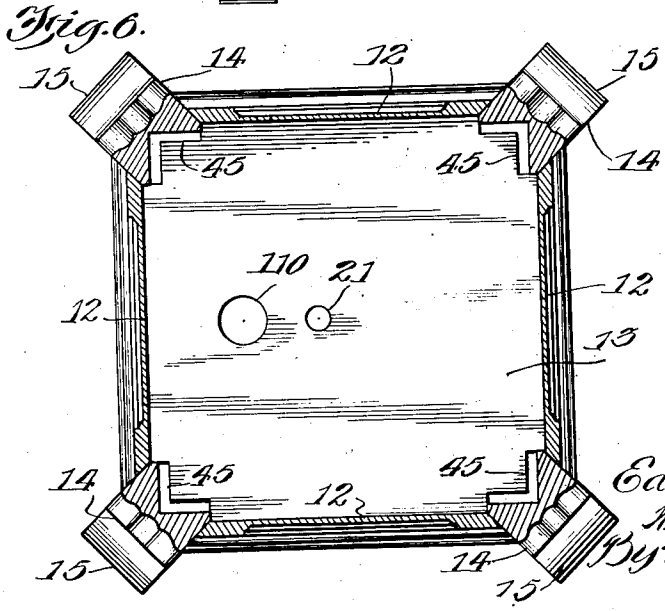


Fig. 6.



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RADIO RECEIVING SET

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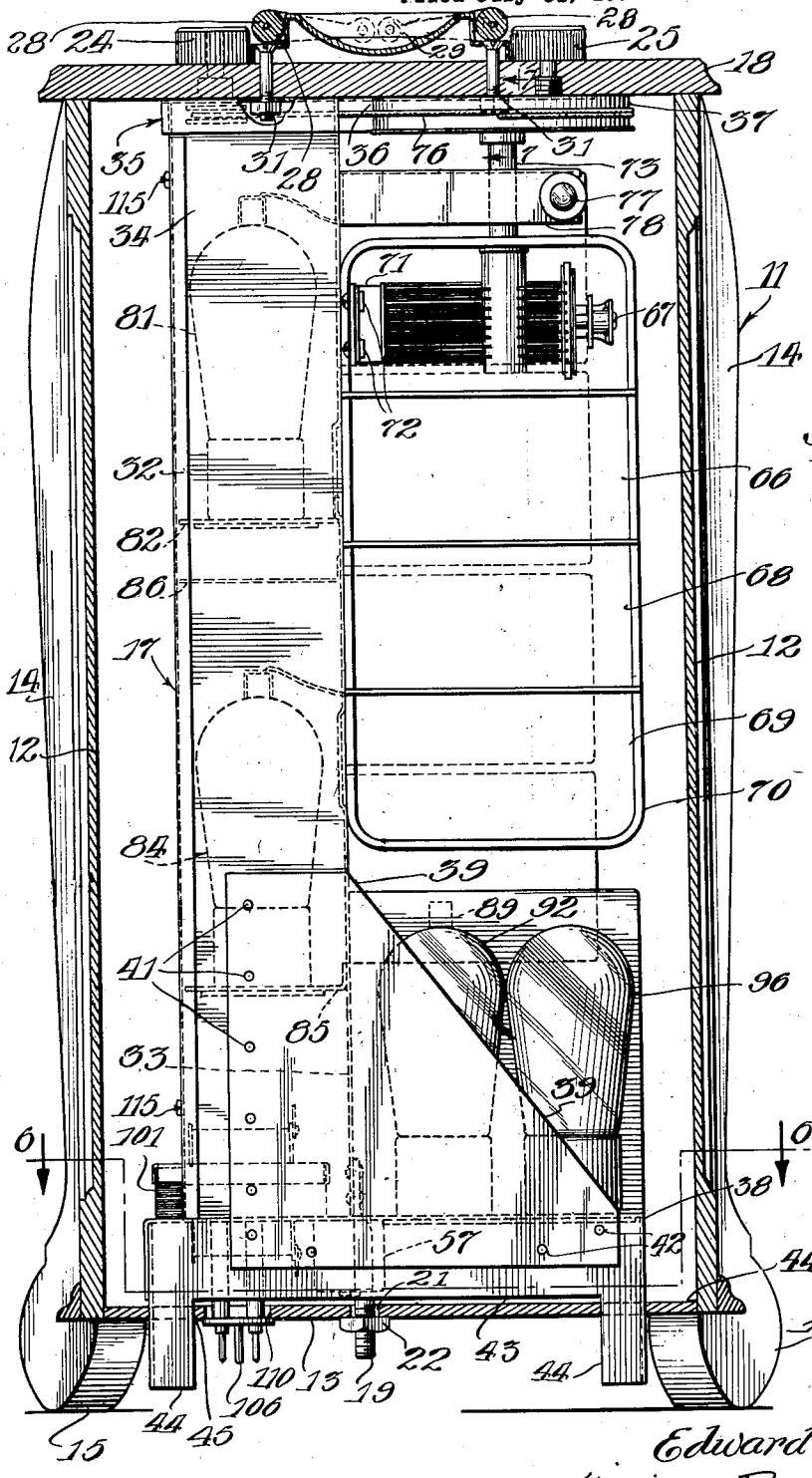


Fig. 2.

