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METHOD OF MAKING LAMINAR MESH

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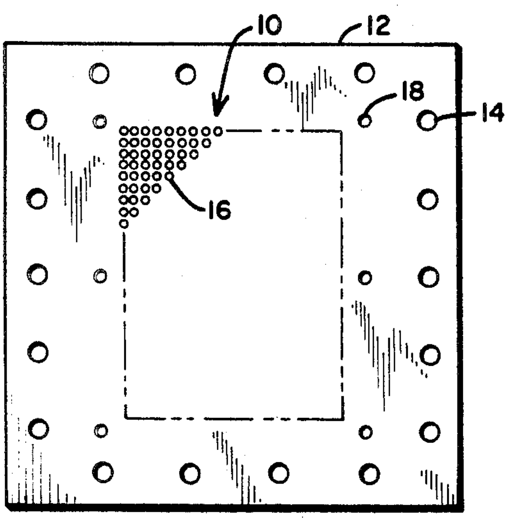

Fig. 1

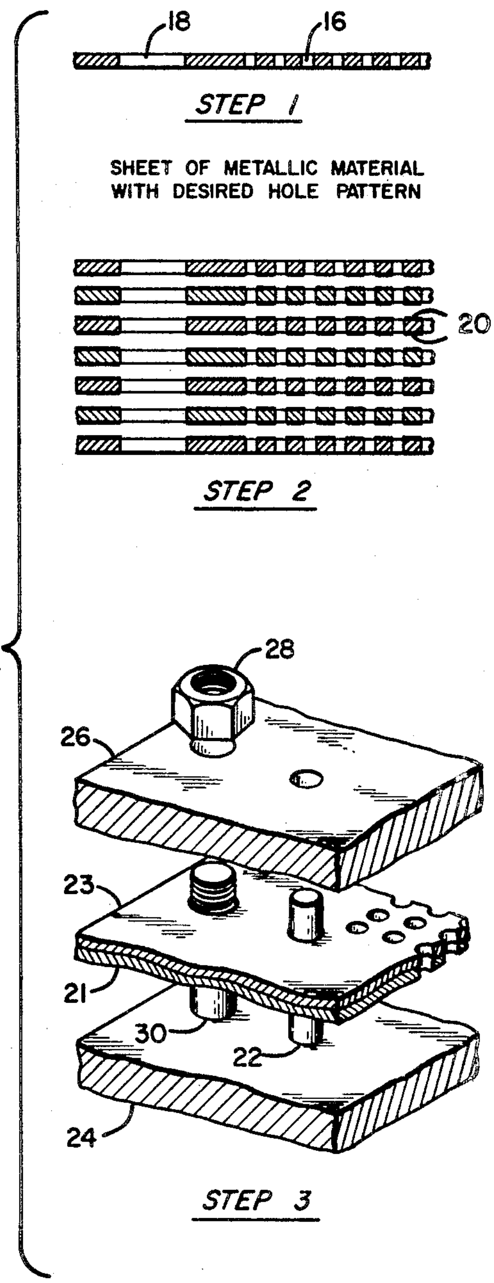

Fig. 2

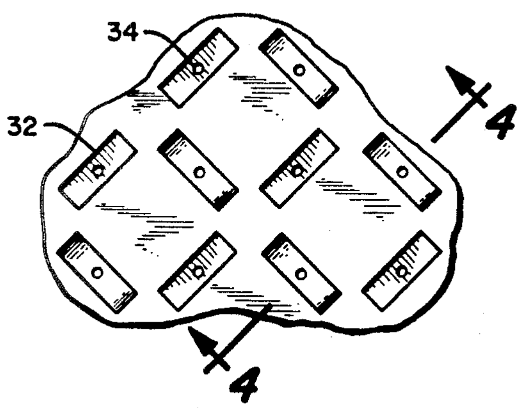

Fig. 3

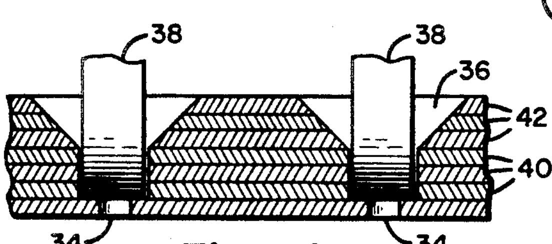

Fig. 4

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METHOD OF MAKING LAMINAR MESH

