

July 28, 1931.

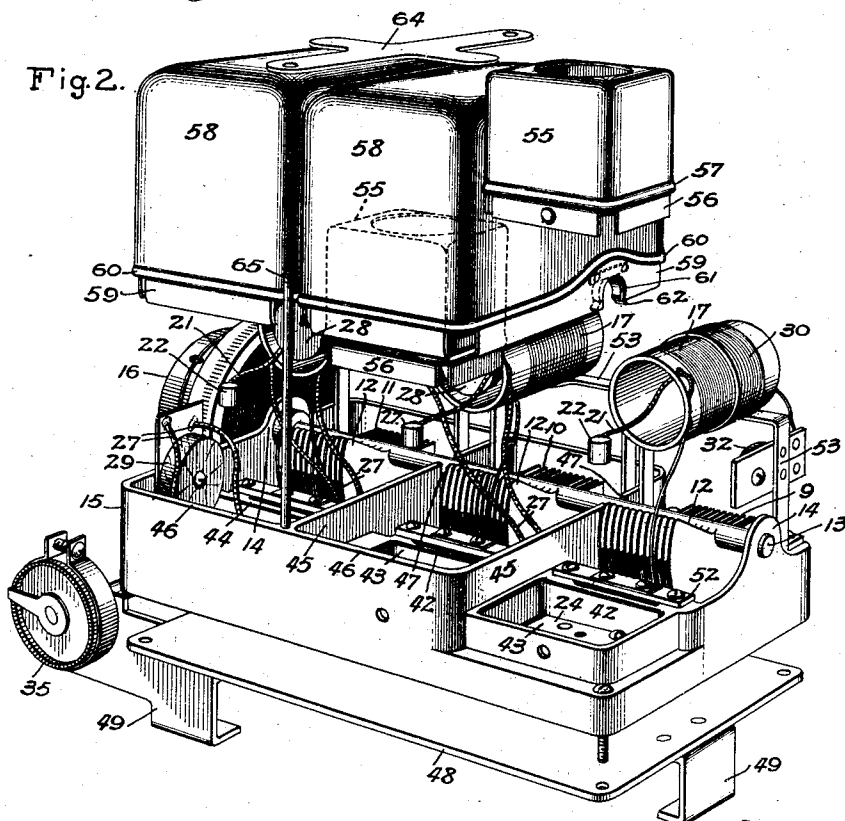
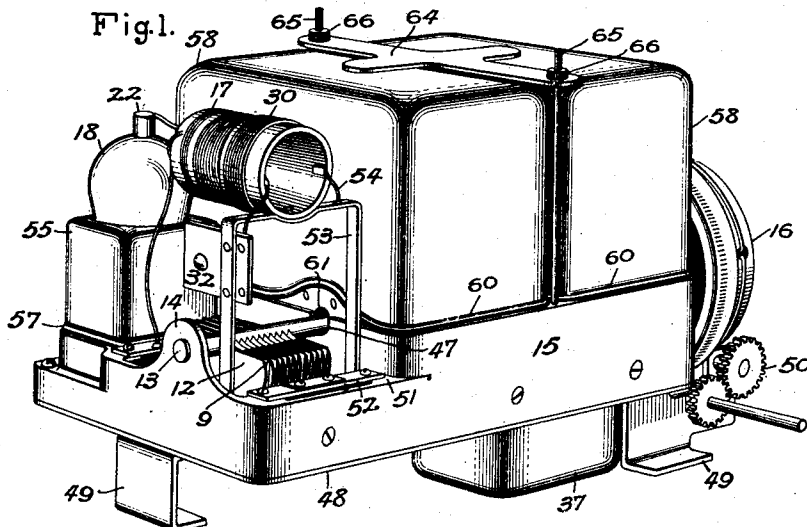
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1,816,718