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Nov. 13, 1934. E. F. ANDREWS 1,980,842

RADIO RECEIVING SET

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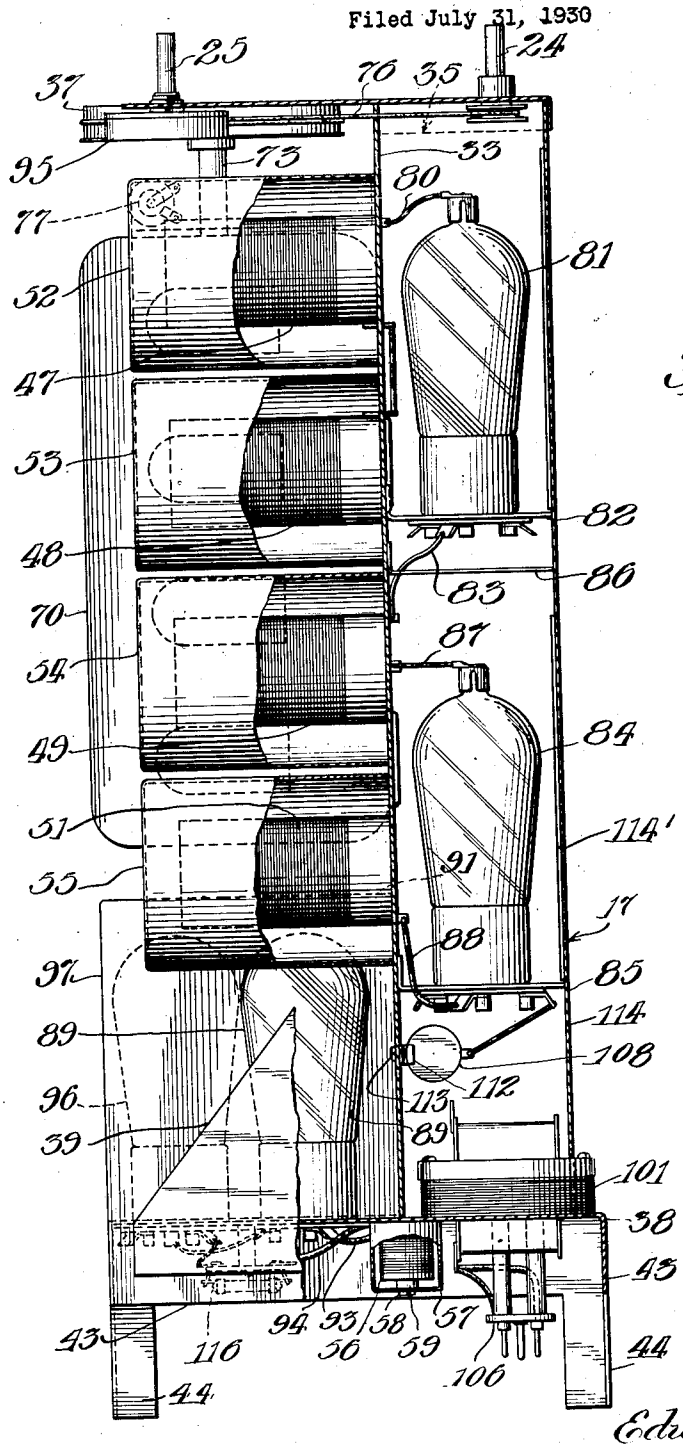


Fig. 5.

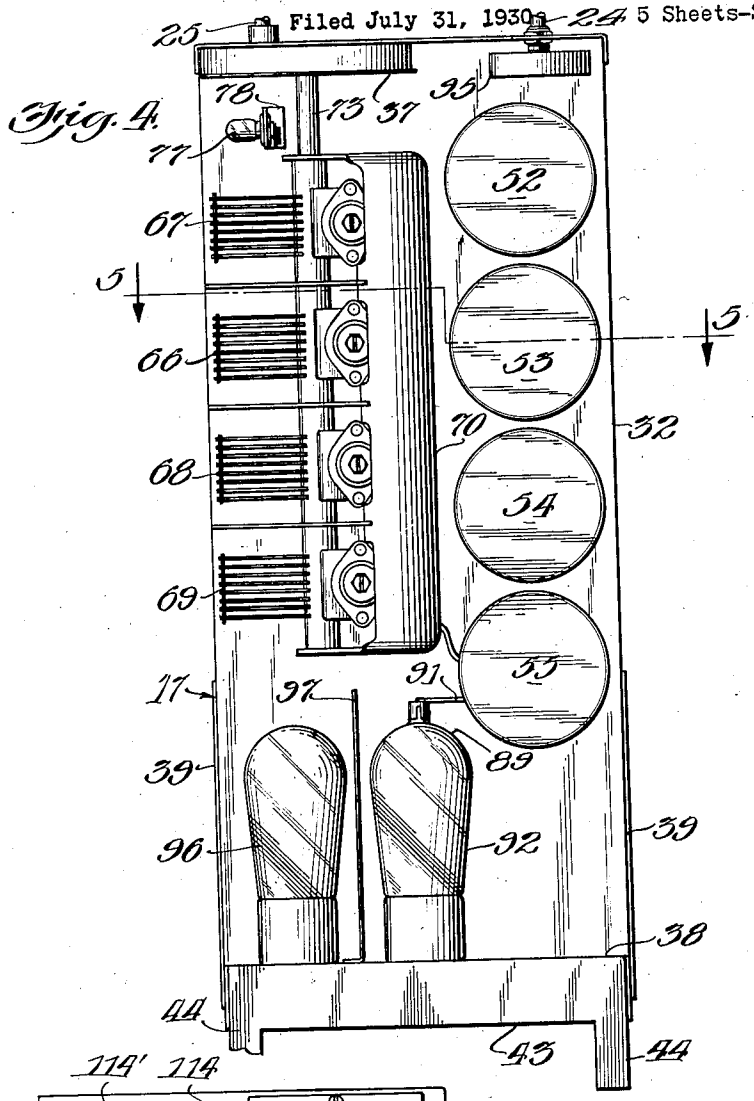
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Nov. 13, 1934. E. F. ANDREWS 1,980,842

