April 16, 1963 J. D. LEICHING 3,085,314

METHOD OF MAKING A CORE PLANE ASSEMBLY

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FIG. 1

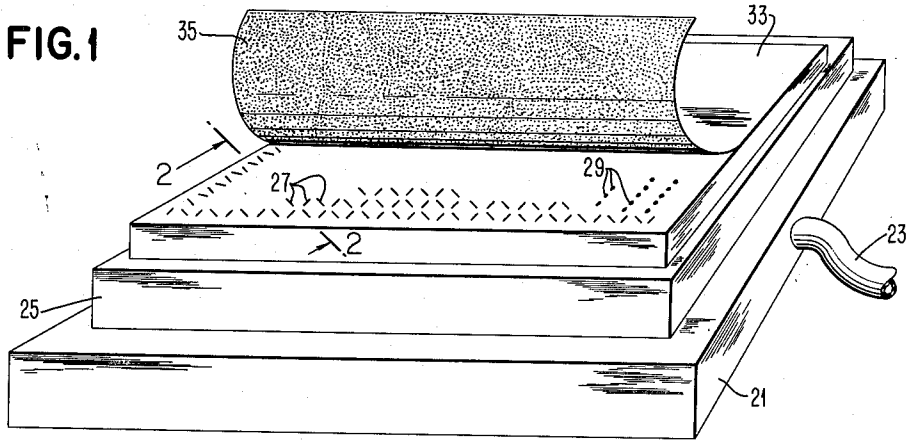


FIG. 3

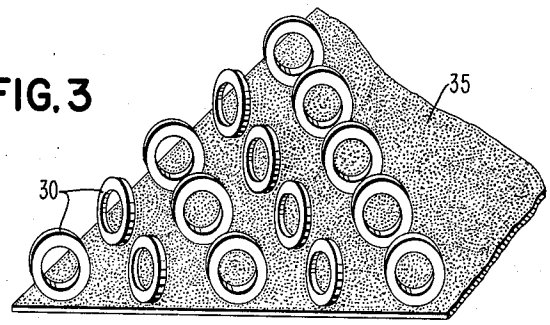
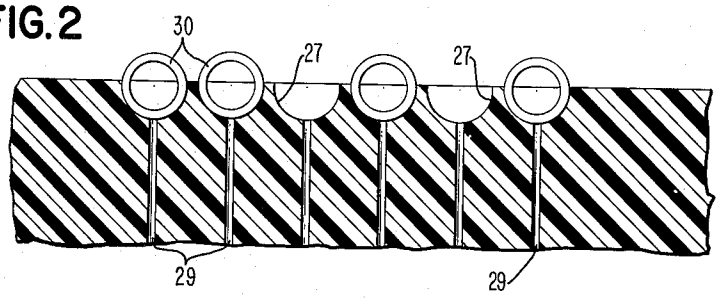


FIG. 2



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METHOD OF MAKING A CORE PLANE ASSEMBLY

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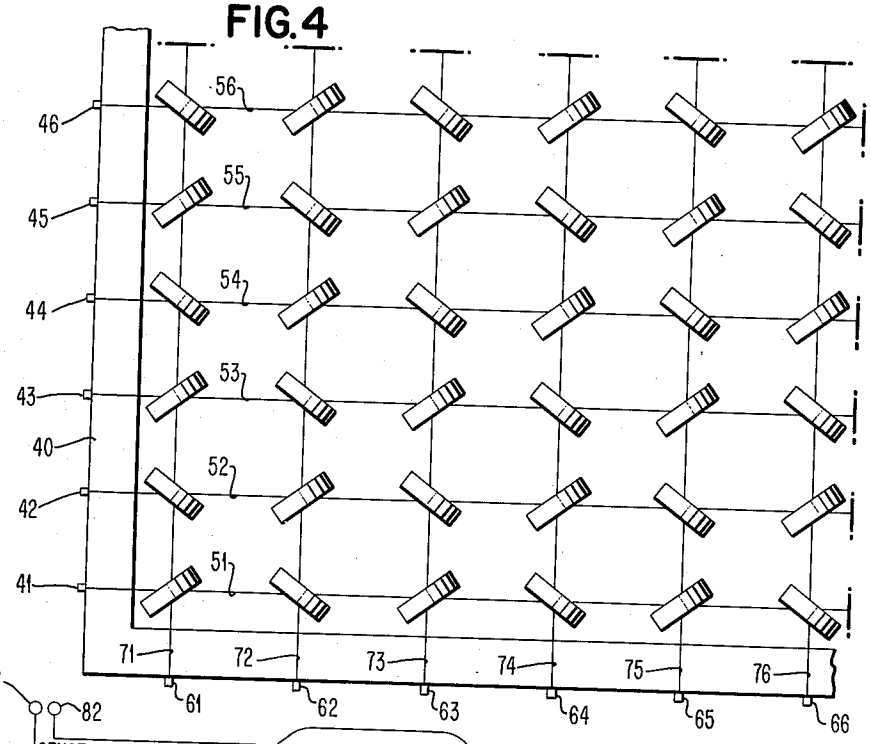
FIG. 4