SHIELDED RADIO RECEIVING APPARATUS AND THE LIKE

Filed Feb. 19, 1930

2 Sheets-Sheet 1



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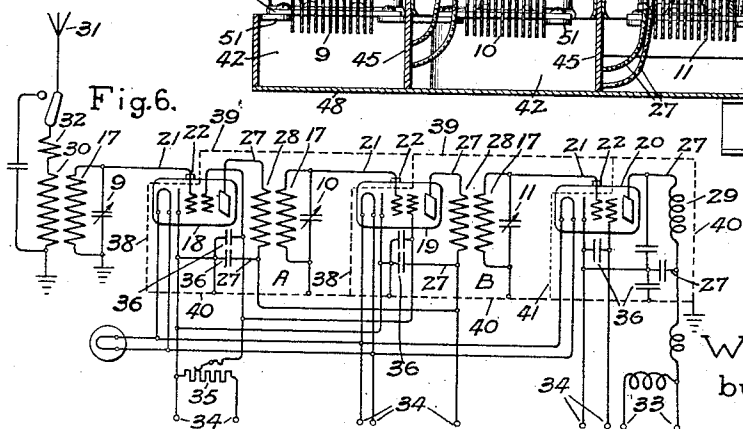
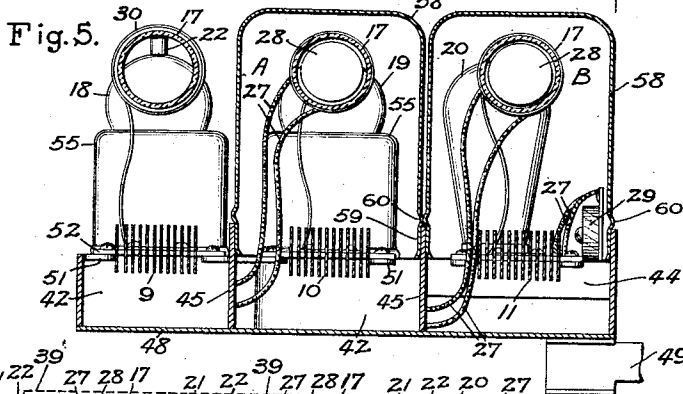
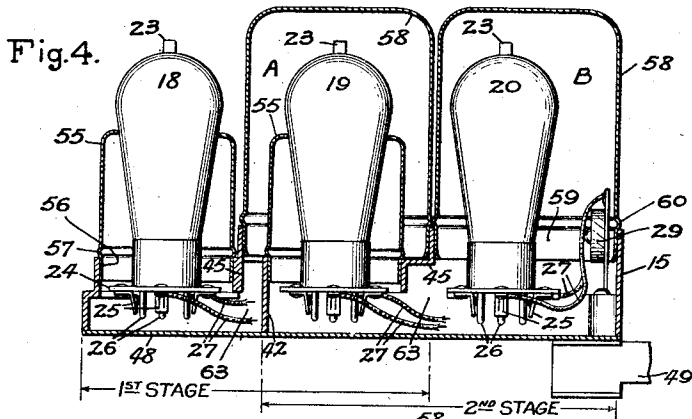
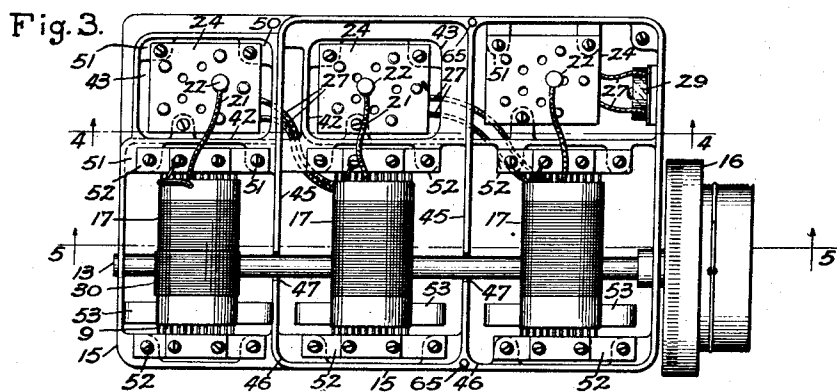
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2 Sheets-Sheet 2



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UNITED STATES PATENT OFFICE

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SHIELDED RADIO RECEIVING APPARATUS AND THE LIKE

Application filed February 19, 1930. Serial No. 423,757.

The present invention relates to shielded radio receiving apparatus and the like, in which metallic shielding is arranged to surround the apparatus and to protect it not only from external electrical influences tending to create disturbing impulses in the various circuits of the apparatus, but also from undesired electrical coupling between the component parts of the apparatus, such as the tuning inductances, for example. Such electrical coupling may be both electrostatic and electro-magnetic, or either one of them.

In modern receiving apparatus and the like, embodying high gain radio-frequency amplifiers, such as screen grid amplifier tubes for example, the shielding of the component parts from each other by metallic envelopes or shields has become increasingly important and various types of shielding are now in use for that purpose. Examples of extensive and effective shielding means for high gain amplifiers may be found in the copending application of Albert W. Hull, Serial No. 166,773, filed February 8, 1927, and in the patent to Harry C. Thompson, 1,659,542, both of which are assigned to the same assignee as the present application. Such shielding may often be complicated in construction, costly, and unadapted for manufacture in quantities. Its effectiveness determines to a large extent the sensitivity or amplifying power of the apparatus for which it is provided.

In modern receiver design and in the design of radio apparatus of this type, intended for commercial use, the problem of cost reduction and adaptability to quantity production is important and must be considered along with the problem of providing adequate and effective shielding. It has been found that while it is comparatively easy to provide an elaborate and expensive shielding to gain effectiveness, it is much more difficult to provide the desirable and necessary features of an effective shield in a construction adapted for commercial and quantity production.

It is, therefore, the primary object of the present invention to provide a shield con-

struction for radio receiving apparatus and the like, embodying high gain amplifiers such as screen grid tubes, which includes the desirable and necessary shielding features in an effective and economical manner.

It is a further object of the present invention to provide an effective and economical shield of the above type having a base which forms a frame or chassis for the apparatus for which the shielding is provided and is a major element of the shielding for such apparatus. In certain apparatus having a multiple tuning means such as a gang condenser or capacitor, it is a further object of the invention to utilize the frame of such capacitor as the chassis or base above defined.

The invention will be better understood and other objects and advantages thereof will be apparent from the following description, when taken in connection with the accompanying drawings, and its scope will be pointed out in the appended claims.

