Nov. 22, 1949 J. H. COOPER 2,488,710

ENCLOSING SHIELD FOR ELECTRICAL APPLICATIONS

Filed Sept. 23, 1946

Fig. 1

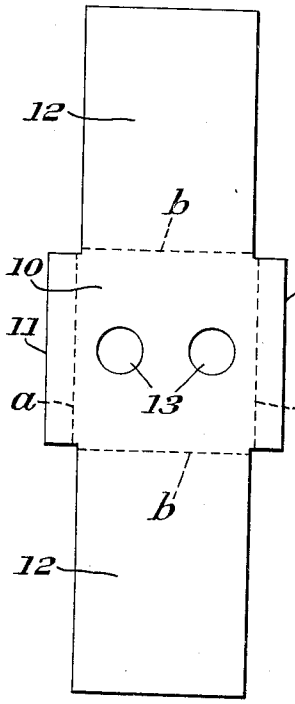


Fig. 2

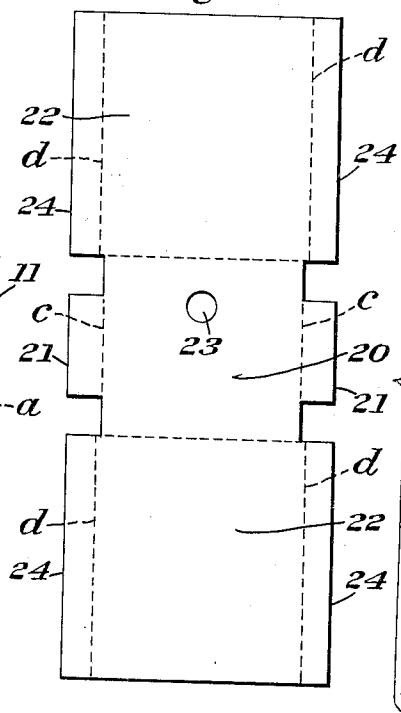
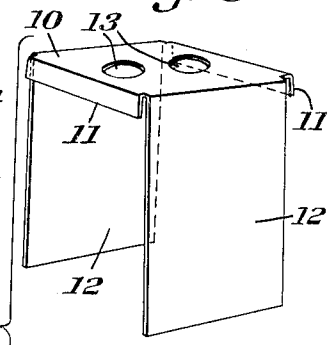


Fig. 3



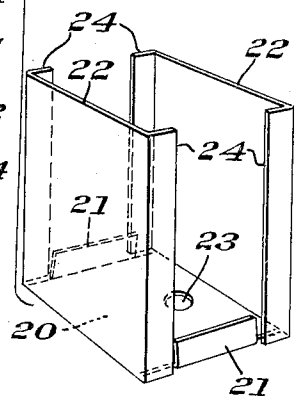


Fig. 4

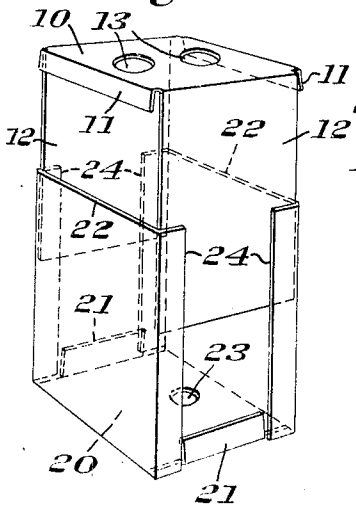


Fig. 5

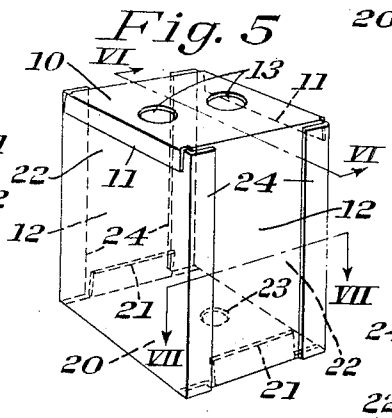


Fig. 6

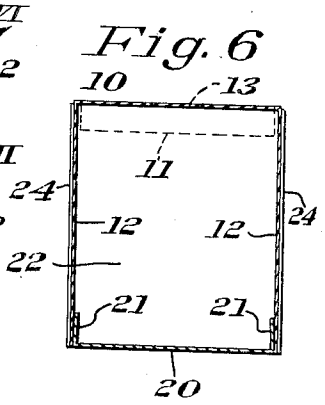
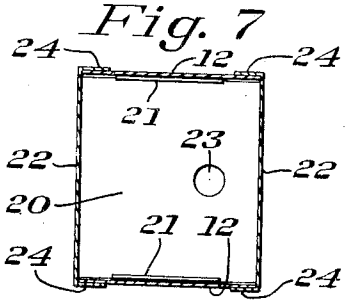


Fig. 7



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ENCLOSING SHIELD FOR ELECTRICAL APPLICATIONS

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10 Claims. (Cl. 174—35)

1

This invention pertains to enclosing shields for electrical apparatus, and more particularly to shields suitable for preventing undesirable coupling in audio and radio frequency circuits.