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Original application July 9, 1963, Ser. No. 293,633, now Patent No. 3,174,837, dated Mar. 23, 1965. Divided and this application June 23, 1964, Ser. No. 382,433
2 Claims. (Cl. 29—472.3)

This application is a division of co-pending application Ser. No. 293,633 filed July 9, 1963, now Patent 3,174,837.

This invention is directed toward improvements in the fabrication of a relatively flat web-like structure having a plurality of accurately defined apertures therethrough and the product formed by this improved fabrication process.

The product of this invention finds a variety of uses. For example, it can serve as a holding fixture for use in the assembly of miniature magnetic core arrays, commonly used in high speed digital computers, or it may be used for what is commonly referred to as a light deflection mask for viewing oscilloscopes, radar viewing screens and other instruments of a related nature. It is understood that these exemplary uses are only illustrative and not intended to be limitive. For use in the former case as a holding fixture for magnetic cores, the plate-like structure of this invention has an array of closely spaced cavities arranged in a predetermined pattern, each one of which must be formed to receive and hold a miniature magnetic core in a standing position. The configuration of the core is such that the cavities must be accurately defined in order to ensure that the core remains in a stable position during assembly which consists primarily of passing a plurality of wires through the apertures of the cores. Additionally, during the step of placing the magnetic cores in the respective cavities in their proper position, vacuum is applied through an aperture extending through the bottom of the holding fixture in each of the respective cavities. A more detailed description of this type of fixture can be found in co-pending application of Vacuum Fixture for Magnetic Cores, by John J. Frantzen, Jr., Ser. No. 147,513, filed Oct. 25, 1961, now Patent No. 3,214,273 and assigned to the same assignee of the instant application. A deflection mask fabricated according to the teachings of the instant invention may be a metallic mesh having in the order of 100 lines per inch, for example, and is placed over the face of a visual indicating instrument such as an oscilloscope or radar screen. The multitude of apertures or slits in the mask allow the substantially straight-line light to pass relatively unimpeded therethrough to permit the viewer, a clear view of the instrument while the fine lines defining the apertures exclude any angularly directed rays which may impede the view of the instrument. Both of the devices briefly described above must, therefore, have accurately defined apertures or cavities and in addition thereto must be structurally stable when used in their intended fashion. Because of the close spacings of the openings in the devices of this nature in the desired pattern array, it has been found that the most feasible methods of making the apertures or cavities or the like have been by photo-etching or electroforming techniques which are well known in the art. However, it has been found that a structurally stable member, say for an example, a substantially flat metallic member in the order of .030–.050 inch thick, when formed by the etching or electroforming process, does not yield the straight sided apertures or slits required for a deflection mask or the accurately defined cavities for a magnetic core holding fixture due to undercutting in the former process or overplating in the latter process. In other words, it has been found that in the photo-etching and electroforming techniques the accuracy of definition of indentations or apertures in the member being formed decreases as the thickness of said member increases.

It is, therefore, an object of this invention to provide a structurally stable, generally flat, plate-like member having accurately defined apertures or cavities formed therein,

It is a further object of this invention to achieve the foregoing object wherein the structure has a pattern of a multitude of closely spaced apertures.

Still a further object of the invention is to provide a device suitable for use as a light deflection mask through which an instrument may be clearly viewed.

