

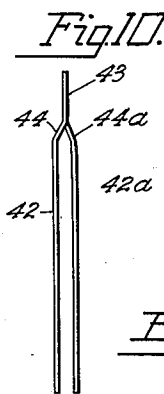
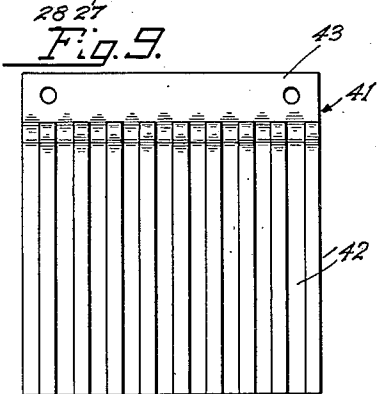
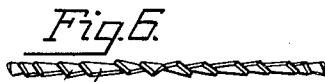
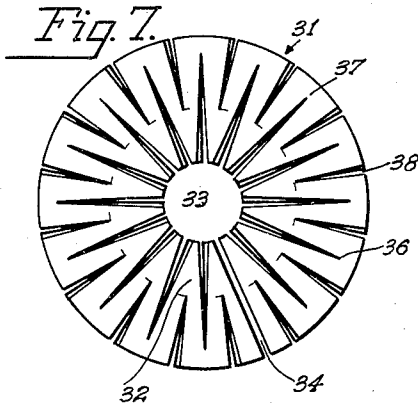
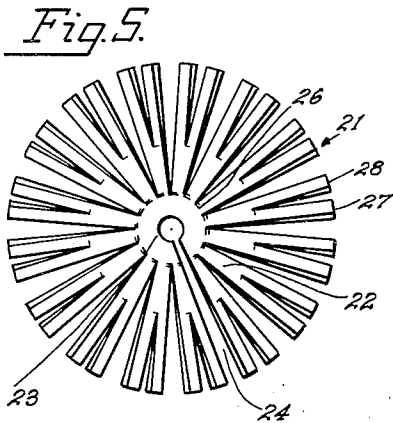
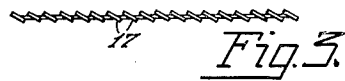
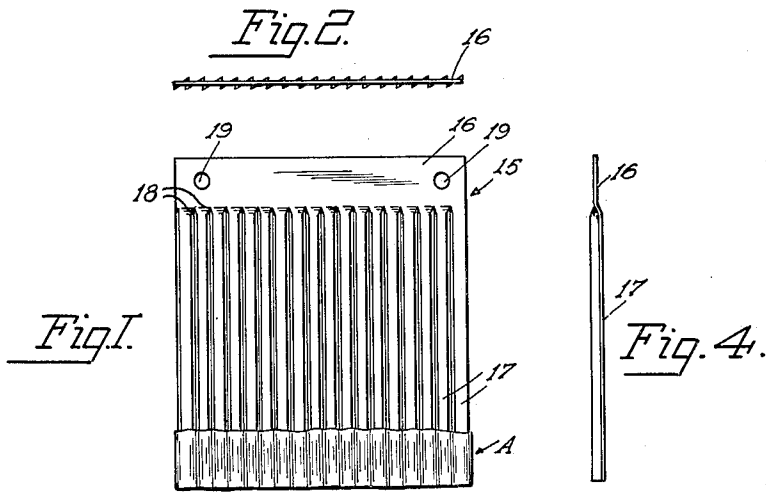
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2,047,159

ELECTROSTATIC SHIELD

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ELECTROSTATIC SHIELD

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15 Claims. (Cl. 250-16)

Our invention relates in general to shielding devices for electrical apparatus, and in particular to an electrostatic shield comprising a broken conducting surface for interposing between two pieces of electrical apparatus carrying currents to prevent electrostatic coupling between said pieces of apparatus. This invention is disclosed but not claimed in Patent No. 2,021,676 in which we were patentees, and in that respect the present application is a continuation in part of the application issuing into that patent.

With the ordinary grounded metallic sheet or wall acting as a shield between the parts of electrical apparatus containing coils, or between the coils themselves, highly objectionable eddy current losses and magnetic reactions will occur in such sheet or wall due to the closed electrical circuits set up in the metal. In radio apparatus in particular, therefore, where it is necessary to shield coils carrying high frequencies from one another to prevent undesirable electrostatic or capacitative coupling between them, it is necessary to provide a broken shield with a suitable grounded connection and serving as a good conductor, yet one of such design that the objectionable eddy currents will not be set up.