In the drawings, Fig. 1 is a front view in perspective of the assembly of a shielded radio receiving apparatus embodying the invention; Fig. 2 is a similar view of the rear of the apparatus of Fig. 1 with parts of the shielding raised to expose the interior thereof; Fig. 3 is an interior plan view of the apparatus as shown in Fig. 2 with parts of the shielding removed; Fig. 4 is a sectional view of the apparatus taken along line 4-4 of Fig. 3 in the direction of the arrows and showing the manner in which the input circuit of each tube is shielded from its output circuit; Fig. 5 is a similar view taken along line 5-5 of Fig. 3 in the direction of the arrows showing the manner in which inductance devices in the apparatus are shielded from each other, and Fig. 6 is a schematic wiring diagram of a radio receiving apparatus embodying a multi-stage high-gain radio-frequency amplifier which the shield of the present example is adapted to enclose.

Referring to Figs. 1 to 5 of the drawings, in which the same reference numerals are applied to like parts, 9, 10, and 11 are the stator sections of a multiple tuning capacitor having a common rotor comprising sec-

tions 12 carried by a common shaft 13. The shaft is journaled in suitable bearings 14 (Fig. 2) provided in the ends of a rectangular metallic frame 15 and is driven by a tuning drum 16. This is a common form of tuning means for a radio receiving apparatus and may include any desired number of sections corresponding to the number of tuned circuits employed in the apparatus.

Connected with each section of the tuning capacitor and providing therewith a tuned circuit, is an inductance or winding 17. In the present example three inductances are shown and together with the tuning capacitor having the same number of sections represent any number of suitable tuning elements for a radio receiving apparatus. The tuned circuits provided by the associated inductances and tuning capacitor may be connected in any suitable manner to tune the apparatus. In the present example they are arranged to provide successive tuned circuits in a multi-stage radio frequency amplifier and detector apparatus for a radio receiver. As the remainder of the radio apparatus, including the output circuits and supply circuits, do not concern the present invention, the same are not shown in the drawings.

For use in a radio receiving apparatus of the above type, the tuned circuits formed by the associated inductances and tuning capacitor are adapted to be connected with the input or control electrodes of electric discharge devices such as screen grid tubes 18, 19 and 20, and for this purpose are provided with output leads 21 and terminal means or caps 22 for connection with the control electrode terminals 23 of such tubes. Suitable circuit terminal means, such as tube sockets 24, are provided for mounting the tubes, and include contact terminals 25 for making connections with the tube base prongs or terminals 26 in the usual manner. The circuit terminals are provided with suitable output circuit leads 27 and are adapted to connect with supply leads (not shown).

With this arrangement, the tubes 18, 19 and 20 are each connected with a tuned input circuit including an inductance and a variable capacitor section and with output circuit leads 27, and represent by way of example, a series of tuned amplifier circuits or stages for a radio receiving apparatus as hereinbefore mentioned. The two stages represented in the present example may be designated as the first or input and the second or intermediate stages, as noted in connection with Fig. 4. It will be seen that these stages overlap physically and that an output tube is located in the second stage.

For the purpose of illustrating the complete high frequency amplifying and detecting system of a radio receiving apparatus, the tube 20 included with the second stage

may be considered to be a detector, while the stages containing tubes 18 and 19 are radio frequency amplifier stages of the high gain type, screen grid tubes being employed therein.

The stages shown are connected in cascade by connecting the output leads 27 of the first and second stages with high inductance primary windings 28, associated with the successive inductance windings 17 as indicated in the drawings, particularly Figs. 2, 3 and 5. It is evident that the output leads of the tube 20 of the present example may be connected in a similar manner to a similar tuned output means. However, with this tube employed as a detector, the output leads therefrom are connected with the remainder of the receiving apparatus (not shown) preferably through a high frequency choke coil 29.

High frequency energy to be amplified and detected is supplied to the first stage through suitable means such as a coupling winding 30 associated with the winding 17 for tube 18 in inductive relation thereto.

The circuit arrangement of the above described radio receiving apparatus embodying a high frequency, tuned amplifier of the high gain screen grid type will be clear from a consideration of a typical circuit diagram for the same shown in Fig. 6, to which, along with the preceding figures of the drawing, attention is now directed, and in which figure the reference numerals of the preceding figures have been applied for the same parts.

In Fig. 6, tubes 18, 19 and 20 are connected with their respective input circuits through leads 21, and the various stages are coupled in cascade through output leads 27 and primary windings 28, each associated with an inductance winding 17. The first stage is supplied with signal energy from any suitable source, such as an antenna 31 through a loading coil 32 and the input primary winding 30, and the amplified signal energy is delivered through the two amplifier stages including tubes 18 and 19 and the detector tube 20, to an output circuit including choke coils 29 and an output terminal 33.

Power terminals for operating currents and voltages are indicated at 34. Included in circuit with certain of such terminals is a volume control potentiometer or volume control device 35 for controlling the screen grid potentials of the amplifier tubes 18 and 19. The power circuit connections between the tubes are suitably by-passed by fixed capacitors or condensers 36. These serve to complete the shielding of the circuits where they leave the various stages and should be closely associated with each stage for which they are provided.