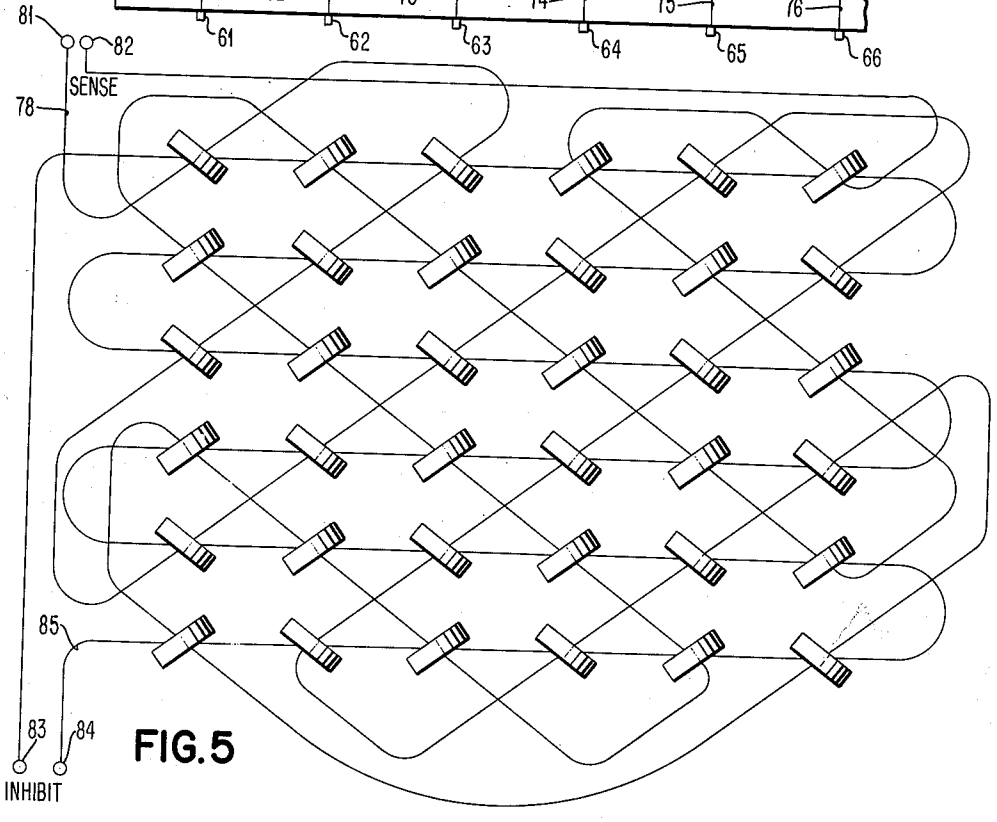


FIG. 5

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METHOD OF MAKING A CORE PLANE ASSEMBLY

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1 Claim. (Cl. 29—155.56)

The present disclosure relates to memory plane assembly and more particularly to a method for assembling a magnetic core plane having a plurality of windings associated with each core.

In the assembly of magnetic core planes which function as memory devices for electrical and electronic computers and the like, it is necessary to interconnect the magnetic cores in a two dimensional array, with a number of windings determined by the function to be provided.

Core plane assembly of the prior art was a tedious, time consuming and expensive operation requiring the cores to be aligned in the desired array and maintained in alignment during the threading operation. To provide a practical and economical method of core plane assembly it was necessary to devise some way of maintaining the cores in a predetermined relationship while exposing the complete opening of the cores during wiring of the core plane.

One known method for maintaining cores in such a predetermined relationship was to utilize a vacuum holding device for jig having apertures or cavities corresponding to the position of the cores in the plane. Due to the extremely small openings in magnetic cores, this method had distinct limitation in that substantially half the interior diameter of each core was below the surface of the holding device thereby substantially reducing the effective opening in each core. In addition, the vacuum lines had to be extended to each assembly point and separate devices were required for each core plane assembler. Since the vacuum holding devices are a relatively costly item to manufacture, the latter situation required a substantial investment, particularly at assembly points where various size magnetic core planes were being fabricated.