As a general rule, baffle shields are employed to prevent capacitative coupling between two circuits, but enclosing shields have been found to be more practical and effective in radio and audio frequency applications to prevent magnetic coupling between transformers, chokes, coils, etc., of radio and other electrical apparatus. Also, in high gain amplifiers, shields are employed to prevent feedback by magnetic or electric fields from the high level to the sensitive low level stages.

Various sizes of shields are needed, since the size of electrical devices to be enclosed varies, and also since in radio frequency applications, the effect of the shielding on a coil Q (where Q is the quality factor of a circuit and equals the reactance divided by the resistance of a coil) and inductance becomes less as the distance between the coil and the shield is increased. More conductive metals, such as copper and aluminum, are generally employed to decrease losses in radio frequency applications, while magnetic materials preferably of high permeability to provide a low reluctance path for the external flux, such as magnetic steels and irons, are better for audio frequency applications.

It will thus appear that the method or methods of making shields should be adaptable to various sizes and to the utilization of various types of metals and materials.

Previous to the present invention, various types of shields have been employed in electrical installations, but particular difficulty has been encountered in the manufacture of shields of a general rectangular shape.

Shields of rectangular shape are difficult and expensive to fabricate with drawing dies, since they require several draws with costly tools, intermediate strain-relieving anneals, and involve a rather high labor charge. One set of tools will produce only one shield size. Different types of tools also will be required for different metals.

As a result, the trade has resorted, to some extent, to the use of built up products from flat stock that is cut, shaped, and welded together. However, such assembly requires special design features to permit the welding to be effected.

My present invention pertains to a new and improved form of shield that can be inexpensively fabricated into various sizes and shapes and that can be made from various types of materials by utilizing simple tools, that can be assembled in a highly effective manner and to provide a positive connection to the ground without welding, and that will withstand shock and vibration, such as encountered in installations of electrical apparatus in motor vehicles, etc.

2

And, it has been an object of my invention to provide a new and improved form of shield.

Another object has been to provide a shield that can be inexpensively fabricated from any suitable type of material and into any desired shape.

Another object has been to devise a shield that may be simply and positively assembled without welding or other securing means.

A further object has been to devise a shield construction that may be assembled and mounted in a permanent relationship about an electrical device, but that at the same time can be readily disassembled, for example, when the electrical device has worn out and it is to be replaced or repaired.

A still further object has been to provide a shield made up of parts that will closely interfit and can be manually mounted in an assembled relationship.

These and many other objects of my invention will appear to those skilled in the art from the description and exemplary embodiment thereof and from the appended claims.

In the drawings:

Figure 1 is a top plan view of a substantially flat piece of material cut to provide a part of the shield of the exemplary form of my invention; it also illustrates how the piece may be formed or bent to its desired shape;

Figure 2 is a view similar to Figure 1, but showing a second part of the shield of the exemplary form of my invention;

Figure 3 is a side perspective view of the pieces of Figures 1 and 2 after they have been shaped or formed; it is also, in effect, an exploded view of the two parts showing their relationship before assembly;

Figure 4 is a side perspective view of the two parts in a partially assembled relationship;

Figure 5 is a side perspective view showing the two parts in a completely assembled relationship of rectangular shape;

Figure 6 is a vertical section taken along the line VI—VI of Figure 5; and,

Figure 7 is a horizontal section taken along the line VII—VII of Figure 5.

In carrying out my invention I have provided a shield that comprises interfitting parts that are in effect locked in position with respect to

each other in such a manner that they will not come apart during usage even where the electrical device or the apparatus of which it is a part is subjected to a certain amount of vibration or shock. The parts can be patterned out of flat stock, for example, strip or sheet metal, and cut into blanks. The blanks then may be notched on adjustable tools and formed or bent to the required shape, for example on a bending brake. Of course, it will be appreciated that dies can be used if standard shapes or sizes are being made in volume, although I prefer to utilize a simple procedure such as above outlined, in order to utilize different materials and sizes for different applications with a minimum of change-over and expense.