The physical location of primary loading coil 32 is indicated in Figs. 1 and 2, while

that of the volume control means 35 is indicated in Fig. 2 only. The by-pass condensers 36 may be mounted in suitable containers or cans such as that shown at 37 in Fig. 1. The container type of mounting means represented by can 37 may be used for mounting other apparatus of the receiver. The location of such containers in the apparatus will be further discussed hereinafter.

The circuit connections in detail do not concern the present invention, hence, further description of the circuit is believed to be unnecessary. The circuit diagram shown is typical of a radio receiving apparatus embodying a high gain high frequency amplifier using screen grid tubes and is shown only by way of example as being illustrative of that type of apparatus for which the shielding of the present invention is particularly adapted.

The essential elements with which the invention is concerned are the shielding and physical arrangement of the high frequency circuits of the apparatus, such as successive tuned stages involving inductances, tuning capacities, high gain amplifier tubes, and the leads by which the coupling means or primary windings and the tuned circuits are connected with the tubes.

In an apparatus of the above character, a compact arrangement of the above named component parts is desirable and necessary for modern receiver design. This necessitates a close arrangement of parts which, without shielding, or protection by metallic casings or walls, would be impossible for electrical reasons. Electrical couplings, electrostatic, electro-magnetic or both, between the tuned circuits of adjacent stages, as well as between the input and output circuits of the same stage must be made as small as possible. To provide shielding to accomplish this which will be highly effective and which may be economically manufactured in quantity, involves a careful consideration of the circuit components to be shielded.

Considering the circuit diagram of Fig. 6 as an example of a circuit to be shielded or to be embodied in shielded receiving apparatus and the like, in accordance with the invention, a wall or shield represented by dotted line 38 may be placed between the input circuit and lead of each tube, and its output and power supply leads, which wall or shield will serve to electrically isolate the input of each tube from the output and power supply leads thereof. By extending the shielding by additional shields, for example by walls indicated by dotted lines 39 and 40, the inductances and condenser units of the tuned input circuits are shielded from each other, that is the tuning elements or tuned circuits of the various stages are shielded from each other.

In the present example, since the first stage is coupled to an open antenna, the tuning means for that stage is not necessarily shielded, as indicated. This is for the reason that, being exposed to external electrical influence through the medium of the antenna coupling, shielding would be relatively ineffective. The tuned circuits of the remaining stages and for the detector are shielded from external electrical influences or forces, by the same shielding which isolates them from each other.

In the circuit of the present example, the third tube, 20, is the detector and accordingly does not require a shield between its input and output circuits. It is obvious that shields may be added, in case that this tube functions in another amplifier stage, in the same manner as shield 38, as represented by the fine dotted line 41. The diagrammatic representation of the shielding is completed by a wall indicated by dotted line 40.

It will be noted that the shielding arrangement as a whole is divided into compartments which are here designated as compartments A and B, each compartment including the elements providing one stage, that is, the tube with its output and supply leads and a tuned circuit coupled with its output circuit or leads. In the case of compartment B which contains a tuned circuit connected with the detector, the detector tube 20 itself is contained in the same compartment. Were it an amplifier tube, however, it would be isolated from the tuned input circuit by shielding wall indicated by dotted line 41 as above mentioned.

The shielding is so placed that it isolates or shields the control electrode terminal from the output circuit of an amplifier device or tube; in a multi-stage tuned high frequency amplifier it isolates or shields the tuned circuits, particularly the inductances, one from another, and it shields the tuned circuits and circuit means, particularly the inductances and the electric discharge devices, from external electrical influence. Each stage, such as shown diagrammatically in compartment A of Fig. 6 is not wholly in the same section of the physical structure, see Figs. 1-5. In order to accomplish the primary object of the invention, the tube or electric discharge device, with its output and power supply leads, is physically located in the section with the preceding stage, but shielded from that stage, as hereinafter described.

The shielding is thus based upon an understanding heretofore not clearly developed in the art, of the essential elements of an amplifier stage for the purpose of applying effective shielding thereto in multi-stage amplifier apparatus. To provide such shielding each stage may best be considered

to include the electric discharge device and its output means, that is, its output circuit together with the necessary power supply connections, and the means for transferring the amplified output to a succeeding apparatus or device. In the present example this last means is the tuned circuit associated with the output circuit of a preceding tube and providing the input circuit for the succeeding stage. A stage is therefore that apparatus contained in compartment A (Fig. 6) of the present example or compartment B, less the detector or output tube 20.

Referring now to the preceding figures of the drawings in which the principles of shielding outlined diagrammatically in Fig. 6, are carried out in a receiving apparatus, in accordance with the invention, the rectangular frame 15 for the multiple tuning capacitor is arranged to support the tube sockets 24 in alignment with the tuning capacitor sections longitudinally of the frame, and laterally in alignment with each other, providing parallel, laterally extending rows of tuning capacitor sections and tube sockets. The tuning inductances 17 for the various stages are arranged to occupy positions above and in spaced vertically aligned relation with their respective tuning capacitor sections, while the corresponding space above each tube socket is adapted to be occupied by the tube for a succeeding stage, when the apparatus is assembled for operation.