RADIO RECEIVING SET

Filed July 31, 1930 5 Sheets-Sheet 4

Fig. 4.



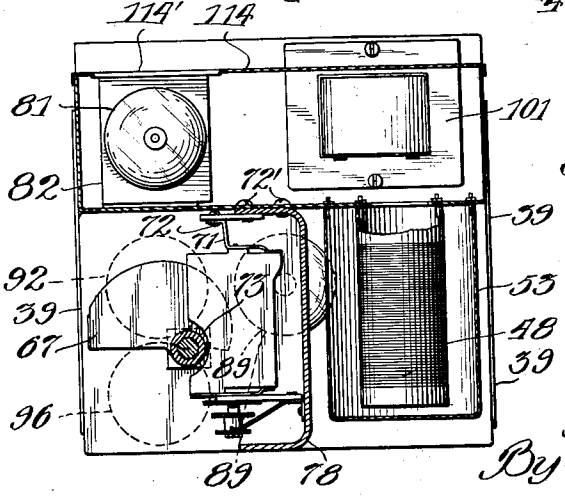


Fig. 5.

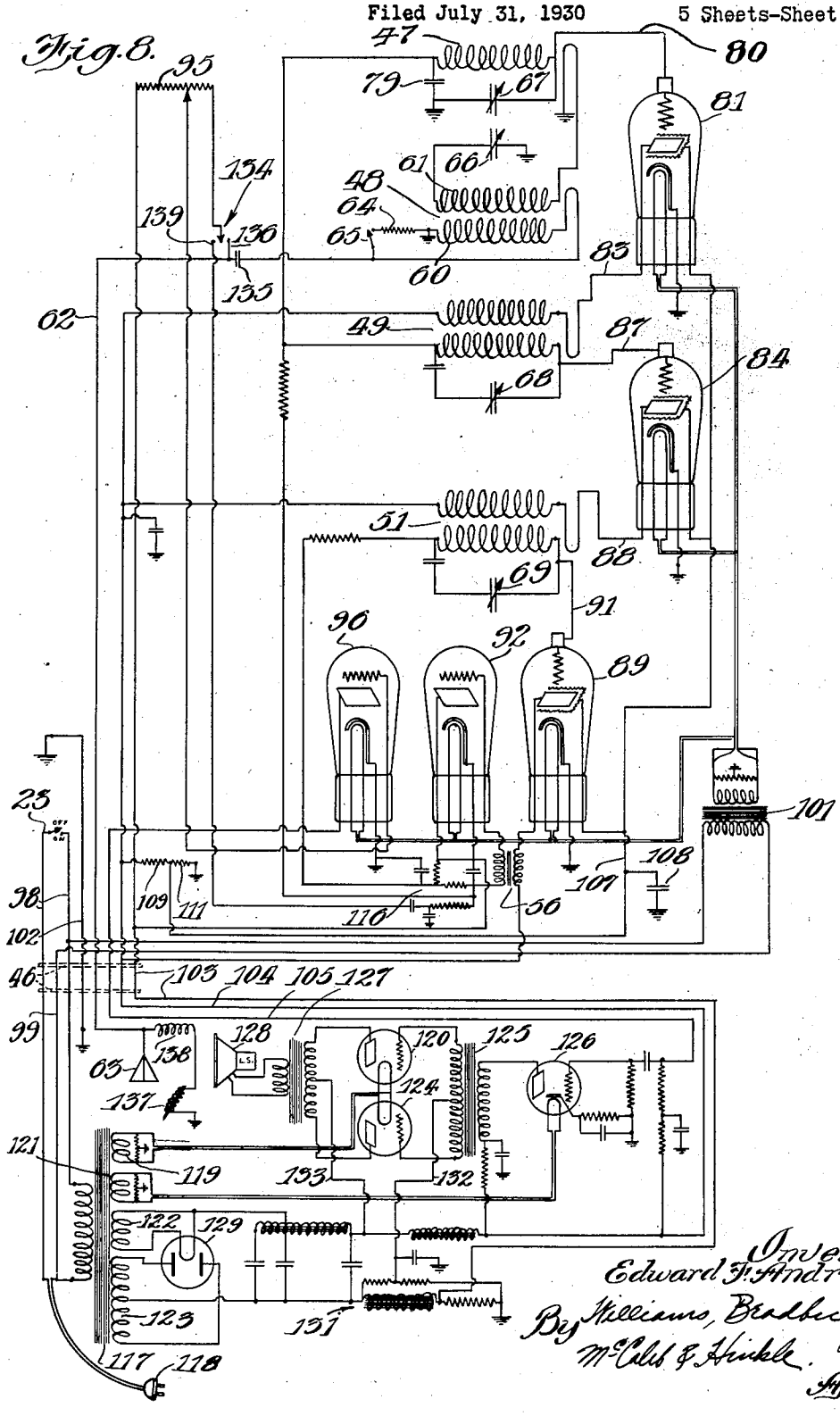
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RADIO RECEIVING SET

Filed July 31, 1930 5 Sheets-Sheet 5

Fig. 8.