The exemplary embodiment of my invention comprises two parts which may be manually assembled by pushing them together in a complementary manner. Each of these parts have somewhat flexible portions, wedge flanges or tabs which guide the assembly and in effect hold the parts in a locked assembled relationship. That is, the two parts can be slid into position against the tension of the particular material utilized. It will be noted that I provide what may be termed an eight-point gripping contact between edge flanges or tabs of the two parts and that the positioning relationship of the tabs is such that they interfit and support adjacent portions of the two parts, both externally and internally of the assembled shape. This prevents them from being distorted out of shape when assembled and provides a maximum interfitting contact consistent with the simple construction involved.

Although the rectangular form of shield assembly has been shown in the drawings to exemplify my invention, it will be apparent to those skilled in the art that the principles of the invention may be applied to other suitable shapes, such as a cylinder, etc., having a rounded outline.

I have found that a shield constructed in accordance with my invention requires no special tools, can be made in various sizes without extra tools and, when assembled, is more rigid than a welded construction. It will also make possible a good ground connection.

Such a type of shield may be made of magnetic steel or iron having suitable tensile strength for an audio frequency utilization and of more conductive materials, such as copper, aluminum, brass, etc., for a radio frequency application. It may be employed to shield coils, chokes, input, output transformers, tubes, and other electrical devices as desired. Although I preferably utilize suitable metallic materials in making such shields, it will be apparent that metal-coated plastics, glasses, etc., may also be used, provided the material has the necessary strength and flexibility.

In the exemplary form of my invention shown in the drawings, the shield is made up of two parts or members 10 and 20 which are constructed and arranged in such a manner that their side body or wall portions interfit and provide four side walls of the rectangular shape. It will also be noted that each part or member is provided with flanges which, in effect, as shown particularly in Figure 5, having an intersupporting relationship for the side body portions of the other part or member.

In Figure 1, I have shown a flat piece of material such as a strip or sheet, out of which a pattern corresponding to the desired outline of one part of the shield is to be provided. This

piece is cut to provide tabs or longitudinally extending wall portions 12 and extending flange portions 11 which are integral with an end portion or, in the layout, a central portion 10. Suitable holes 13 may be drilled or punched out for the electrical leads of the device to be enclosed. The dotted lines *a* and *b* indicate how the portions 11 and 12 may be bent upwardly to provide a shape, such as shown in Figure 3.

Figure 2 is a layout similar to Figure 1, but represents a pattern for a second member or part of the assembly of Figure 5 and comprises a central body or end wall portion 20, side wall portions 22 and bent over or flange portions 21 and 24. A hole or a number of holes, such as 23, may be drilled or stamped out of the flat piece to provide a mounting for the shield. The dotted lines *c* and *d* indicate how the portions of the piece may be bent or formed to provide the ultimate shape shown in Figure 3. It will be noted that the portions 21 have a spaced-apart, cut-out relationship with respect to the portions 24, in order to permit them to be bent up as shown in Figure 3, without interfering with longitudinally-extending side wall flanges 24 of the side wall portions 22.

In making the parts or members of the shield, I prefer to use some suitable material that has properties of flexibility and sufficient tensile strength to support the holding action of the two members when in an assembled relationship. Referring particularly to the first part or member, it will be noted that it comprises a central or end body portion 10, a pair of spaced-apart side tab body or wall portions 12, and extending, spaced-apart, offset side flange portions 11. As noted, the flanges 11 are transversely offset with respect to side edges of adjacent side wall portions or tabs 12. The tabs 12 will preferably have a length substantially corresponding to the desired ultimate length of the assembly and will preferably be formed so that they have a slope with respect to the longitudinal plane of the wall portions 22 and normally extending slightly outwardly or away from the central or end wall portion 10. The offset flange portions 11 extend slightly outwardly to provide a wedge or interlocking surface for extending side body portions of the second member or part 20.

The second member comprises a central or end body portion 20, a pair of spaced-apart side wall or body portions 22 extending longitudinally therefrom and at right angles to the portion 20, and a pair of spaced-apart offset side edge flanges 24 which are preferably transversely offset with respect to side edges of the side wall portions 22 in the sense that they are inclined slightly inwardly to wedgingly engage the transverse ends of the side body portions 12 of the first-mentioned part. The side body portions 22 preferably have a longitudinal extent substantially equal to that of the assembly and are provided with inwardly-projecting offset side flanges 24 extending substantially at right angles thereto.