It will be seen that this arrangement of the parts or elements of the apparatus makes for a high degree of compactness which is desirable in an apparatus of this character, and is best shown in Figs. 3, 4 and 5. It will be noted that this arrangement permits the grid leads 21 to be short and well spaced from other apparatus in all directions, that is, it provides low capacity to ground for these leads and avoids the more common use of piping or other enclosing means to shield these leads.

The tube sockets and tuning capacitor are on substantially the same level in the frame while the tubes and inductances are, respectively, vertically above them. The coils or inductances, tuning capacitor sections, tube sockets and tubes for the various stages are thus physically aligned in substantially parallel, vertical, longitudinally extending planes and it will be seen without interfering with the electrical circuit arrangement of the stages or their interconnection. With this physical arrangement and grouping of the various elements of the apparatus, shielding is readily applied thereto in accordance with the principles outlined in connection with Fig. 6.

Within the confines of the frame 15, low vertical metallic walls 42 cooperating with the walls of the frame provide rectangular

shielding walls 43 about the circuit terminal means or amplifier tube sockets 24 in the present example. The well construction about the circuit terminals for the tubes serves to shield each amplifier tube with its base output and power supply leads from all parts not electrically associated with it as a stage or compartment, as defined in connection with Fig. 6 and the explanation of it already given. In the present example, the detector socket terminals are not so shielded as it is found to be unnecessary. In connection with the detector tube socket shown, the well construction is reduced to a transverse bar or bridge wall 44, arranged to form with certain portions of the walls 42 of the socket wells which are aligned with it, a bridge wall which extends transversely across the frame between the walls which carry the tuning control shaft bearing, and parallel to the shaft between the tuning capacitor sections and the tube sockets. This serves to brace the frame, and also to support the tuning capacitor stators.

The frame is also divided longitudinally by parallel, vertical, metal partitions 45, located between the stators of the tuning capacitor and extending between the front and rear walls of the frame to shield said stators one from another and to form in said frame a series of parallel rectangular openings 46, substantially at the level of the tuning capacitor shaft, the partitions being notched as indicated at 47 to provide slight clearances about the shaft.

The shield structure of the frame is completed by a closure means at the bottom in the form of a flat metal base plate 48, secured to the bottom of the frame in contact with the walls of the frame and the partitions 42 and 45 as indicated in the drawings, particularly in Figs. 2 and 5. The plate is provided on its lower side with suitable supporting brackets 49 which serve as feet to support the apparatus when the plate is applied to the frame and to provide a space beneath the plate for mounting such apparatus as the can 37, Fig. 1. The brackets or feet on the frame serve not only as spacing and supporting feet for the apparatus, but are so located at the edges of the base plate that they are also adapted to carry auxiliary apparatus such as the volume control potentiometer 35, Fig. 2, and its control means indicated at 50, Fig. 1. For the sake of simplifying the drawings, this is not shown in Fig. 3, nor is the volume control device shown except in Fig. 2 and as represented in Fig. 6. One of the brackets is shown in Figs. 4 and 5 and these figures together with Figs. 1 and 2 illustrate the construction of the supporting means for the frame.

Further in regard to the above chassis or base construction, it is obvious that any suitable means may be provided to close the

bottom of the frame. For example, the base plate may be provided integral with the frame, that is, the frame may be provided with a closed bottom wall represented by plate 48. As shown it merely represents a removable base or bottom wall for the frame, and being removable serves to facilitate wiring or inspection of the interior of the frame from the bottom.

In the present example, the partitions 45 are integral with the frame and form a part of it as are also the walls 42 for the socket wells and the transverse wall represented by the extension of wall 44. This construction is easily carried out in manufacture by casting the entire frame structure above named in one piece of metal such as an alloy of zinc, or aluminum.

With this construction, suitably spaced lugs or brackets 51, are provided throughout the frame on the walls and partitions for the support of the sockets 24, the tuning capacitor stators 9, 10 and 11 and the base plate 48, as indicated in the drawings, particularly in Fig. 3. The lugs or brackets 51 are preferably cast integral with the frame and partitions as indicated. The tube socket bodies are of insulating material and are secured directly to the lugs 51 in the socket wells while the tuning capacitor stators are secured to strips of insulating material 52 which are in turn mounted upon suitably located lugs 51.

For the support of the inductances 17, simple U-shaped metal brackets 53 are provided and secured at their ends to the base plate 48. Being thus grounded to the metallic structure they serve as a combined supporting and grounding means for each inductance, one inductance lead being readily connected therewith as indicated at 54, Fig. 1.

It will be seen from the foregoing description that the tube sockets are isolated from each other and from the tuning capacitor by walls about the tube sockets, certain of the walls thereof forming a common partition wall which divides the frame transversely between the tuning capacitor and the row of tube sockets; that the frame is divided longitudinally by partitions between the tuning capacitor stators, which shield the latter one from another, and which, together with the walls of the frame, enclose the apparatus within the frame in a series of sections having top openings, the bottoms of which sections are closed by a common base plate attached to the frame.