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Patented Nov. 13, 1934

1,980,842

UNITED STATES PATENT OFFICE

1,980,842

RADIO RECEIVING SET

Edward F. Andrews, Chicago, Ill.

Application July 31, 1930, Serial No. 471,949

11 Claims. (Cl. 250—14)

This invention relates, in general, to systems and sets for receiving wireless signals and it pertains more particularly to a novel radio receiving set or system.

A prime object of the present invention is the provision of a novel radio receiving set having receiving apparatus so arranged at a plurality of levels as to permit the use of short connections between connected apparatus.

An important object of this invention is the provision of a multi-stage receiving set in which the amplifier stages are arranged one above the other and so connected as to minimize the effects of feedback.

A further important object of the invention is the provision of a novel radio receiving set or system in which the major dimension of the cabinet is determined by the vertical arrangement of the receiving apparatus therein and by the convenient height of the control devices arranged on top of the cabinet.

Still another important object of the invention is the provision of a novel radio receiving set provided with a chassis or mounting frame of such construction as to permit the efficient utilization of mounting space within the cabinet or housing for the receiving set.

Another object of the invention is the provision of a novel radio receiving set or system having an open-top cabinet and a control panel providing a closure for the open-top cabinet.

Another object of this invention is the provision of a novel chassis or frame for radio receiving sets, positionable in a cabinet and removable therefrom, through the top of the cabinet.

Still another object of the invention is the provision of a novel radio chassis or frame which is so formed or shaped as to promote mechanical stability and as to provide a shield for the capacity affected apparatus mounted thereon.

A further object of the invention is the provision of a substantially L-shaped radio chassis or frame receivable in an open-top cabinet and having radio receiving apparatus mounted on all sides of the chassis whereby the vertical and horizontal arms of the L-shaped chassis serve as shields between the apparatus mounted on opposite sides thereof.

Another object of the invention is the provision of a substantially L-shaped radio chassis or frame having centering means adapted to project through the bottom of a cabinet for securing the chassis therein.

Another object of the invention is the provision of a novel radio receiving set having an instrument mounting frame or chassis suspended from the top of the cabinet.

Another object of this invention is the provision of a novel mounting for a radio chassis in an open-top cabinet.

A further object of the invention is the provision of a tuning indicator or indicating means secured at the top of a novel radio chassis and adapted to actuate the tuning means of the set carried by the chassis.

Other objects and advantages of the invention will be apparent from the drawings and as the following description proceeds, these objects including, generally, the provision of a novel radio receiving set which is compact in assembly, yet free from the disturbances produced by coupling between adjacently positioned apparatus and between adjacently arranged wires; which may be readily dismantled for purposes of inspection, repair and replacement of parts; which is so constructed as to permit its convenient control by an operator in any conventional posture; and which is sightly in appearance and readily adaptable for remote control or for moving from place to place to render it accessible at various desired places in the building where it is operated or used.

In the drawings:

Figure 1 is a perspective view of a radio receiving set embodying the features of the invention;

Figure 2 is a vertical section through the cabinet showing a side view of the chassis or frame in the cabinet;

Figure 3 is a side elevation of the chassis shown in Figure 2, showing parts of the chassis in section and parts cut away;

Figure 4 is an elevation of another side of the chassis;

Figure 5 is a section taken substantially on the line 5—5 of Figure 4;

Figure 6 is a horizontal section taken substantially on the line 6—6 of Figure 2, the chassis being removed from the cabinet;

Figure 7 is a section taken substantially on the line 7—7 of Figure 2; and

Figure 8 is a circuit diagram of a receiving set or system, schematically showing one arrangement of a radio set for the cabinet of Figure 1.

In order to accomplish the foregoing objects, the instant invention, as illustrated, contemplates the arrangement of coupling coils and amplifier tubes one above the other in an upright cabinet and so connecting the coupling coils and amplifier tubes that the tube lead wires or connecting wires are of such length that the coupling therebetween is negligible. This may be accomplished by con-

necting the second coil from the top to the antenna, that is, by utilizing this coil as the first stage primary input coil and connecting the top coil to the grid circuit of the top tube which is arranged at substantially the same level as the top coupling coil. The output or plate circuit of this top tube or first stage of the amplifier is then connected to the third coil or the coil next below the antenna coil which, in turn, supplies the input energy or grid circuit of the second stage, and so on, as will be described presently.

It is desirable to provide a cabinet for the receiving set of the invention which will have small plan dimensions as well as a small or convenient vertical dimension and to sufficiently utilize the mounting space within this cabinet in order to permit the use of short connections between adjacent receiving apparatus. To accomplish this it is necessary to utilize the vertical depth or dimension of the cabinet in arranging the receiving apparatus therein. Accordingly, the chassis or apparatus mounting frame is provided of such shape as to permit the compact arrangement of receiving apparatus at various vertical levels. It has been found that a substantially L-shaped chassis having a substantially horizontal arm or member and a relatively long vertical arm or member provides sufficient mounting space to permit the use of a cabinet for the receiving set which will be of convenient height for the manipulation of controls carried at the top of the cabinet by a standing, sitting or reclining operator. A chassis of such shape permits mounting the receiving apparatus at opposite sides of both the horizontal and vertical members and the use of such members as shields between the apparatus at opposite sides thereof.