These and other more detailed and specific objects and features will be shown in the course of the following detailed description, reference being had to the drawings in which:

FIG. 1 illustrates an embodiment of this invention fabricated in accordance with the novel process taught by this invention;

FIG. 2 pictorially illustrates the principal steps in the process of this invention;

FIG. 3 illustrates the top view of a portion of another embodiment of this invention fabricated according to the noval process as taught by this invention;

FIG. 4 is a sectional end view of a portion of the embodiment shown in FIG. 3.

Referring now to FIG. 1 there is shown what may be referred to as a light deflection mask for use as a screen over the face of instruments such as an oscilloscope or radarscope to confine the field of vision to a straight line from the viewer's eyes to the instrument face. In order to set this invention in its proper perspective, it is worthwhile to point out that the mesh-like appearance of the deflection mask resulting from the circular holes or apertures passing therethrough in a typical case is formed by fine lines of metallic material, such as indicated at 10, having a mesh in the order of 100 lines per inch. For clarity, only a small portion of the mesh-like structure is shown in detail in FIG. 1, it being understood that the same general pattern exists generally throughout the length and width of the mask. Furthermore, it should be understood that even though circular apertures are shown in FIG. 1 other configurations, such as rectangular slits or combinations of aperture configurations, are contemplated within the scope of this invention. From this it is obvious that the apertures must be accurately defined with prefectly straight side walls to insure full viewing capabilities therethrough. There is also shown in the illustration of FIG. 1 six indexing or registration holes indicated at 12 which serve as guides in properly aligning the multiple layers when stacked together to form the deflection mask. Additionally, there may be further included holes such as at 14 which are used for mounting the deflection mask to the particular instrument with which it is to be used and, as will be subsequently described in greater detail, for mounting in a holding fixture for assembly.

Referring now to FIG. 2 there is shown in Step 1 a cross-sectioned end view of one of the layers forming the laminar deflection mask. The dimensions of the apertures or holes, such as indicated at 16, may selectively range from one-quarter inch down to twelve microns and in the typical case of 100 lines per inch would be in the order of .008 inch. The thickness of the metallic sheet may selectively range from .0005 up to .010 inch, depending upon the desired hole size and required line definition. In a typical case this thickness would be in the order of .002 inch thick. The register hole 18 is formed at the same time as the other holes are formed and provides the means for accurately indexing each of the multiple layers to one another so that the respectively corresponding apertures are in alignment. The individual sheets with the apertures therethrough may be formed in any well-known manner which will produce the straight-sided apertures having the required close spacing relationship in the desired pattern. In general, these sheets would be formed either by electroforming or photo-etching processes. It should be pointed out at this juncture that the sheet of metallic material must be sufficiently thick to insure some stability so that the apertures remain dimensionally fixed with respect to the register hole. On the other hand, the sheet must not be so thick as to result in poorly defined apertures during the electroforming or etching process.

After the sheets have been fabricated, at least one surface of each is solder coated. This is indicated at **20** in Step 2, which shows seven sheets arranged in stacked relationship with a coating layer of solder between each of the facing surfaces of the layers. The coating layer of solder which is preferably plated onto the surface of the sheets of metallic material may be in the order of .00005 inch thick. In order to ensure uniform bonding of the layers to one another, a coating of flux is applied to the solder coating prior to stacking the sheets.

The third step in the process is illustrated in FIG. 2 by showing a portion of a holding and alignment fixture in which the sheets are mounted in their stacked relationship. For clarity the fixture is shown partially disassembled and only two layers of metallic material, **21** and **23**, are shown inserted in the fixture with the fixture indexing pin **22**, which is affixed to base plate member **24** passing through the respective registration holes in the two sheets. After the plurality of sheets have been stacked on one another with their respective registration holes mating with the corresponding indexing pins, the top plate member **26** is placed over the top layer of the stack and pressure is applied to the stack by the top plate member via the action of tightening the nut **28** on the threaded portion of bolt **30** which is also affixed to the bottom plate member **24**. The entire assembly is then subjected to sufficient temperature to cause the solder to flow and then is allowed to cool to room temperature while maintaining the pressure to result in bonding the layers to one another. The top plate member **26** is then removed and the stack, which forms the deflection mask, can then be removed from the fixture. In a typical case fifteen layers of sheets, each of approximately .002 inch thickness, are bonded together to form a deflection mask having a thickness in the order of .030 inch.