Figures 4 and 5 show how the two substantially U-shaped parts or enclosure members may be assembled. That is, one hand of the operator may hold and compress the tabs 12 of the first member while the other hand of the operator may grip the second member adjacent its side body portions 22 to slightly compress them inwardly until the two parts are slidably entered with respect to each other. It will be apparent that the side tab portions 12 of the first member fit inside the longitudinal flanges 24 of the second member

and that the wall portions 12 and 22 of both members form a complete side wall enclosure.

It will also be apparent that the flanges 11 of the first part fit over transverse ends of the side body portions 22 of the second member, while the flanges 21 of the second member fit under the transverse ends of the side body wall portions 12 of the first member. In this manner the side walls of both parts or members are supported against distortion either inwardly or outwardly of the assembled shape. The inner flanges 21 exert an outwardly wedging, locking, or holding force on the portions 12, while the outer flanges 11 exert an inwardly wedging, locking or holding force upon the side body portions 22 of the second part. The side flanges 24 support the side portions 12 of the first member against outward distortion and the flanges 21 support them against inward distortion when the two members are in an assembled relationship. It will also be noted that the flanges 19 support the side portions 22 of the second member against outward distortion and side edges of tabs 12 support them against inward distortion.

Although the members of the assembled shield are wedgingly engaged in a tightly locked and interfitting relationship in the illustrated embodiment of my invention, it will be apparent that a spot weld may be used to secure the two parts if desired, although one of the advantages of the present arrangement is that welding is not necessary.

It will appear that each of the members 10 and 20 has three sides, and when assembled in a complementary relation, provide a six-sided complete enclosure.

Although for the purpose of my invention I have shown an exemplary form thereof, it will be apparent to those skilled in the art that other forms may be employed to utilize the principles of my invention without departing from the spirit and scope thereof. It will also be apparent that various additions, revisions, and omissions may be made to the illustrated embodiment without departing from the spirit and scope of my invention, as indicated by the appended claims.

What I claim is:

1. A shield box for electrical apparatus comprising, a pair of interfitting members, said members being constructed of flexible tensile metal having suitable electrical characteristics, each of said members having a shaped end wall portion, the end wall portion of one of said members having a pair of spaced-apart longitudinal tabs extending substantially at right angles and inclining outwardly with respect to their associated end wall portion, the second of said members having a pair of spaced-apart longitudinal side portions extending substantially at right angles to their end portion and having turned-over longitudinal edge portions constructed and arranged to slide over and inwardly flex the longitudinal tabs of said first member to provide a four-sided enclosing wall.

2. A shield box for electrical apparatus comprising, a pair of interfitting members of suitable flexible material having desired electrical characteristics, each of said members having an end wall and a pair of spaced-apart side walls extending longitudinally and integrally from opposite side edges of its associated end wall, said side walls being constructed and arranged to slideably and flexibly interfit with respect to side walls of the other of said members, each of said members having bent-over edge portions adapted

to slideably receive and lockingly abut extending portions of side walls of the other of said members and to support said side walls against inward and outward distortion when said members are in an assembled relationship, the bent-over portions being shaped to provide wedging engagement of increasing force as said members are moved endwise into a fully assembled relationship.

3. A rectangular shield box for electrical apparatus which comprises, a pair of interfitting members of flexible metal construction having suitable electrical characteristics, each of said members having an end wall portion and a pair of spaced-apart side wall portions extending longitudinally therefrom, the pair of side wall portions of one of said members being sloped slightly outwardly with respect to their associated end wall portion; the other of said members having spaced-apart side wall portions provided with longitudinally-extending side edge flanges constructed and arranged to receive and slide over and flexibly compress inwardly the pair of side wall portions of the above-mentioned one of said members to provide a four-sided enclosing wall therewith; each of said members having a pair of oppositely-positioned and spaced-apart side flanges extending from opposite edges of its end wall portion and transversely between and spaced from adjacent side edges of its pair of side wall portions; transverse edges of the side flanges of the end wall portion of each of said members having an offset spacing with respect to adjacent side edges of its associated pair of side wall portions; the side flanges of the end wall portion of the above-mentioned one of said members being constructed and arranged to slideably receive transverse outer ends of the longitudinally-extending side wall portions of the other of said members thereover when said members are in an assembled relationship; and, the side flanges of the end wall portion of the other of said members being constructed and arranged to slideably receive transverse outer ends of the longitudinally-extending side wall portions of the above-mentioned one of said members thereunder when said members are in an assembled relationship.