The invention further contemplates the provision of such a novel chassis or frame for radio receiving sets which will be suspended from a control panel or top for closing an open-top cabinet in which the chassis may be detachably secured and from which it may be readily removed. The chassis or frame is so constructed and the receiving apparatus so arranged thereon that the chassis will be receivable in a relatively small vertical or upright cabinet or casing and when so assembled the control panel will be of convenient height, as already mentioned, for a standing, sitting or reclining operator or user of the set or system. This cabinet may be portable and, as here contemplated, may carry therein only the radio frequency amplifier, a portion of the audio frequency amplifier and the radio control and operating devices for the receiving set. This unit so assembled is connectible by a cable with a suitable source of energy or a power unit and separate audio frequency apparatus. Where desired this latter apparatus may also include a phonograph controlled from the control panel forming the top of the portable cabinet.

Illustrative of the invention, I provide a radio cabinet or casing 11 having side and bottom panels 12 and 13 supported by corner standards or frame members 14 terminating at their lower ends in feet or supports 15, as shown in Figures 1 and 2. The cabinet or casing 11 is adapted to house or encase a radio receiving set or system and for this purpose two of the side panels 12 may be provided with sound openings, as illustrated by the dotted lines 16 in Figure 1, to permit the escape of sound from the loud speaker of the set. A substantially L-shaped chassis or frame 17, receivable in the cabinet, is adapted to carry the receiving set. As illustrated, however, this chassis 17 carries a radio frequency amplifier and detector together with the associated tuning and receiving apparatus. A top 18 closes the top of the casing 11 when the chassis 17 is inserted therein, where the chassis is secured by means of a retaining lug or bolt 19 projecting from the chassis through an aperture 21 in the bottom panel 13, and a nut 22 threading on the bolt 19.

The cabinet 11 is of such height as to render the control panel or top 18 readily accessible by a standing, sitting or reclining operator for the manipulation of a control or on and off switch 23, a tuning handle or knob 24, and a volume control handle or knob 25 on the control panel or cabinet top 18 and for viewing a glass or celluloid plate 26, substantially flush with the top 18 and closing a dial or sight opening 27 therein. The control panel or top 18 is provided with suitable handles 28 to render the cabinet portable. The handles 28 are adapted to pivotally span a plate 29 having bolt and nut assemblies 31 securing it to the top 18. If desired, the plate 29 may be dished, as illustrated in Figures 1 and 2, and used as a receptacle for an article of personal convenience such as an ash tray.

As already mentioned, the chassis or frame 17, shown more particularly in Figures 2 and 3, is substantially L-shaped and is so fabricated that relatively light-gauge metal may be employed in its construction, and yet the chassis will have sufficient strength and rigidity to provide a mechanically stable and light mounting for the receiving apparatus. This L-shaped chassis or frame 17 has a relatively long vertical arm 32 formed as a channel with a face 33 and sides 34 and is riveted or spot-welded to a top plate 35. This top plate 35 is secured to the under side of the cabinet top or panel 18 by the bolt and nut assemblies 31 so that the chassis 17 is suspended from the top 18 and is slidably receivable in the cabinet. The top plate 35 is cut away as at 36 to accommodate a tuning dial pan 37 carrying an indicator dial 40 having transparent tuning indicia thereon. The relatively long vertical arm 32 is secured at its lower end to a relatively short horizontal arm or base 38 by corner tie plates 39 riveted as at 41 to the channel or arm 32 and as at 42 to the short horizontal arm 38.

The short horizontal arm 38 may be formed from a single sheet of metal to provide a skirt portion or depending sides 43, and legs 44 for supporting the chassis 17 when it is removed from the cabinet or casing 11. The legs 44 are adapted to project through openings 45 in the bottom panel 13 and to be concealed behind the cabinet feet or supports 15, the legs co-operating with the retaining bolt 19 to center the chassis in the casing.

Fig. 8 shows a schematic diagram of a radio receiving set which may be encased in the cabinet 11. As shown, however, the receiving system or set is divided and that part of the set shown above the cable, schematically illustrated at 46, is shown with the various units in substantially the relative positions in which they are mounted in the cabinet 11, that part below the cable 46 being adapted to be mounted outside the cabinet 11. Thus the embodiment of the invention illustrated in Fig. 8 provides a multi-stage, radio frequency amplifier, a portion of the audio frequency amplifier, and the radio control and tuning means for mounting in the cabinet 11 whereby to provide a portable remote control unit for the radio receiving set or system.

A portion of the audio frequency amplifier, together with the radio frequency amplifier, is mounted on the chassis 17 in the cabinet 11 to avoid a high impedance connection between the detector output and the audio frequency amplifier.

The multi-stage, radio frequency amplifier, as shown in Fig. 8, is also carried by the chassis 17 and the various elements of the amplifier are so mounted and arranged on the chassis that the capacity effects between adjacent units are reduced to a minimum.