The portion of a top view of a magnetic core nest fabricated according to the teachings of this invention is illustrated in FIG. 3. The plurality of cavities, such as indicated at **32**, are illustrated as rectangular straight-walled cavities arranged in a symmetrical pattern for receiving and holding annular magnetic cores. This is used for facilitating assembly of a core matrix by stringing a series of wires, therethrough, as described in the copending Frantzen application, supra. Located within each of the cavities is a further aperture extending through the fixture, as indicated at **34**, through which a vacuum may be applied in order to seat each core in the respective cavities. The cavity may take other forms or shapes, for example as illustrated at **36** in FIG. 4 which shows a funnel-shaped cavity. For the purpose of placing this invention in its proper perspective, in a typical case the core sizes are of .030 inch inside diameter and .050 inch outside diameter and the center-to-center spacing of the cavities is in the order of .080 inch. Reference to the cross sectioned view of the nesting fixture for magnetic cores in FIG. 4 shows its laminated structure in detail. The apertures **34** through which the vacuum is applied are in the bottom layer and are centrally located with respect to the cavity in which the cores **38** are held. The next three layers, grouped at **40**, are illustrated as having apertures of substantially identical dimensions while the top three layers, grouped at **42**, have apertures of successively increasing dimensions. The funnel-shaped cavity **36** formed in this manner serves to facilitate placing of the cores in the respective cavities. The process for forming the laminar structure is similar to that previously described with relation to the deflection mask. Each of the individual sheets comprising the respective layers of the laminar with their respective apertures, registration holes, and mounting holes are individually formed by the well-known photo-etching or electroforming process. The solder coating with the covering layer of flux is then applied to the respective surfaces and the sheets are placed in their desired stacked relationship in the holding fixture and subjected to the pressure and heat treatment to effect the bonding between the layers. The resulting product forms a structurally stable nesting fixture having the accurately defined cavities and apertures therein in the desired pattern array.

Although this invention has been described in detail with respect to two particular embodiments, it is understood that no limitation thereto is intended. It is contemplated that other devices having a wide variety of sizes and shapes of apertures in a variety of pattern arrays can be fabricated within the teachings of this invention. Different embodiments of this invention can be made without departing from the spirit and scope thereof, it is to be understood that the invention is not to be limited except as defined by the claims.

What is claimed is:

1. The process of forming a relatively thick mesh having accurately defined apertures passing therethrough, comprising the steps of:

(a) forming a predetermined precision pattern of miniature holes in a plurality of individual thin flexible sheets of metallic material;
(b) applying a thin coating of solder material to at least one major surface of each of the sheets;
(c) stacking the sheets one on another with the solder material in a solid state between each of the facing surfaces;
(d) aligning the sheets so that all the corresponding holes are centered with respecto to one another, and
(e) applying pressure and heat to the stack sufficient to cause the solder coating to bond the stacked layers to one another without blocking any of the holes.

2. The process of forming a relatively thick mesh having accurately defined apertures passing therethrough, comprising the steps of:

(a) forming substantially identical patterns of holes having dimensions ranging from one-quarter inch to twelve microns in a plurality of individual sheets of metallic material of substantially identical thickness in the range of .0005 to .010 inch thick;
(b) applying a coating of solder material in the range of .00005 to .001 inch thick to at least one surface of each of the sheets, the selected thickness being determined by the thickness of the metal sheets;
(c) stacking the sheets with the layer of solder material in solid form between each of the facing surfaces in indexed relationship such that corresponding holes of the respective layers are centered with respect to one another, and
(d) bonding the layers together without blocking off any of the holes by applying the pressure and heat to change the solder material to the molten state and then cooling.

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