In accordance with the present invention, there is provided a novel method of core plane assembly that is flexible, reliable and relatively inexpensive. The cores are initially arranged in a predetermined array in a supporting device connected to a vacuum fixture having cavities arranged in the desired pattern, and a backing strip having an adhesive on one side is applied over the supporting device and forced into contact with the cores whereby the cores are adhesively secured to the strip. This backing strip is then removed from the supporting device, the cores are retained in the same relative position on the adhesive, and the full opening of the cores are exposed for the threading operation. The plane is then wired by threading the windings through the array either manually or by machine. By means of this arrangement, the assembly and wiring operations may be separated, and a single operator and vacuum fixture can provide a number of adhesively secured core assemblies for subsequent fabrication at various assembly points.

A primary object of the present invention is to provide an improved method of fabricating magnetic core plane assemblies.

Another object of the present invention is to provide an improved method for retaining the cores in a core plane assembly in position during the assembly operation.

Another object of the invention is to provide an improved means and method whereby two and three dimensional core plane assemblies may be speedily and accurately performed either manually or semi-automatically.

Other objects of the invention will be pointed out in the following description and claims and illustrated in the

accompanying drawings, which disclose, by way of example, the principle of the invention and the best mode, which has been contemplated, of applying that principle.

In the drawings,

FIG. 1 is a perspective view of the core plane assembly apparatus.

FIG. 2 is a section taken along line 2—2 of FIG. 1 illustrating details of the core holder.

FIG. 3 is a perspective view illustrating the manner in which the cores are arrayed on the adhesive strip prior to the wiring operation.

FIG. 4 is a plan view illustrating the X and Y coordinate wiring of the core plane assembly.

FIG. 5 is a plan view illustrating the sense and inhibit winding of the core plane assembly.

Referring now to the drawings and more particularly to FIG. 1 thereof, the vacuum holding device comprises a vacuum box 21 connected to a vacuum producing device (not shown) by a hose 23. Vacuum box 21 includes a core support unit 25 having a plurality of apertures or cavities 27 for holding the cores in a predetermined position relative to the core matrix being assembled. Suitable material, for example, sponge rubber, is placed between the vacuum box 21 and the support unit 25 to provide a vacuum seal, and each cavity in the core support member 25 includes an associated vacuum port 29 for retaining the core in its cavity as described hereinafter. It will be understood that the cavities 27 with their ports 29 are uniformly distributed over the core support member 25, but for ease of illustration, some have been omitted from FIG. 1.

Referring to FIG. 2, which is a section view along the lines 2—2 of FIG. 1, the details of the core support member are illustrated. Six cavities 27 are shown, four of which contain magnetic cores 30. Each cavity 27 has a vacuum port 29 extending from its lowermost point through the support 25 to its bottom side. The support 25 forms a lid for the vacuum box 21 and the vacuum applied to ports 29 serves to retain the cores 30 within their respective cavities 27.

From FIG. 2 it will be noted that when cores 30 are positioned within their cavities 27, substantially half the core diameter is below the surface of the core support member 25. Since the inner diameter of such cores may vary between .050 and .080 inch, and the cores are at an angle of approximately 45° with respect to the axis of the ordinate conductors, the difficulties in threading an opening of such reduced size will be appreciated.

Returning to FIG. 1, when the cores have been positioned within their respective cavities 27, a backing strip consisting of a sheet of flexible material 33 having an adhesive on surface 35 thereof is placed over the cores in the support 25 and the adhesive side of the backing strip is moved into uniform contact with the core support by a suitable medium such as a sponge rubber roller. One type backing strip which provides satisfactory operation is paper back masking tape. After the tape has been brought into adhesive contact with the core support unit, the backing strip 33 is peeled from the core support 25 and the magnetic cores 30 adhere to the adhesive surface 35 of backing strip 33 in the positions corresponding to the cavities in the core support. The cores are then positioned on the adhesive surface of the backing strip ready for the wiring operation as described hereinafter.