4. A shield box assembly for parts of an electrical apparatus which comprises, a pair of substantially U-shaped enclosure members, each of said members having a transverse end wall portion and a pair of side wall portions extending longitudinally and in a spaced-apart relation from opposite transverse sides of said end wall portion, the end wall portion of each member of said pair having a pair of side flanges extending longitudinally and in a spaced-apart relation from opposite transverse sides thereof and located between the side wall portions of the same member, each side flange of the end wall portion of each of said members having a transversely-offset relation with respect to side edges of adjacent side wall portions of the same member, and opposite side edges of each side flange of the end wall portion of each of said members having a spaced-apart relation with the side edges of adjacent side wall portions of the same member sufficient to slideably pass a side wall portion of the other member there between; each side edge of each side wall portion of each of said members being constructed and arranged to lie adjacent to a side edge of a side wall portion of the other of said members when said members are in an assembled relation, and at least one side edge of each pair of adjacent side edges of the side wall portions of said pair of members hav-

ing a side flange extending over the adjacent side edge of another member when said members are in an assembled relationship; the whole being constructed and arranged in such a manner that the side wall portions of said members provide an enclosing side wall for the box, the end wall portions of one of said members provides one end wall of the box, and the end wall portion of the other of said members provides an opposite end wall of the box.

5. A shield box assembly for parts of an electrical apparatus and having opposite end walls and an enclosing side wall extending longitudinally between the end walls which comprises, a pair of substantially U-shaped enclosure members, each of said pair of members having a transverse end wall portion and a pair of side wall portions extending longitudinally and in a spaced-apart relation integrally from opposite transverse sides of said end wall portion, the end wall portion of each member of said pair having a pair of side flanges extending longitudinally and in a spaced-apart relation integrally from opposite transverse sides thereof and located between the side wall portions of the same member, each side flange of the end wall portion of each of said members having a transversely-offset relation with respect to side edges of adjacent side wall portions of the same member, and opposite side edges of each side flange of the end wall portion of each of said members having a spaced-apart relation with the side edges of adjacent side wall portions of the same member sufficient to slideably pass a side wall portion of the other member therebetween; each side edge of each side wall portion of each of said members being constructed and arranged to lie adjacent to a side edge of a side wall portion of the other of said members when said members are in an assembled relation, and side edges of each pair of adjacent side edges of the side wall portions of said pair of members having side flanges extending over the adjacent side edge of another member when said members are in an assembled relationship; the whole being constructed and arranged in such a manner that the side wall portions of said members provide the enclosing side wall of the box, the end wall portions of one of said members provide one end wall of the box, the end wall portion of the other of said members provides the opposite end wall of the box, and the side wall portions of each of said members are supported against inward and outward distortion by the side flanges of the end wall portions and by the extending side flanges of the side wall portions of said members.

6. A shield box as defined in claim 5, wherein the end wall portions of each of said members are of rectangular shape and define a six-sided enclosure with the side wall portions of said members.

7. A shield box as defined in claim 5, wherein

the side flanges of the end wall portion of one of said members are transversely-inwardly offset with respect to side edges of adjacent side wall portions thereof, the defined extending side flanges are along opposite side edges of the side flanges of the end wall portion of the other of said members, and the side flanges of the end wall portion of the other of said members are transversely-outwardly offset with respect to side edges of adjacent side wall portions thereof.

8. A shield box as defined in claim 5, wherein said members are of flexible construction, and a pair of side wall portions of one of said members are sloped with respect to a longitudinal plane of the pair of side wall portions of the other member in such a manner that said members having a wedging engagement when moved into an assembled relationship with respect to each other.

9. A shield box as defined in claim 5, wherein the side flanges of the end portions of said members are sloped with respect to a plane representing side wall portions that slide therealong to provide a wedging engagement therebetween when said members are moved into an assembled relation with respect to each other.

10. A shield box for electrical apparatus comprising, a pair of interfitting members of suitable flexible material having desired electrical characteristics, each of said members having an end wall and a pair of spaced-apart side walls extending longitudinally and integrally from opposite side edges of its associated end wall, said side walls of one of said members having turned-over longitudinal edge portions constructed and arranged to slidably and flexibly interfit with respect to side walls of the other of said members, at least one of said members having bent-over edge portions adapted to slidably receive and lockingly abut extending portions of side walls of the other of said members and to support said walls against inward and outward distortion when said members are in an assembled relationship, the bent-over portions being shaped to provide wedging engagement of increasing force as said members are moved endwise into a fully assembled relationship.

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