In the prior art electrostatic shields, a multi-piece device has been used wherein a plurality of separate fingers are held together by a soldered connection, or devices have been used wherein metal is cut out to provide the necessary separation and insulation from one another of the shielding portions thereof. These devices, however, are expensive to manufacture and in cutting away the metallic surface of the shield, lose some of their electrostatic shielding efficiency.

It is an object of our invention to provide an improved electrostatic shield.

A further object is to provide such shield having a maximum metallic capacitative shielding surface with a minimum eddy current loss.

A still further object is to provide a highly efficient, yet simple shield which may be manufactured at low cost.

It is also an object of our invention to provide an electrostatic shield having structure adaptable for a substantially square or round design to fit various types of coil assemblies.

A further object is to provide an electrostatic shield which is conveniently adapted to separate and shield from one another electrical apparatus of various sizes and shapes; and

A still further object is to provide a one-piece metallic shield which may be entirely machine made.

Other objects and advantages of our invention will be apparent from the following description taken with the drawing, in which:

Fig. 1 is a front elevation of the preferred embodiment of our invention.

Fig. 2 is a top plan view thereof.

Fig. 3 is a bottom plan view looking upwardly.

Fig. 4 is a side elevation of the shield of Fig. 1.

Fig. 5 is a front elevation of a modified embodiment of our invention.

Fig. 6 is an end view thereof.

Fig. 7 is a front elevation of a further modification.

Fig. 8 is an end view thereof.

Fig. 9 is a front elevation of a still further modification; and

Fig. 10 is an end elevation of the structure of Fig. 9.

In practicing our invention we provide a one-piece non-magnetic metallic electrostatic shield having a plurality of fingers extending from an integral common connecting portion with the individual fingers separated from one another over their length by twisting or bending the same to provide an insulating air space therebetween. The fingers are separated from one another in an extruding process in the manufacture thereof, and the entire shield is designed so as to be free from closed circuits or eddy currents.

Referring now to the drawing, and particularly to Figs. 1 to 4 illustrating our preferred embodiment of the invention, we provide a metallic plate 15 of good conducting material, preferably copper, having a connecting strip 16 and integral fingers 17 extending downwardly from the portion 16 and lying parallel over their entire length. The fingers are extruded so as to lie at such an angle with the portion 16 that they individually will be insulatingly separated from one another. This twisting may be readily accomplished at the top 18 of the fingers in the extrusion process without danger of twisting them from the connecting portion 16. The angle of twist of the fingers is governed by the thickness of the material and width of the fingers, and it is desirable to have the fingers twisted only enough to separate them and prevent short-circuiting between adjacent members. With such twisting, the shield presents substantially a closed wall that is, closed physically in projection, the distance between transverse planes of adjacent edges of adjoining members being practically negligible.

This construction accomplishes the most desirable shielding characteristics against undesir-

able electrostatic or capacitative coupling between adjacent coils, inasmuch as there is almost a closed wall to the passage of currents between said adjacent coils, yet the individual fingers of the shield are narrow enough and separated against short circuiting so that the possibility of closed circuits or eddy current losses is a minimum. Inasmuch as in some particular designs the fingers may be so long as to be slightly unwieldy at their lower ends, we dip the lower end of the shield in molten insulating wax, and when this hardens it forms an inexpensive yet entirely satisfactory hard insulating guard at the lower end of the fingers to keep them in parallel separated relationship. This is shown at A in Fig. 1. Apertures 19 may be provided in the connecting portion for mounting purposes and to facilitate a ground connection thereto for the entire shield.

A very satisfactory commercial embodiment of our invention is provided in a .035 inch copper shield, $2\frac{7}{16}$ inches long by $2\frac{1}{4}$ inches wide, having fingers $2\frac{7}{8}$ inches long and $\frac{1}{8}$ inch wide. The fingers are twisted to an angle of 45° with the connecting portion. As previously explained, this angle may vary slightly depending upon the thickness of material and width of the fingers.