Successive stages of the amplifier are coupled by any suitable coupling means, such as by coils 47, 48, 49 and 51, respectively arranged in cup shields 52, 53, 54 and 55 projecting horizontally, one above the other, from the rear face of the vertical channel 32 and by coils 56 in cup shield 57 secured to the lowermost face of the horizontal arm 38 inwardly of the depending sides 43 by a nut 58 threading on a lug or bolt 59.

The coil 48, as illustrated, has two windings 60 and 61 inductively coupled and receiving energy from a conductor 62 connected with an antenna 63. The conductor 62 is included in the cable 46 and suitably shielded from the other conductors to provide a low capacity antenna lead. A resistor 64 and switch 65 shunting the winding 60 in the grounded antenna circuit provide for distant and local reception. The winding 61 has its terminals connected to the terminals of a tuning or variable condenser 66 which with tuning or variable condensers 67, 68 and 69 are secured one above the other in a condenser frame or housing 70 by means of brackets 71 and bolt and nut assemblies 72.

The condenser housing or frame 70 is mounted on the rear face of the channel 32 by means of bolt and nut assemblies 72', and the condensers therein are provided with the usual movable plates fixed on a common shaft 73 for operating or tuning the condensers. This shaft 73 carries the dial pan 37 having a sight aperture 37' therein for exposing a portion of the dial 40 which is secured in the pan by a ring 74, the pan 37 being operable by coil springs 75 having corresponding ends attached to the pan and other ends connected with a cord 76 operably engaging the tuning handle or knob 24 for tuning the set.

A light 77 secured to the channel 32 by a bracket 78 illuminates the dial or indicator 40 and the light is projected through the sight opening 27 on the plate 26 flush with or above the top 18 for indicating the tuned position of the condensers 66 to 69. In other words, an image of the indicia on the indicator dial 40 is projected on the plate 26 which is so positioned as to be visible from directly above the plate or from above and at an angle to the plate.

The coil 48 is arranged below the top coil 47 in the input circuit of the first radio frequency amplifier stage, the top coil 47 being shunted by the tuning condenser 67 and a condenser 79 and being connected by means of a conductor 80 to the grid of a 224 amplifier tube 81 supported on a bracket 82 mounted on the inner face of the channel 32 between the channel sides 34. This conductor 80 connects to the grid of the tube 81 through the top of the tube as shown in Figs. 3 and 8, and this feature, together with the vertical arrangement of the tube and the relative positioning of the coils 47 and 48, permits the use of a grid lead or conductor of minimum length to prevent feedback effects due to the capacitance between the grid lead 80 and leads in the output circuit of the tube. It will be observed that the face 33 of the channel 32, as here described, serves as a shield between the tube 81 and the devices on the opposite side of the channel face.

The output circuit of the top tube 81 is inductively coupled by the coil 49, the third coil from the top, to which the plate of the tube is connected by a conductor 83, to the input circuit of another 224 amplifier tube 84 mounted on a bracket 85 attached to the channel 32 below the tube 81 and shielded therefrom by a horizontal partition 86 secured to the face 33 of the channel between the sides 34. A conductor 87 leading into the top of the tube 84 connects the coil 49 to the grid of the tube, as in the preceding stage. The output circuit of the tube 84 is inductively coupled by the coil 51 to which the plate of the tube is connected by a conductor 88, to the input circuit of a third 224 amplifier tube 89 including a conductor 91 connecting the coil 51 with the grid of the tube as in the previously described stages.

The tube 89 is mounted in the angle made by the vertical and horizontal arms 32 and 38, respectively, of the L-shaped frame and on the same side of the face 33 as the condensers 66 to 69, the tube being supported on the horizontal arm or base 38. Thus a cascade-connected amplifier is provided with the stages arranged in the order of their numbers one above the other. The output of the tube 89 is inductively coupled by the coil 56 mounted to the under side of the base or horizontal arm 38 to the input of a 227 detector tube 92 by means of conductors 93 and 94. This tube 92 is mounted on the base 38 adjacent the tube 89 and may be any suitable detector such as that illustrated in which the cathode is connected to the plate in order to provide a two element detector having substantially linear characteristics.

The output of this radio frequency amplifier and detector is connected through a variable resistance or voltage divider 95, operable by the volume control handle or knob 25 to adjust the volume of the received signal, to a 227 amplifier tube 96 mounted on the base 38 in spaced relation to the tube 89 and shielded therefrom by a substantially square panel 97 upstanding from the base 38. The tube 96 is in the first audio frequency stage and is mounted in the cabinet 11 in order to avoid a high impedance connection between the detector output and the audio frequency amplifier, such as may obtain when the audio frequency amplifier is remotely positioned with respect to the detector.

The cable 46 includes conductors 98 connecting the on and off or control switch 23, a conductor 99 for supplying energy to a transformer 101 mounted on the base 38 between the channel sides 34 for supplying current to the filaments of the tubes 81, 84, 89 and 96, a ground conductor 102, the low capacity antenna conductor 62, and conductors 103, 104 and 105 for supplying energy to the radio frequency amplifier and for connecting the output of the first audio frequency stage with the input of the next stage. This cable makes the foregoing connections by means of a plug connector 106 depending from the base 38 inwardly of the sides 43 and adapted to project through an aperture 110 in the bottom 13 of the cabinet 11, the plug 106 being complementary to a connector member (not shown) on the cable.

