

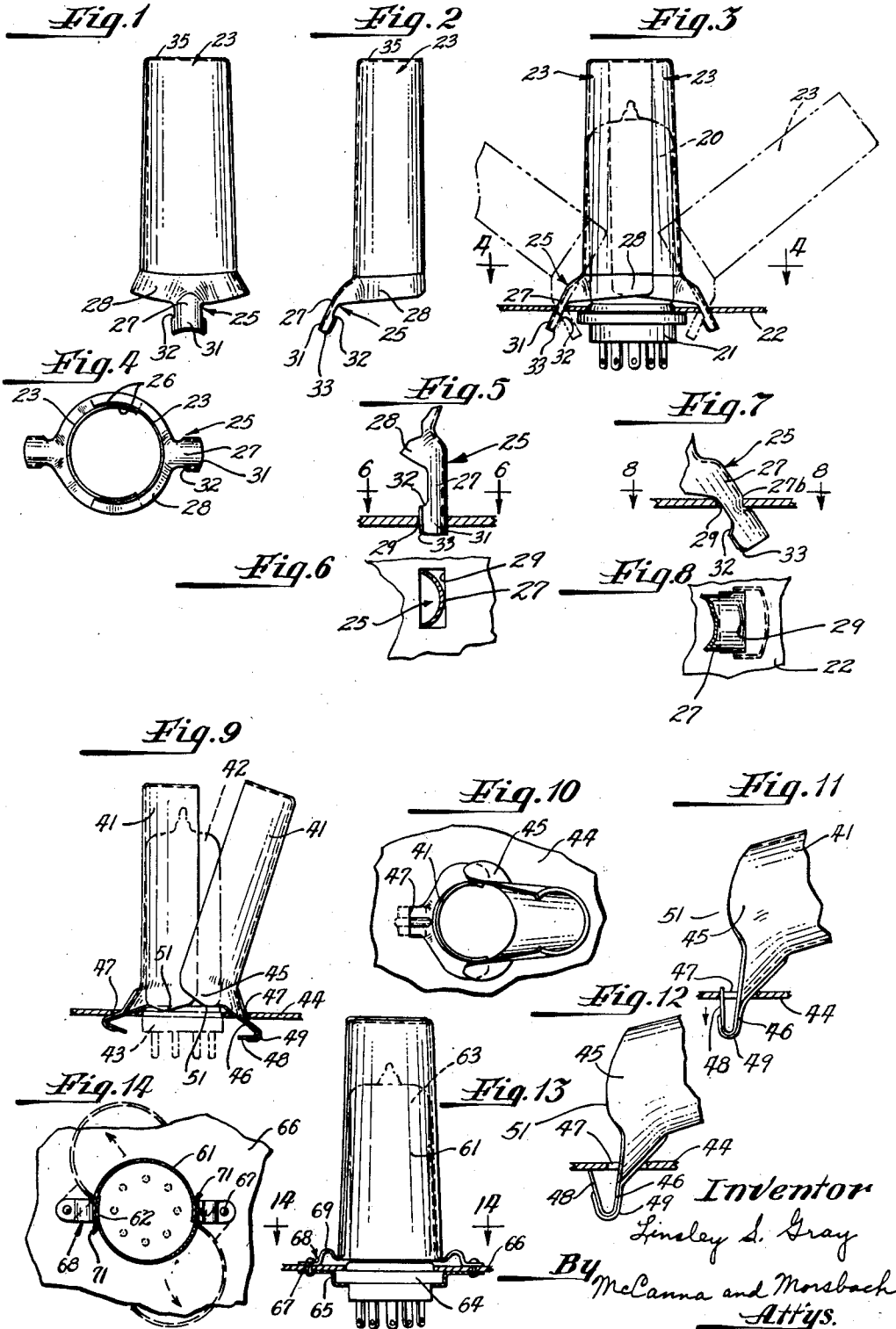
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SHIELDING DEVICE

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SHIELDING DEVICE

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This invention relates to shielding devices and more particularly to a shielding device for electron discharge devices.