The tuning capacitor frame thus serves as a combined shield and base unit or chassis for the apparatus, being provided in its side walls with bearings for the condenser shaft, with stator and socket supporting brackets on its inner walls, with partitions providing openings 46 for the application of

further shielding, and with coil supporting means in connection with its base plate. The frame is strengthened and made rigid by its closed rectangular construction and by the transverse and longitudinal partitions.

Mounted on the frame or chassis are a plurality of inverted shields or shield cans 55 adapted to be placed over the sockets 24 and being of a size and height to enclose the tubes and provide a shield between the input or control terminal connection therefor, and the output and other socket or base connections. For this purpose the shields are provided with top openings through which the tubes may project as indicated in Figs. 1, 4 and 5.

The shields 55 are rectangular in shape in the present example, and are provided with flexible lower edges 56 whereby they are adapted to be pressed into the socket wells 43 to a seated position against a bead 57 formed in each shield, about and spaced from its lower flexible edges. The socket wells in the chassis thus serve to close the bottoms of the tube shields.

A plurality of similar inverted shields or shield cans 58 are provided for the coils or inductances 17 and are similarly mounted upon the frame or chassis to surround said inductances and to shield them from each other and from external disturbances. These shields are provided with flexible lower edges 59 surrounded by a bead or stop means 60 and are of such rectangular shape that they may be pressed with a tight fit to a seated position in the openings 46 in the chassis. The chassis thus serves to support the shields and the latter serve as closure means for the openings 46 therein. The shields 58 must be of such size and height that with the chassis they will completely enclose tube shields 55, the tubes and the tuning capacitor section for each stage and in conjunction with the chassis section form a series of enclosures or compartments A and B, Figs. 4 and 5, for the successive stages corresponding to the compartments as outlined diagrammatically in Fig. 6. The input stage is not so shielded in the present example, although it is obvious that such shielding may be placed about it. The coils or inductances are located wholly within separate individual shields 58 although such shields have a common base.

With this arrangement a double wall shield is provided between the coils, Figs. 1, 2 and 5, which is more effective than a single wall, and each shield forms a lap joint with the chassis or base, providing an effective continuous shielding with the chassis. It will be noted that the corners of the bottom edges or skirts 56 and 59 of the shields or shield cans 55 and 58, respectively are cut away. This is not only to give the edges or skirts flexibility, but also to avoid the possi-

bility of poor or changeable contact in the corners between the shields and the chassis, whereby contact noises and irregular operation are avoided. Contact is thus made along the sides and ends of the shields and not at the corners.

The larger or outer shields 58 are notched or recessed as indicated at 61, corresponding to notches or recesses 47 in the partition walls to surround the shaft 13 with a slight clearance space as indicated in the drawings. At each recess 61, the larger or outer shields are provided with spring clips or contacts, one of which is indicated at 62 in Fig. 2. These contacts are adapted to engage the shaft 13 when the shields are seated on the chassis, and serve to connect the shields electrically with the shaft by a better contact than that provided through the end bearings to the chassis.

Each circuit terminal well communicates with the adjacent compartment in the direction of the output, or the compartment of the succeeding stage with which the output leads are connected, through an opening 63 (Fig. 4) in the adjacent longitudinal partition wall 45, and in one side of the well, as indicated in Figs. 3, 4 and 5. The output leads 27 may thus extend directly from the circuit terminals of the tube of one stage to the primary winding 28 associated with the inductance 17 of the tuned output means for that stage (see Fig. 6). This places the interior of the inner or tube shield and the socket terminal well in communication through a shielded channel with the succeeding section or the inductance shields (in the direction of the output) whereby the output and power supply connections for the tube are electrically in the same compartment with the tuned circuit means or inductance associated with its output.

The shield may be considered to include a few simple component parts such as the chassis 15, the outer removable portions 58 of the shield, and the removable inner or tube shields 55. The latter are located within the larger shields to provide what may be considered to be a shield within a shield. The chassis includes a simple rectangular frame, preferably of cast metal, divided by longitudinal partitions into a plurality of main sections. Each of the main sections is further divided by a transverse partition into two smaller sections. The longitudinal partitions at 45 shield the individual sections of the variable tuning capacitor from each other and the transverse partitions at 42 shield the tube sockets from the variable tuning capacitor and from each other. The chassis is therefore a partitioned and chambered frame having top openings and shielded communication channels between the interior sections of the frame.

In the present example the two larger

or outer shields 58 fit snugly into the center and right sections of the chassis, and with the chassis provide two compartments completely shielded from each other and from the left section. They form a double wall shield between the inductance coils of the last two circuits which is far more effective than a single wall shield for the proper operation of apparatus embodying high gain amplifier stages.

It will be noted in Figs. 1 and 2 that while the shield cans 58 are provided with lower edges 59 which are pressed into tight overlapping engagement with the frame or chassis, an additional holding down means is provided in the form of a plate 64 of suitable form to engage the tops of shield cans 58 and is pressed down against them by suitable clamping means in the form of a pair of tie rods 65 mounted on the frame 15 and provided with threaded upper ends on to each of which is screwed a thumb nut 66. The plate is easily stamped from sheet metal and the tie rods and thumb nuts are relatively inexpensive to manufacture.