The square or rectangular construction possible with the embodiment of Fig. 1 is suitable for interposing between annular coils of various types or between elongated coils placed in parallel horizontal relationship. In some types of coil design and assembly, however, due to space limitations and the like, it is desirable to have a round disc-like electrostatic shield. We provide for such a contingency in our embodiment of the invention illustrated in Fig. 6 which shows a round disc 21 having a plurality of fingers 22 extending outwardly from a central connecting portion 23. To prevent closed circuits arising in the shield and subsequent eddy current losses, we remove a narrow strip extending from the connecting portion 23 to the outside of the disc providing an open slit 24. The fingers 22, like the fingers 17 of the embodiment of Fig. 1, are extruded in the manufacture of the shield and formed at an angle to one another as shown most clearly in Fig. 7. With this construction we obtain the necessary separation between adjacent fingers without removal of the shield material itself.

We have found that with the larger diameters for the shield of Fig. 6, in order to have sufficient supporting material at the junction point 26 the outer portion of a finger 22 is somewhat expansive. Where this condition arises we have been able to prevent eddy current losses at this point by splitting the ends of the fingers to have a pair of supplementary fingers 27 and 28 extruded and formed in the same manner as each of the main fingers 22. The angle of twist will correspond to that found most satisfactory under the requirements set forth for the structure of Fig. 1. This particular shield may be readily extruded at low cost and forms a very satisfactory electrostatic barrier between adjacent coils.

A further modification of our invention is illustrated in Fig. 8. In this embodiment we provide a disc-like member 31 having a plurality of fingers 32 extending inwardly toward a center aperture 33. A slit 34 similar to slit 24 in Fig. 6 is provided in order to prevent a closed path around the entire disc and the removal of material at this point, and the central aperture as will be hereinafter described is all that is necessary

over the entire ring-like member. The individual fingers 32 are extruded and shaped to be separated from one another by angling the same as heretofore described and illustrated, particularly in Fig. 9. Instead of being connected at the inner portion of the disc, however, the fingers are connected around the periphery at 36 for instance, but in order to prevent eddy current losses in this portion we split and shape the periphery intermediate the split portions 37 of the fingers in slits 38 opening out of the periphery. The slits 38 extend down considerably beyond the outer point of slits 37 so as to obtain the necessary broken surface.

In both of the embodiments of the invention, as illustrated in Figs. 6 and 8, if it is necessary to support the ends of the fingers we may dip this portion in wax in the same manner as discussed with respect to the embodiment of Fig. 1.

A still further modification of our invention is illustrated in Figs. 10 and 11. Instead of bending the individual fingers 42 in the plate 41 so that they are separated from one another by standing at an angle to the connecting portion 43, we extrude the fingers and shape them so that alternate fingers extend in opposite directions, such as fingers 42 bending to the left at 44 of Fig. 11, and fingers 42a bending to the right at portion 44a at the connection portion 43 of the shield. With this construction the individual fingers lie wholly in two parallel vertical planes separated by the distance that the fingers are bent to the left or right as shown in Fig. 10.

For shielding purposes, this embodiment presents in effect a solid surface, that is, solid physically in projection only, between the pieces of electrical apparatus, yet the fingers are of such size and separated so that no closed circuits will occur. Electrically the electrostatic shield presents a substantially complete barrier to the passage of electrostatic charges from one coil to another adjacent coil carrying electrical currents. Although there is practically no likelihood of adjacent fingers short-circuiting with this particular construction, if it is desired we may dip the lower portion of the shield in wax as previously discussed in connection with the embodiment of Fig. 1.

It is thus seen that in our invention we increase the efficiency of the electrostatic shield over those of the prior art in which fingers were separated from one another by cutting out portions of the shield material, and from those multi-piece structures where fingers were soldered to a connecting strip and separated by virtue of open spaces in the plane of the shield between adjacent fingers or covered with insulating material over their length. In extruding the fingers of the shield an inexpensive and very rapid method of manufacture is accomplished to produce the most effective shield at an extremely low cost.

Although we have described and illustrated the preferred embodiments of our invention, it is understood that we are not limited thereby, but limit our invention only by the scope of the appended claims.

We claim:

1. An electrostatic shield for electrical apparatus comprising a metallic single plane plate slit to form a plurality of supported fingers, with each of said fingers bent out of the single plane of the plate in such a manner as to be insulatingly separated from one another over their length.