It is common practice to provide shields for electron discharge devices, generally referred to as tubes, in certain applications as when it is desired to shield the discharge device for external radiation; to prevent inductive or capacitive coupling between the discharge device and the apparatus external to the discharge device being shielded, and also when it is desired to limit radiation from the discharge device. Such shields are formed of an electrically conductive material and shaped to surround the tube to form an enclosure therefor. In order to function effectively, the shield must be electrically grounded, usually to the chassis of the electrical apparatus.

In addition to the electrical requirements of shielding the tubes, it is also desirable to maintain the tubes firmly in their sockets to provide proper electrical contact between the tube prongs and the socket. This is particularly essential where the discharge devices are mounted other than in an upright position on a horizontal chassis, as where the tubes are mounted to extend horizontally from a vertically disposed chassis or even to depend downwardly from an inverted chassis. When the tubes are mounted in this manner, any vibration of the chassis will obviously tend to loosen the tube and impair the contact between the tube prongs and the socket. It is therefore highly advantageous to provide a tube shield which, in addition to its shielding function, will serve to maintain the discharge device firmly on the tube socket.

The problem of maintaining the tube in its socket is aggravated by the relatively wide variations both in length and diameter of the tubes in any given series of tubes. A shielding device which is to maintain the tubes firmly in their socket must be capable of accommodating these wide variations in length and diameter.

A further problem in the shielding of the discharge devices arises in the use of the so-called "hot chassis" type electrical apparatus particularly in metal cabinets. Since the chassis in such apparatus is not at ground potential, it is essential that the chassis be electrically insulated from the metal cabinet in order to prevent the cabinet from also becoming electrically "hot." Since a misplaced tube shield could provide a conductive path between the chassis and the otherwise insulated metal cabinet, it is desirable in such applications to provide a tube shield which cannot become thus misplaced.

An important object of this invention is to provide a shielding device which will overcome the above-mentioned problems and provide a highly effective shield for the discharge device.

Another object of this invention is to provide an im-

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proved shielding device which will maintain the electron tube firmly on the tube socket to prevent loosening of the tube from the socket and assure proper contact between the prongs of the tube and its socket.

5 Another object of this invention is to provide a shielding device which is arranged to grip tube envelopes having widely different dimensional tolerances in both length and diameter and to hold the same firmly on the tube socket.

10 Yet another object of this invention is the provision of a shielding device which obviates the necessity of providing a separate base and which may be directly attached to the chassis of the electrical apparatus to provide a direct ground for the shielding device.

15 Still another object of this invention is the provision of a shielding device which need not be detached from the chassis to permit replacement of the discharge device and which therefore cannot be accidentally misplaced during servicing either on the wrong discharge device or between the chassis and the cabinet.

20 A further object of this invention is to provide a shielding device of simple and economical construction, which can be easily fabricated and mounted on the chassis of the apparatus.

25 A still further object of this invention is to provide a shielding device which can be easily detached from the tube to permit replacement thereof and thereafter readily reapplied to the tube.

30 These, together with various ancillary objects and advantages of this invention will be more readily appreciated as the same becomes better understood by reference to the following detailed description when taken in connection with the accompanying drawing.

Figure 1 is a rear view of one of the shield sections;

35 Fig. 2 is a side elevational view of the shield section taken on a plane at right angles to the plane of Fig. 1;

Fig. 3 is a side elevational view of the shielding device shown mounted on a chassis and clamped in position around a tube, the shield sections being shown in dotted

40 lines in their tube release position;

Fig. 4 is a horizontal sectional view taken on the plane 4—4 of Fig. 3;

Fig. 5 is a fragmentary sectional view through the chassis illustrating the tube shield in the process of being

45 mounted on the chassis;

Fig. 6 is a sectional view taken on the plane 6—6 of Fig. 5;

Fig. 7 is an enlarged fragmentary view illustrating the shield section mounting leg in the position thereof

50 when the shield section is clamped around the tube;

Fig. 8 is a fragmentary sectional view taken on the plane 8—8 of Fig. 7;