Referring briefly to FIG. 3, there is shown an enlarged view of a section of the core array after the backing strip 33 has been peeled from core support unit 25. It will be noted that the magnetic cores 30 are maintained in an erect position with their entire opening available for wiring and with their edge secured to the adhesive surface 35. In the arrangement herein employed to illustrate the subject invention, the core matrix is arranged in horizontal

rows and vertical columns, wherein each core is at an angle of 90° with respect to adjacent cores and angularly displaced with respect to both the horizontal and vertical coordinate conductors. It may be noted that the cores are oriented in the illustrated pattern to facilitate the threading operation, particularly the sense winding. The problem may be more readily appreciated from the fact that the total dimensions of a 64 x 64 core matrix is approximately 6½ x 6½ inches. From this and the small size of the core openings it will be readily apparent that even a slight displacement of the cores from their assigned position will unduly hamper the threading operation and possibly result in a core being missed. The core and adhesive backing strip assembly is sufficiently rigid to permit moving to a remote assembly point where the final fabrication can be performed, thereby providing increased flexibility. In the embodiment herein described, each core has four windings, two of which require manual threading, and two of which may be threaded either manually or by machine. One method of manual wiring is by means of a hollow needle in which the wires are threaded through cores after which the wires are driven through the needles and held while the needles are withdrawn thereby leaving the cores threaded by wires. An alternative method of automatically threading all horizontal rows in a single operation and all vertical columns in another operation is described in copending application Serial No. 613,985, "Perforated Article Threading Device" filed by Walter P. Shaw on October 4, 1956. Using this latter method, the flexible material **33** is placed on the cores following completion of the horizontal and vertical coordinate wiring, and the cores are retained in position for wiring the remaining conductors to complete the core plane assembly.

Referring now to FIG. 4, when the adhesive surface **35** of backing strip **33** containing cores **30** is separated from the core support unit, it is placed on a fixture for the wiring phase of the assembly operation. This fixture includes a frame **40** having terminals **41–46** for the horizontal conductors **51–56** and vertical terminals **61–66** for the vertical conductors **71–76** respectively. While only six vertical and horizontal terminals are employed in a 6 x 6 matrix to illustrate the subject invention, it will be understood that the number of terminals will correspond to the size of the particular matrix, and in one embodiment will include 64 horizontal and 64 vertical terminals on opposite sides of the frame. As heretofore noted, the horizontal and vertical coordinate conductors may be threaded manually as heretofore described or by machine as described in the aforecited copending application 613,985.

Referring now to FIG. 5, there is illustrated the sense and inhibit winding pattern of a 6 x 6 core array having the same configuration shown in FIG. 4 wherein the frame has been omitted to better illustrate the details of the wiring pattern. The sense winding **78** is wound in a checkerboard pattern in which alternate rows of cores are first wound in one direction and the remaining cores in the other direction. Terminals **81** and **82** identify the terminals of the sense winding, terminals **83** and **84** the terminals of the inhibit winding **85**. The inhibit winding is wound parallel to the horizontal winding but in opposite

directions in adjacent rows. Since both the sense and inhibit windings must pass through all cores, they are manually threaded by a hollow needle in the manner heretofore described.

When the wiring has been completed, the adhesive strip may be removed from the two dimensional array, if desired, since the wiring of the matrix provides sufficient support to maintain the cores in their designated position in the array, or it may remain with the matrix for shipping purposes.

By fabricating the two dimensional frames in the above described manner, a three dimensional memory can be provided by stacking a plurality, of two dimensional frames and interconnecting them through the terminals on the frame.

While there have been shown and described and pointed out the fundamental novel features of the invention as applied to a preferred embodiment, it will be understood that various omissions and substitutions and changes in the form and details of the device illustrated and in its operation may be made by those skilled in the art without departing from the spirit of the invention. It is the intention therefore, to be limited only as indicated by the scope of the following claims.

What is claimed is:

The method of fabricating a magnetic core plane assembly comprising the steps of positioning a plurality of magnetic cores aligned in a predetermined matrix pattern within the cavities of a core holder such that a substantial portion of the periphery of each of said cores is exposed above the surface of said core holder, said matrix pattern including a plurality of magnetic cores arrayed in a non-abutting relationship, applying under resilient pressure to said core holder and said array of exposed cores a strip of flexible material having an adhesive surface, said pressure being exerted directly against one surface of said flexible material whereby said cores are adhesively bonded to said flexible strip, removing said flexible material and said attached cores from said core holder, said cores being rigidly secured to said flexible strip with sufficient force to maintain their positions in relation to each other with the complete openings of said cores exposed and aligned for threading, and interconnecting said magnetic cores in a predetermined configuration while said cores are supported solely by said flexible strip by threading a plurality of conductors through said exposed openings thereof.

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