2. An electrostatic shield for electrical apparatus comprising a one-piece non-magnetic metallic single plane plate slit to form a plurality of supported fingers, with each of said fingers bent out of the single plane of the plate in such a manner as to be insulatingly separated from one another over their length.

3. An electrostatic shield for electrical apparatus comprising a normally flat metallic plate in a single plane slit to provide a plurality of fingers extending away from a connecting portion, with said fingers deformed at the connecting portion out of said single plane to insulatingly separate one finger from another.

4. An electrostatic shield for electrical apparatus comprising a one-piece metallic single plane plate slit to form a plurality of fingers extending away from an integral connecting portion with said fingers twisted at the connecting portion to insulatingly separate adjacent fingers over their length.

5. An electrostatic shield for electrical apparatus comprising a metallic plate slit to form a plurality of fingers extending downwardly from a connecting portion, with said fingers lying parallel over their length and each twisted at the connecting portion to insulatingly separate one from another.

6. An electrostatic shield for electrical apparatus comprising a metallic plate slit to form a plurality of fingers extending downwardly from a connecting portion, with each of said fingers bent outwardly at the connecting portion and extending downwardly in a vertical plane parallel with the vertical plane of the connecting portion, with alternate fingers being bent to one side and then to the other to insulatingly separate one from another over their length.

7. An electrostatic shield for electrical apparatus comprising a metallic single plane plate slit to form a plurality of supported fingers, with alternate fingers bent out of the plane of the plate to a plane parallel to the plane of said plate.

8. An electrostatic shield for electrical apparatus comprising a metallic plate having a horizontal connecting portion, with said plate slit to form a plurality of fingers extending downwardly therefrom with every other finger bent outwardly at the connecting portion to a plane parallel to the single plane of the metallic plate and connecting portion.

9. An electrostatic shield for electrical apparatus comprising a metallic disc slit to form a plurality of fingers extending outwardly from a central connecting portion, with each of said fingers twisted to a similar angle with said connecting portion, said angle being such as to insulatingly separate adjacent fingers.

10. An electrostatic shield for electrical apparatus comprising a metallic disc slit to form a

plurality of fingers extending outwardly from a central connecting portion, with each of said fingers twisted to a similar angle with said connecting portion, said angle being such as to insulatingly separate adjacent fingers, with said disc having a slit extending from the center to the circumference thereof to prevent closed electrical circuits from forming over said disc.

11. An electrostatic shield for electrical apparatus comprising a metallic disc slit to form a plurality of fingers extending inwardly from the periphery thereof to a central aperture, with each of said fingers twisted to a similar angle to the plane of the disc, said angle being such as to insulatingly separate adjacent fingers.

12. An electrostatic shield for electrical apparatus comprising a metallic disc slit to form a plurality of fingers extending inwardly from the periphery thereof to a central aperture, with each of said fingers twisted to a similar angle to the plane of the disc, said angle being such as to insulatingly separate adjacent fingers, with said disc having a peripheral slit extending into each finger to break up the surface of said finger and prevent eddy currents from forming therein.

13. An electrostatic shield for electrical apparatus comprising a one-piece metallic plate having a mounting portion and a shielding portion extending therefrom, with the material of said shielding portion maintained complete but slit at right angles to said mounting portion to provide a plurality of elongated parallel fingers, with said fingers twisted at the mounting portion to an angle such as to insulatingly separate one finger from another over their length.

14. An electrostatic shield for electrical apparatus comprising a substantially rectangular one-piece single plane metallic plate having a mounting portion, and a shielding portion extending therefrom and slit at right angles to said mounting portion to provide a plurality of elongated fingers lying parallel to one another, and twisted at the mounting portion out of the single plane of the plate to substantially a 45° angle therewith to insulatingly separate one finger from another over their length.

15. An electrostatic shield for electrical apparatus comprising a normally flat one-piece metallic plate in a single plane slit to provide a plurality of fingers extending away from an integral connecting portion, with said fingers using all of the metal of the same portion of the original flat plate, and deformed out of the single plane sufficiently and in a manner to insulatingly separate one finger from another, but with said fingers in a position to cover substantially the entire area of the face of the same portion of the original flat plate of the shield.

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