Fig. 9 is a side elevational view of a modified form of shielding device shown mounted on a chassis;

55 Fig. 10 is a top plan view of the shielding device illustrated in Fig. 9;

Fig. 11 is a fragmentary view illustrating the shield section, of the form shown in Fig. 9, in the process of being attached to the chassis;

60 Fig. 12 is an enlarged fragmentary view of one of the shield sections, of the form illustrated in Fig. 9, shown in its released position;

Fig. 13 is a side elevational view of another form of shielding device shown mounted on a chassis; and

65 Fig. 14 is a transverse sectional view taken on the plane 14—14 of Fig. 13.

The shielding device of the present invention is adapted

for use with any type electron discharge device, hereinafter referred to as an electron tube or simply a tube, and as shown in the drawings is applied to a tube of the so-called "miniature" type, it being understood that the size of the shielding device may be varied in accordance with the average dimensions of the tubes in other series so as to be used therewith to effect shielding of the tubes from external radiation and also to shield the tubes against radiation therefrom to other parts of the electrical apparatus. The tubes, indicated generally by the numeral 20, are mounted in a socket 21 which is attached to the chassis 22 of the electrical apparatus. The shielding apparatus is adapted to be mounted on the chassis adjacent the socket 21 to form an enclosure for the tube and thereby effect shielding of the latter.

The shielding device of the present invention comprises a plurality of channel-shaped sections formed of an electrically conductive material, which sections are adapted to surround the electron tube and shield the latter. In the embodiments illustrated, a pair of channeled sections, designated by the numeral 25 in the embodiment shown in Figs. 1-8, are provided, which shield sections are formed with an arcuate cross section to provide a somewhat cylindrical enclosure for the tube. Provision is made for releasably clamping the shield sections together around the tube and for this purpose the sections are formed so that the side portions 26 thereof overlap, as best shown in Figs. 3 and 4. Advantageously, the shield sections are identically shaped to reduce the number of different parts which must be fabricated and accordingly both of the transversely arcuate shield sections are formed to extend through an arc of more than 180° to provide the aforementioned overlap. While it is preferable to have both sections extend through an arc of more than 180° to permit overlap of either section on the other section, it is apparent that one of the sections may be formed to extend through an arc of 180° or less in which event the section which extends through an arc of more than 180° will always overlap the other, and if desired both sections may extend through an arc of only 180° in which event some separate means must be provided to lock the sections together.

In addition to shielding the electron tube against radiation to or from the tube, the shielding device is also arranged to releasably grip the tube envelope to retain the tube in its socket 21. The shield sections are preferably formed with a small inward taper, from the bottom to the top thereof and terminate at the upper end above the discharge device in a diameter smaller than the diameter of the tube. Consequently, when the shield sections are clamped together around the tube, the sections will contact the tube envelope around the periphery thereof at the upper end of the tube, as is clearly shown in Fig. 3. The overlapping portions of the tube sections, which extend beyond the center line of the tube, serve to clamp the sections together and draw the sections around the tube.

Provision is made for mounting the shield sections 23 for movement into and out of shielding position around the electron tube, to permit removal and replacement of the tube. Preferably, the means, designated generally by the numeral 25, for mounting the shield sections is arranged to support the shield sections directly on the chassis 22 of the electrical apparatus and in such a manner as to provide proper electrical connection therebetween. This obviates the necessity of providing a separate base for mounting the shield sections on the chassis and also provides an improved ground connection for the shield since it is directly grounded to the chassis instead of being connected thereto through a separate mounting base.

In the preferred form of the invention illustrated in Figs. 1-8, the mounting means is arranged to support the shield sections on the chassis for swinging movement in a plane through the axis of the electron tube, into and

out of overlapping relation. The mounting means comprises a leg 27 which extends downwardly from the lower end of each of the sections, at a point intermediate the side edges thereof, and preferably, the legs are formed integrally with the respective shield sections. In this embodiment, the leg is formed with a transversely arcuate cross section, as best shown in Fig. 6, and flairs smoothly at the upper end thereof into the downwardly and outwardly flared skirt 28 on the lower end of the shield section. The skirt reinforces the juncture between the shield section and the leg and provides clearance for any obstruction which may be present on the chassis around the tube socket, such as the rivets and the like for attaching the tube socket 21 to the chassis.