The purpose of the holding down means is to prevent any slight movement of the shield cans 58 with respect to the chassis when the apparatus is in operation as it has been found that with high gain amplifiers any slight movement of two abutting portions of the shielding may and usually does cause noises in the output of the apparatus. This is believed to be due to changes in the resistance of the shielding path to circulating currents flowing in the shielding.

Viewed in one of its aspects, the shielding system thus described may be considered to include a chambered apparatus base or chassis and a series of inductance chambered apparatus base or chassis and a series of inductance and tube shields or shield cans mounted upon said base, each inductance shield being in shielded communication through the base with one of the tube shields and each inductance shield being arranged in connection with the base to provide a shielded compartment to surround and to enclose the tuning capacitor section associated with the inductance, along with another tube shield electrically isolated and shielded from the interior of said compartment, whereby the input of said tube is located adjacent the output lead from the tuned circuit provided in the compartment.

Viewed in another of its aspects, the shielding system above described may be considered to include a rectangular base providing an apparatus chassis and having a series of top openings with removable shield cans adapted to be seated in said openings and providing lapped joints therewith to close the same, and the base being adapted by the provision of suitable partitions be-

tween said openings to cooperate with the shield cans to provide a series of closed compartments. Located in each compartment is an inductance, and a circuit terminal connection means, such as a tube socket, and in at least one of said compartments is located an inner shielding means interposed between said inductance and the circuit terminal connection means, such shielding means including a removable portion and a base portion, the latter being in the form of a circuit terminal shielding well and communicating with an adjacent compartment.

What I claim as new and desire to secure by Letters Patent of the United States, is:

1. A shield for radio receiving apparatus and the like including in combination, an open metallic frame having integral transverse and longitudinal partitions dividing it into sections, a well in one of said sections communicating with an adjacent section of said frame, a removable shield mounted in said well, a second removable shield mounted on said frame and providing a closure means for said adjacent section, and an enclosing means for one of said shields.

2. A shield for radio receiving apparatus and the like including in combination, a chambered apparatus base having a series of top openings, a series of shield cans mounted on said base and forming closure means for said openings, a second series of shield cans mounted on said base, at least one of said last named shield cans being enclosed by one of said first named shield cans and being in shielded communication through the base with the interior of another of said first named shield cans.

3. A shield for radio receiving apparatus and the like including in combination, a chassis for said apparatus, a plurality of shield cans mounted on said chassis for shielding electric discharge devices of the radio tube type, a plurality of inductance shield cans mounted on said frame in spaced relation to each other, a plurality of spaced partitions extending longitudinally across said chassis and arranged to cooperate with said inductance shield cans to provide a plurality of shielded compartments, said partitions being arranged to provide openings between said tube shield cans and said compartments.

4. A shield for radio receiving apparatus and the like including in combination, a frame providing a chassis for said apparatus, a plurality of open end shield cans mounted on said frame and adapted to provide shields for surrounding electric discharge devices of the vacuum tube type, a plurality of inductance shield cans mounted on said frame in spaced relation to each other, means providing a shielded channel of com-

munication between one of said tube shields and one of said inductance shields, a plurality of partitions extending across said frame and arranged to cooperate with said inductance shield cans to provide a plurality of shielded compartments, at least one of said tube shield cans being mounted within one of said compartments.

5. A shield for radio receiving apparatus and the like including in combination, a rectangular metallic shield frame, a shaft extending transversely across said frame, bearings for said shaft in the end walls of said frame, a plurality of longitudinally extending partitions in said frame providing with the walls thereof a plurality of openings in the frame, means for closing said openings and providing with the frame a plurality of shielded compartments, walls in at least one of said compartments providing a well communicating with an adjacent compartment, a circuit terminal means located in said well, and a removable shield adapted to seat in said well and provide a shielding enclosure about said circuit terminal means.

6. The combination with an electrical apparatus including a circuit tuning control means having a plurality of sections, a control shaft therefor and a plurality of inductances cooperating with said tuning control means to provide a plurality of tuned circuits, of a shielding means for said apparatus including an open metallic frame adapted to surround and support said tuning control means and shaft, a plurality of tube sockets mounted in said frame, walls integral with the frame providing wells about said tube sockets, partitions integral with the frame extending between the sections of said tuning control means, means for supporting said inductances substantially vertically above and in spaced relation to each of said tuning control sections, a separate shield can adapted to surround each of said inductances and to engage the frame with a lap-joint, said shield cans providing a double wall shield between one inductance and another and a closure means for the frame, and a tube shield mounted in each of said socket wells.

7. The combination with an electrical apparatus including a circuit tuning control means having a plurality of sections, a control shaft therefor and a plurality of inductances cooperating with said tuning control means to provide a plurality of tuned circuits, of a shielding means for said apparatus including an open metallic frame adapted to surround and support said tuning control means and shaft, a plurality of tube sockets mounted in said frame, walls providing wells about said tube sockets, said walls being arranged to provide a common shield wall between said sockets and said

sections of the tuning control means, partitions extending between the sections of said tuning control means and arranged to shield said sections of the tuning control means from each other, a separate shield can adapted to surround each of said inductances and to engage said partitions with a lap-joint and form a double wall shield between said inductances, individual tube shields adapted to be mounted in said socket wells to surround and shield a tube when mounted in the socket of said well, and a closure means for the bottom of said frame.