The tubes 81, 84 and 89, as illustrated, may be of the four-element or screen-grid type to provide high amplifying characteristics. The screen grids of these tubes are so connected by means of a wire or conductor 107 to a condenser 108 and

to resistors 109 and 111 as to provide a suitable bias for these screen grids and to minimize the feed-back of high frequency current from the plates to the grids of the tubes. The condenser 108 is mounted on the face 33 just above the transformer 101 by means of a bracket 112 and a bolt and nut assembly 113.

The tubes 81 and 84 vertically arranged one above the other, the transformer 101, the condenser 108, and the other apparatus mounted between the channel sides may be enclosed by a closure plate 114 cooperating with the channel 32. This plate 114 is provided with openings or apertures 114' registering with the tubes 81 and 84 to expose them to view for inspection and to facilitate replacing the tubes, the plate 114 being suitably secured to the channel as by bolt and nut assemblies 115 (see Fig. 2). The various condensers, resistors, and other apparatus are attached to the chassis or frame in substantially the relative positions illustrated in Fig. 8, the filter, designated generally by the reference character 116, being attached to or suspended from the under side of the base or arm 38 inwardly of the depending sides as shown by the dotted lines in Fig. 3.

Thus, it will be seen that the substantially L-shaped chassis or frame provides a compact and mechanically rigid mounting for the units of a radio receiving set and facilitates shielding the units and wires from other units and wires to reduce the capacity effects to a minimum. By arranging the coils so that coil 48, the second coil from the top, is in the antenna circuit and coil 47, the topmost coil, is connected by the conductor 80 to the grid of the first stage and is led into the tube through its top, and by so arranging the succeeding stages that similar connections are made, the grid leads are reduced to a minimum length. The mounting of the tubes, condensers, and coils on the vertical channel 32 permits the use of a comparatively light gauge of metal for the chassis, thereby contributing to the provision of a light and portable receiver or remote control unit for a receiver. This substantially L-shaped chassis also provides a large mounting surface for the receiving apparatus so that it is possible to arrange the units of the receiving set on all sides of the chassis in order that it may be so constructed as to be of convenient height for the manipulation of the controls by a standing, sitting or reclining operator.

If only the radio frequency amplifier, detector, a portion of the audio frequency amplifier, and the tuning and control means of the radio receiver are carried by the cabinet 11, the cable 46, schematically illustrated in Fig. 8, may extend to a suitable source of energy and to the other audio frequency amplifier stages enclosed in the same cabinet or in different cabinets not shown.

As illustrated, a transformer 117, connectible by a plug 118 to a suitable electrical outlet which supplies current to the transformers 101 and 117 through the conductors 98 and 99, is controlled by the control switch 23 in the cabinet 11. This transformer 117 is provided with secondary windings 119, 121, 122 and 123 for supplying electrical energy to the set. The winding 119 supplies current to the filaments of two 245 audio frequency tubes 120 and 124, the grids of which are connected together through the secondary of a transformer 125, the primary of which couples them to the output circuit of a 227 audio frequency amplifier tube 126 having a resistance coupling with the first audio frequency stage by means of conductors 104 and 105 in cable 46. The filament of tube 126 is supplied with energy from coil 121 of the transformer 117.

The plates of the tubes 120 and 124 are connected together through the primary winding of a transformer 127, the secondary of which supplies energy to a loud speaker 128. The winding 122 supplies current to the filament of a 280 rectifier tube 129 which rectifies the output of coil 123 and supplies this rectified current to a filter generally designated at 131. Conductors 132 and 133 connect intermediate points of this filter with intermediate points of the secondary and primary windings of transformers 125 and 127, respectively. The output of the filter 131 is connected by the wire 104 to the plate circuits of the tubes in the cabinet 11. It will be understood that any suitable energy supply unit and audio frequency amplifier may be employed with the radio frequency amplifier and control unit in the cabinet 11 and that the invention is not limited to the detailed description above.

Where desired, a selective switch 134 (see Fig. 8) for selectively controlling the radio set and a phonograph, not shown, may be employed to disconnect the radio frequency amplifier, leaving the audio frequency amplifier connected for use with the phonograph. The switch 134 may be mounted on the control panel or top 18 or a single, multi-point switch may replace the switches 23 and 134. For this purpose a condenser 135 may be connected in the antenna circuit between the antenna 63 and the coil 48 and between a contact point 136 of the switch 134, providing a phonograph connection, and the coil 48 to avoid short circuiting the audio frequency amplifier through the coil 48 while the phonograph is being operated. A phonograph pick-up, diagrammatically illustrated by a coil 137 in series with a radio frequency choke coil or inductance 138, may also be connected to the contact point 136 of the switch 134 for stopping the phonograph when the switch 134 is thrown from the point 136 to a radio frequency amplifier for radio reception. The choke coil 138 prevents short circuiting of the antenna 63 while the radio is being used.

The energy supply for the phonograph pick-up may be carried by the antenna conductor 62 whereby to substantially prevent capacity coupling between this conductor and the other conductors in the cable 46. Attention is here again directed to the mounting of the audio frequency tube 96 in the cabinet 11. Such a mounting, in addition to the advantage of avoiding high impedance in the output of the detector stage, permits the volume of the phonograph to be controlled from the cabinet 11.