A pair of elongated openings 29 (see Fig. 6), here shown as rectangular in shape, are formed in the chassis 22 at opposite sides of the socket 21 and spaced radially therefrom for the reception of the legs 27 on the shield sections. In order to prevent accidental detachment of the shield sections from the chassis, after the legs have been inserted through the openings 29, the lower end portions 31 of the legs are enlarged and extend through a somewhat greater arc than the intermediate portions of the legs to provide a retaining shoulder 32. The length and width of each of the elongated openings 29 is made such as to snugly receive the enlarged lower end portion 31 of the leg 27 when the latter is inserted therein, as shown in Figs. 5 and 6, and the lower ends of the legs are rounded as indicated at 33 to facilitate insertion of the legs into the openings. The shield sections and legs are formed of a somewhat resilient material so that the sides of the lower end portion 31 of the legs may deflect inwardly when the legs are inserted therein, the lower end portions thereafter expanding so that the shoulders 32 are effective to retain the shield sections on the chassis.

As previously described, the intermediate portions of the legs are smaller than the lower end portions 31 and are therefore loosely received in the openings 29 and permit limited pivotal movement of the shield sections in these openings. The legs extend downwardly and outwardly from the shield sections at an angle to the axis thereof such that when the shield sections are disposed around the tube, with the axes of the sections extending normal to the chassis, the legs extend at an angle through the openings 29 as is clearly shown in Figs. 3 and 5. The angle at which the legs extend from the axis of the shield sections is correlated with the width of the elongated openings and the depth of the channel defined by the intermediate portion of the transversely arcuate legs so that the inner edges of the intermediate portions of the legs engage the upper radially inward edge of the opening 29 and the back of the channeled legs engages the lower radially outer edge of the opening, when the axis of the shield section is inclined upwardly away from the tube axis. Therefore, as the shield section is moved into position around the tube, the leg 25 will bind between the inner and outer edges of the opening 25 and deform the forward edges and the back of the leg slightly, as shown in Fig. 7 to provide a firm binding contact between the leg and the chassis. This provides a rigid mechanical connection between the shield sections and the chassis, when the shield sections are clamped together around the tube, and prevents relative movement therebetween. Consequently, the shield sections will hold the tube firmly in the tube socket whereby the tube cannot become loosened and further, a firm electrical contact is established between the shield sections and the chassis to ground the latter. Moreover, the deformation of the legs, produced when the shield sections are clamped together, tends to flatten the transversely arcuate lower end portions of the legs and expand the latter in a direction circumferentially of the tube socket whereby the shoulders 32 underlie the chassis and prevent subsequent accidental removal of the shield sections.

As is apparent, the angle that the legs must subtend

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with the shield section axis, to provide the aforementioned "binding" of the leg in the opening 29, will vary with the thickness of the chassis 22. By making this angle between the leg and the shield section such that the leg will bind in the opening 29 even when very thin chassis material is used, the leg will obviously also bind in the opening when thicker chassis material is used. In the latter case, the leg will begin to bind in the opening, as the shield section is initially moved to its shielding position around the tube, when the axis of the shield section is inclined appreciably to the normal to the chassis. Further movement of the shield section to shielding position around the tube will produce bending of the leg relative to the shield section and effect a change of the angle between the leg and the shield section. In this manner, the shielding device will automatically adapt itself to chassis of different thickness.

On the other hand, if the angle between the leg and the axis of the shield section is insufficient to produce a binding action between the leg and the edges of the opening 29, when the shield section is disposed around the tube, as may be caused by improperly sized openings 29 or repeated use which deforms the shield sections, then the angle between the leg and the shield section can be increased by tilting the sections outwardly, as shown in dotted lines in Fig. 3, and pressing the sections downwardly to bend the legs outwardly. Since the channeled legs are rigid and resist bending, most of the bending will occur at the junction between the leg and the shield section, thereby effectively increasing the angle between the leg and the shield section.