8. The combination with an electrical apparatus including a circuit tuning control means having a plurality of sections, a control shaft therefor and a plurality of inductances cooperating with said tuning control means to provide a plurality of tuned circuits, of a shielding means for said apparatus including an open metallic frame adapted to surround and support said tuning control means and shaft, a plurality of tube sockets mounted in said frame, walls providing wells about said tube sockets, said walls being arranged to provide a common shield wall between said sockets and said sections of the tuning control means, partitions extending between the sections of said tuning control means and arranged to shield said sections of the tuning control means from each other, a separate shield can adapted to surround each of said inductances and to engage the frame with a lap-joint, said shield cans providing a double wall shield between one inductance and another and a closure means for the frame, individual tube shields adapted to be mounted in said socket wells to surround and shield a tube when mounted in the socket of said well, and a closure means for the bottom of said frame, said means including a plate secured to the bottom of said frame and supporting feet for said frame arranged to provide a mounting space below said frame.

9. The combination with a radio frequency amplifier of a shielding and supporting means therefor, including a tuning capacitor frame, a base connected to said frame, partitions extending across said frame and dividing the same into sections, a bottom plate for said frame, shield cans mounted on said partitions and providing covers for said sections, each of said shield cans forming with its corresponding resilient frame section and said base a shielded compartment, a plurality of tube shields, and means for mounting each of said shields in the frame, at least one of said means being located within the confines of one of said sections whereby it is adapted to be enclosed by one of said shielded compartments, and the interior of said shield mounting means being in communication with the interior of an adjacent section.

10. The combination with a tuning capacitor having a plurality of sections and a common control shaft, a plurality of inductances associated therewith, and tube sockets for a plurality of amplifier tubes, of a common support and shielding means including a metallic frame for said tuning capacitor providing bearings for said shaft and a support for said tube sockets, transverse and longitudinal metallic partitions in said frame arranged to separate and shield said tube sockets and tuning capacitor sections from each other, a shield can adapted to surround and with the base to enclose an inductance, a tuning capacitor section and a tube socket, and means for holding said can in a seated position on said frame.

11. In combination, a multiple tuning capacitor having a shaft, a frame supporting said shaft, a closure means for the bottom of the frame, individual removable closure means for the top of the frame, certain of said last named closure means being adapted to cooperate with the frame to provide a series of closed shielded compartments, a tube terminal well in one of said compartments communicating with an adjacent compartment, and a removable tube shield mounted on and forming a closure means for said well.

12. In combination, a multiple tuning capacitor having a shaft, a frame supporting said shaft, a closure means for the bottom of the frame and individual removable closure means for the top of the frame, certain of said last named closure means being adapted to cooperate with the frame to provide a series of closed shielded compartments, a tube terminal well in one of said compartments communicating with an adjacent compartment, a removable tube shield mounted on and forming a closure means for said well, a tuning capacitor section located in each of said shielded compartments, and an inductance coil connected and located in the same compartment with each of said sections of the tuning capacitor to provide a series of tuned shielded circuits.

13. In a radio receiving apparatus, a metallic base, a tuning control means mounted on said base and including a series of individual sections, walls on said base extending between said sections to shield the latter one from another, an inductance coil associated with and mounted in spaced relation to each of said sections, a removable metallic shield can mounted on said base in contact with said walls, and forming with the base a closed shielding compartment for one of said tuning capacitor sections and its associated inductance, means providing a shielded channel of communication between the interior of the compartment and the exterior thereof, walls providing a well within said compartment and in said channel of

communication, and a shield for an electric discharge device arranged to provide a closure for said well within the compartment.

14. In a radio receiving apparatus, a base, a tuning control means mounted on said base and including a series of individual sections, walls on said base extending between said sections to shield the latter one from another, an inductance coil associated with and mounted in spaced relation to each of said sections, a plurality of removable metallic shield cans mounted on said base in contact with said walls, said cans being arranged to provide closure means for the base and with the base a series of closed compartments, a tuning capacitor section and its associated inductance being located in each of said compartments, and said cans being spaced apart to provide a double wall shield between said enclosed inductances, walls in one of said compartments providing a circuit terminal well communicating with an adjacent compartment, and a shield for an electric discharge device arranged to provide a closure means for said well.

15. A shield for radio receiving apparatus and the like including in combination, a metallic base providing a chassis for said apparatus and having a series of top openings, a plurality of removable shield cans each being adapted to seat in one of said top openings to close the same and to provide with the chassis a series of shielded compartments, an inductance winding located in each of said compartments, a circuit terminal connection means located in one of said compartments, and an inner shielding means interposed between said circuit terminal means and the inductance winding in said compartment, said shielding means including a removable portion and a base portion, the latter being in the form of a circuit terminal shielding well in communication with an adjacent compartment.

In witness whereof, I have hereunto set my hand this 18th day of February, 1930.

WILLIAM L. BOND.

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