Thus the cabinet 11 may be so constructed that the control panel will be at a convenient height for the manipulation of the control and tuning devices by a standing, sitting or reclining operator. The cabinet being adapted to slidably receive through its open top a substantially L-shaped chassis or frame, carrying receiving apparatus at opposite sides of both the vertical and horizontal arms. These arms or members serving as shields permit the vertical arrangement of coupling coils and tuning condensers at one side of the vertical arm and amplifier tubes vertically arranged one above the other at the opposite side of the vertical arm of the chassis or frame so that energy is supplied from the output of one tube to the input of a tube next below the first tube. Such an arrangement of receiving apparatus permits arranging the coils in such posi-

tions that the grid leads or conductor from each coil to the corresponding tube has a minimum length whereby to minimize feed-back effects caused by long grid leads being capacitively coupled with other apparatus and wires.

Furthermore, the vertical arrangement of the tubes, condensers and coils permits the use of a relatively light vertical arm as a mounting for this apparatus and the chassis or frame carrying the receiving apparatus may be suspended from a control panel adapted to serve as a closure for the cabinet whereby to provide a compact and sightly assembly. By providing the top separable from the cabinet, the receiving apparatus may be withdrawn from the cabinet simply by removing the top, thereby facilitating inspection, repair and replacement of parts.

While I have illustrated a preferred embodiment of my invention, many modifications may be made without departing from the spirit of the invention, and I do not wish to be limited to the precise details of construction set forth, but desire to avail myself of all changes within the scope of the appended claims.

Having thus described my invention, what I claim as new and desire to secure by Letters Patent of the United States is:

1. A radio receiving set including thermionic tubes in combination with a chassis having a vertical channel member and carrying receiving apparatus, a plurality of said thermionic tubes being vertically arranged in superposed and shielded relation within said vertical channel member, and other thermionic tubes arranged behind said vertical channel member.

2. A radio receiving set comprising a substantially L-shaped chassis for receiving and tuning apparatus, having a metallic base and a vertical metallic channel member mounted on said base, a plurality of thermionic tubes carried by said base outside of said channel member, and a plurality of thermionic tubes arranged vertically one above the other and carried within said channel member, the first said thermionic tube being shielded from the last said thermionic tubes by the central web of the channel member.

3. A radio receiving set comprising a substantially L-shaped chassis for receiving and tuning apparatus, having a metallic base and a vertical metallic channel member mounted thereon, said base having depending sides, receiving and tuning apparatus mounted on said vertical channel member at opposite sides thereof, receiving apparatus mounted on said base at opposite sides of said vertical channel member, and other receiving apparatus mounted under said base inwardly of said depending sides.

4. A radio receiving set having an energy supply source and audio apparatus in combination with an L-shaped metallic chassis having a vertical channel member and a relatively short horizontal member supporting said vertical arm, a multi-stage amplifier mounted on said chassis, said horizontal arm having depending sides and providing a mounting at opposite sides thereof for amplifier apparatus, said amplifier apparatus being mounted on, and within and without said chassis members.

5. A radio set comprising a rigid chassis having a vertical metallic channel member and a relatively short horizontal channel member secured thereto, said members being adapted to carry radio receiving apparatus, radio frequency and audio frequency thermionic tubes supported on said horizontal member at a side of said vertical member, a shield between said audio frequency and radio frequency tubes, and other radio frequency thermionic tubes supported within said vertical channel member and shielded thereby from the first said tubes.

6. A radio receiving set comprising a cabinet, an energy supply source, a vertical chassis comprising a vertical metallic sheet positionable in said cabinet, a multi-stage amplifier carried by said chassis and connectible with said energy supply source, said amplifier including stage couplers mounted one above the other on one side of said vertical sheet, and a plurality of vertical screen grid tubes arranged one above the other on the opposite side of said sheet, one of said stage couplers being located at a height adjacent the base of one tube and the top of the other tube to which it is connected so that the connections between the couplers and tubes may be short.

7. A radio receiving set in combination with a cabinet having bottom and side walls providing a vertical enclosure for said radio receiving set, said bottom wall having a plurality of apertures therein, a control panel for said receiving set forming a top closing said vertical enclosure, an L-shaped chassis suspended from said top and slidably fitting within said enclosure, said chassis carrying a portion of said receiving set, means projecting from said chassis and co-operating with said apertures to position and to detachably secure said chassis within said enclosure, and a handle on said control panel for removing said chassis from said casing.

8. A radio receiving set in combination with a casing having a separable top, an L-shaped chassis comprising two channel members secured together at right angles carrying said receiving apparatus and positioned in said casing, and a plate positioned on said top and secured to said chassis to suspend said chassis from said top.

9. A radio receiving set comprising a cabinet having an open top, a substantially L-shaped chassis comprising two channel members secured together at right angles receivable in said cabinet through said open top, receiving apparatus mounted on both sides of the channel members of said chassis and a cover secured to said chassis and control means thereon.

10. A radio set comprising an open top cabinet, receiving and tuning apparatus therein, and a substantially L-shaped chassis comprising two channel members secured together at right angles supporting said receiving and tuning apparatus in said cabinet, said chassis being removable through the top of said cabinet, and a cover secured to said chassis.

11. A radio receiving set in combination with a chassis for the radio receiving set, comprising an L-shaped frame having a vertical channel, a base provided with depending sides, and a top, said top and base being connected by said vertical channel.

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