The outwardly flared skirt 28 is preferably formed so as to extend around the entire lower end of the shield sections. As the shield sections are pivoted upwardly, from the position shown in dotted lines in Fig. 3, to the solid line position, the outwardly flared skirt engages the electron tube envelope and expands the shield sections. Further movement of the shield sections toward their position around the tube 20 causes the skirt on one of the shield sections to overlap the other shield section and thereby guide the sections into their overlapping positions shown in solid lines in Figs. 3 and 4. Thus, the skirt serves the multiple function of reinforcing the juncture between the legs and the shield sections and guiding the shield sections into overlapping position. In addition, the skirt provides clearance for any obstruction adjacent the tube base and permits the shield to extend into closely spaced adjacency with the chassis to thereby completely shield the tube.

Conveniently, the upper edge of the shield sections may be inwardly rolled, as indicated at 35 to provide a smooth upper edge and to reinforce the shield sections.

A modified form of shielding device is illustrated in Figs. 9-12. As in the preceding embodiment, the shielding device includes a pair of transversely arcuate channels 41 dimensioned to snugly grip the envelope of the electron tube 42. Preferably, the shield sections taper inwardly from the bottom to the top thereof whereby the shield sections grip the tube adjacent the upper end of the latter to firmly retain the tube in its socket 43 on the chassis 44.

A downwardly and outwardly flared skirt 45 is formed on the lower end of each of the shield sections, which skirt guides the shield sections onto the tube and into overlapping relation with each other. A leg 46 extends downwardly and outwardly from the lower edge of the skirt, intermediate the side edges of the shield sections to provide a mounting leg for the sections. The leg is adapted to extend through an elongated opening 47 in the chassis 44 to thereby support the shield sections directly on the chassis for vertical swinging movement in a plane through the axis of the electron tube 42. In order to prevent accidental detachment of the shield sections from the chassis, a locking finger 48 is formed on the lower end of the leg 46 and, as shown in the drawings,

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extends inwardly at an acute angle to the leg. A reinforcing rib 49 is formed in the locking finger and leg and extends upwardly into the skirt portion 45 to rigidify the leg and inhibit bending of the leg during use.

When mounting the shield sections on the chassis 44, the sections are positioned at an angle to the chassis such that the apex of the knuckle defined by the leg 46 and the locking finger 48 is aligned with the pre-punched opening 47 in the chassis 44. The shield section is then pressed in a direction to urge the knuckle through the opening, the locking finger 48 deflecting inwardly towards the leg 46 as the finger moves through the opening, as shown in Fig. 11. After the locking finger has passed through the opening, it springs back to its original position with respect to the leg 46 and thereby retains the leg 46 in position in the opening.

The angle at which the leg 46 extends from the axis of the shield section is made such that the under edge of the leg will engage the upper radially inner edge of the opening 47 and the rib 49 at the back of the leg and will engage the lower radially outer edge of the opening, when the shield section 41 is pivoted upwardly to a position in which the axis thereof is inclined upwardly away from the axis of the electron tube 42, such as the position to which the right hand shield section is shown in Fig. 9. Further movement of the shield section into its clamping position around the other shield section will cause the leg to be bent slightly thereby forming a firm binding contact between the leg and the chassis. The extent to which the leg must be bent, when moving the shield section into alignment with the electron tube, will vary with the size of the opening 47 and the thickness of the chassis 44 and if this angle through which the leg must be bent is appreciable, some permanent deformation of the leg will occur. However, the leg will still be resiliently urged into firm contact with the chassis to provide a proper ground connection thereat.

The under edge of the skirt 45 is undulated as shown in the drawings, to clear obstructions such as rivets and the like around the tube socket and is arranged to provide contact between the shield sections and the base at a pair of spaced points on each shield section. Preferably, the points of contact, designated 51, are located between the axis of the shield sections and the leg 46. Consequently, as the overlapping shield sections are brought together, the shield sections pivot about these points and tend to draw the legs upwardly to thereby assure firm electrical contact between the legs and the chassis. There is thus provided a multiple point contact between the shielding device and the chassis, namely, at each of the four contact points 51 and at the pair of legs 46.

Still another form of the invention is illustrated in Figs. 13 and 14. In this embodiment, the transversely arcuate shield sections 61 are also shaped to extend through an arc of more than 180° so as to overlap along the side portions thereof as indicated at 62 to thereby resiliently clamp the shield sections together around the electron tube 63, although it is to be understood that the shield sections need not overlap and that other clamping means may be provided. As is conventional, the electron tube is mounted in a socket 64 which is attached by a flanged locking collar 65 to the chassis 66, as by rivets 67. In this form of the invention, the sections are mounted for swinging movement with the axis thereof at all times substantially parallel to the axis of the electron tube, into and out of overlapping relation. Conveniently, a pair of laterally extending mounting arms 68 may be provided on the lower ends of each of the shield sections, adjacent one of the side edges thereof. The arms are attached for swinging movement about an axis normal to the chassis in any desired manner and conveniently may be attached by the same rivets 67 which are provided for mounting the tube socket 64 on the chassis. Preferably, the arms 68 have an undulated portion 69 intermediate the ends thereof

and the arms are formed of a resilient material to thereby yieldably urge the shield sections in a direction toward the socket 64. As in the preceding embodiments, the shield sections are advantageously formed with a slight inward taper from the bottom to the top thereof to thereby grip the periphery of the tube adjacent the upper end thereof.

As is apparent from Fig. 14, the shield sections are swingable in relatively opposite directions with the axis thereof parallel to the axis of the tube, into and out of overlapping relation around the tube and, conveniently, one of the side edges of each of the shield sections may be bent outwardly as indicated at 71 to facilitate guiding of the sections into overlapping relation.

From the foregoing it is apparent that the shielding device of the present invention may be mounted directly on the chassis of the electrical apparatus without the necessity of providing a separate mounting base, and which shielding device is thus arranged to be directly grounded on the chassis. Moreover, the shield sections are formed of a resilient material and shaped to releasably clamp together whereby the shielding device is adapted to snugly grip tubes having different lengths and diameters, within somewhat wide limits. For different tube series, where the tube envelopes differ markedly in size and configuration, different size shielding devices must be fabricated. However, the shielding device for any series of tubes will adapt itself to the variations in length and diameter of the tubes in that series. The shielding device is therefore arranged to retain the electron tubes in their sockets and, since the shield sections are disposed in closely spaced adjacency to the tubes, they are effective to radiate the heat from the tubes and maintain cool operation thereof. In the embodiments of the invention shown in Figs. 1-8 and in Figs. 9-12, it is only necessary to provide openings in the chassis adjacent the tube sockets for the reception of the support legs for the tube sections. The tube sections then may be readily mounted on the chassis by inserting the legs through the openings, the legs having provision thereon for retaining the latter in the openings to prevent accidental detachment of the shield sections from the chassis. In the embodiment of Figs. 13 and 14, the shield sections are permanently riveted to the chassis, preferably at the time of mounting the sockets thereon. Each of the shielding devices is thus constructed and mounted so that it cannot be left off of the tube or replaced on the wrong tube during servicing of the electrical apparatus. Further, since the shields are permanently affixed to the chassis, they cannot become accidentally misplaced between the chassis and the other parts of the electrical apparatus or between the chassis and the cabinet to provide a conductive path therebetween. This is of particular importance in the so-called "hot chassis" type apparatus since the chassis is not at ground potential and, when such apparatus is used in a metal cabinet, it is necessary to assure that the chassis is not electrically connected to the cabinet.

Since the shielding device is formed in a plurality of sections which extend longitudinally of the tube, it is apparent that removal of the shielding device can be conveniently and expeditiously effected by separating the sections.

I claim:

1. For use with an electronic apparatus comprising a chassis having a tube socket and an electron discharge device mounted in said socket, a shielding device comprising a pair of cylindrically-shaped shield sections adapted to be arranged in opposed relation around the discharge device to form an enclosure therefor, a leg formed integrally on the lower end of each of said sections extending downwardly and outwardly therefrom, and a pair of openings in said chassis at opposite sides of the tube socket and spaced outwardly therefrom, said legs extending through said openings to thereby swing-

ably support said sections and to electrically connect the shielding device on the chassis, said legs being arranged to bind in said openings as said sections are moved into opposed coaxial relation to provide a firm electrical and mechanical connection between said sections and said chassis.

2. For use with an electronic apparatus comprising a chassis having a tube socket and an electron discharge device mounted in said socket, a shielding device comprising a pair of cylindrically-shaped shield sections adapted to be arranged in opposed relation around the discharge device to form a shielding enclosure therefor, a channel-shaped leg formed on the lower end of each shield section intermediate the side edges thereof, a pair of openings formed in said chassis on opposite sides of said socket, said legs extending downwardly and outwardly from the lower ends of said sections through said openings to swingably support said sections directly on the chassis, said legs being adapted to bind in said opening when the shield sections are moved into position around the tube to thereby provide a firm electrical and mechanical connection between the shielding device and the chassis.

3. The combination of claim 2 wherein each of said sections extends through an arc of more than 180° to thereby releasably clamp said sections together.

4. The combination of claim 3 wherein said sections are shaped to snugly embrace the periphery of said discharge device to thereby retain the discharge device in its socket.

5. For use with an electronic apparatus comprising a chassis having a tube socket and an electron discharge device mounted in said socket, a shielding device comprising a pair of cylindrically-shaped shield sections adapted to be arranged around the discharge device to form a shielding enclosure therefor, a pair of openings in said chassis at opposite sides of said socket, legs formed integrally on said sections extending downwardly through said openings to swingably support the sections on the chassis, said legs being arranged to bind in said openings as the sections are moved into opposed coaxial relation to provide a firm electrical and mechanical connection between said sections and the chassis, and lateral projections formed integrally with the lower ends of said legs adapted to be inserted with the legs through said openings for engaging the underside of said chassis to retain said shield sections thereon.

6. For use with an electronic apparatus comprising a chassis having a tube socket and a tube disposed in said socket, a pair of channel-shaped sections adapted to be arranged around the discharge device to form a shielding enclosure therefor, an integral leg on the lower end of each of said sections extending downwardly and outwardly therefrom, openings in said chassis on opposite sides of said socket adapted to receive said legs and swingably support said sections for movement in a plane through the axis of the discharge device, said sections having means on the lower ends thereof located between the axis of the shield section and the leg thereof and adapted to engage the chassis to cause the sections to pivot thereon as the sections are moved to a position around the tube whereby to raise said legs into firm contact with the chassis adjacent said openings.

7. A shielding device for use with an electronic apparatus including a chassis having a tube socket and an electron discharge device mounted in said socket, said shielding device comprising a pair of elongated transversely arcuate shield sections each extending through an arc of more than 180°, said sections having an outwardly flared skirt formed on the lower ends thereof, a leg formed integrally with said skirts intermediate the side edges of the respective sections and extending downwardly and outwardly from the sections to a point below the lower end of the respective section, and a pair of openings

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formed in said chassis at opposite sides of the socket for receiving said legs, the radial width of said openings being arranged such that the legs on said sections engage the radially inner and outer edges thereof at the top and bottom of said chassis respectively when said sections are moved into opposed coaxial relation with the side portions of the sections overlapping to firmly clamp the sections together.

8. The combination of claim 7 wherein said legs are transversely arcuate to minimize bending of said legs as the sections are moved into overlapping relation.

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9. The combination of claim 8 including projections on the side of said legs adjacent the lower ends thereof, the length of said openings being sufficient to permit the passage of said legs and projections therethrough when the sections are initially assembled on the chassis.

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