April 26, 1966 P. R. MUNK 3,247,572

METHOD FOR OBTAINING SMOOTH WINDING SURFACES
ON ROUGH MINIATURE CORES

Filed May 17, 1962

FIG. 1

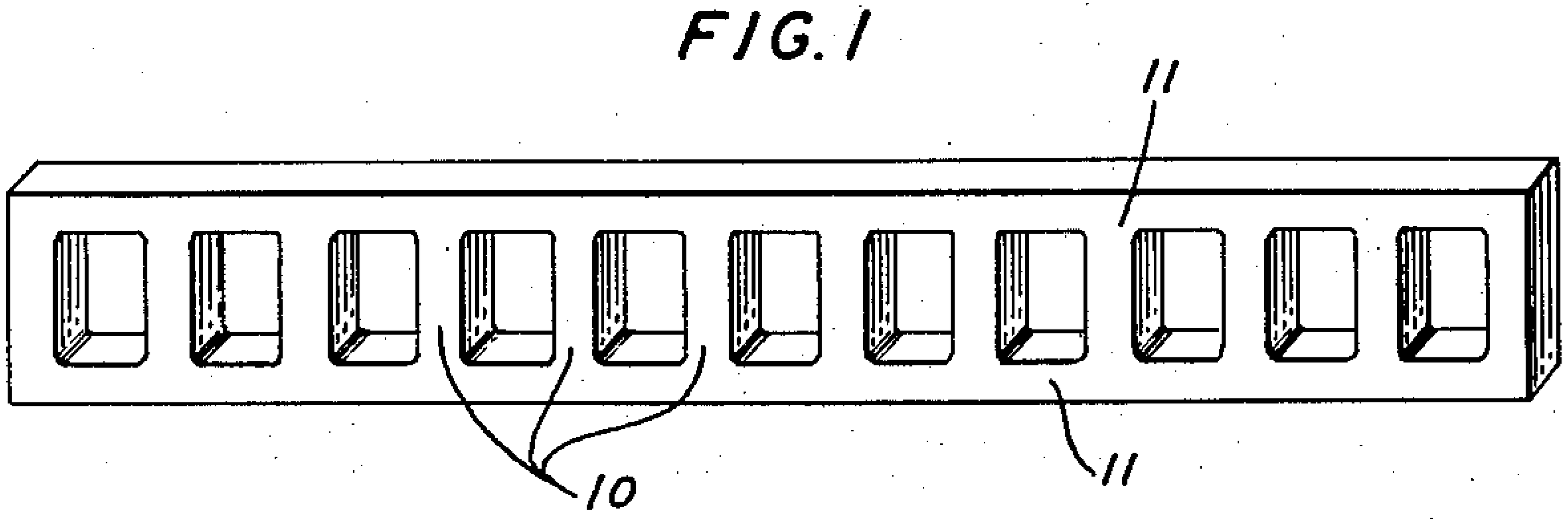


FIG. 2

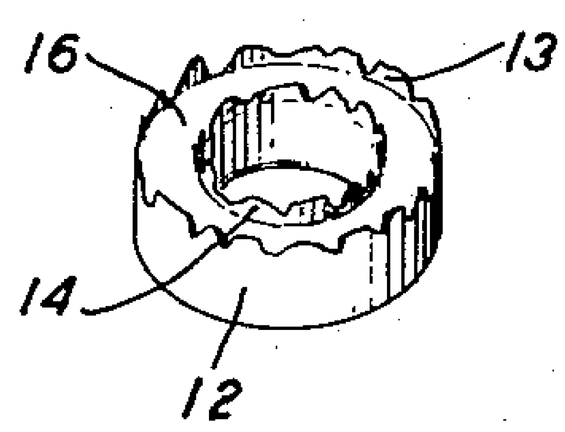


FIG. 3

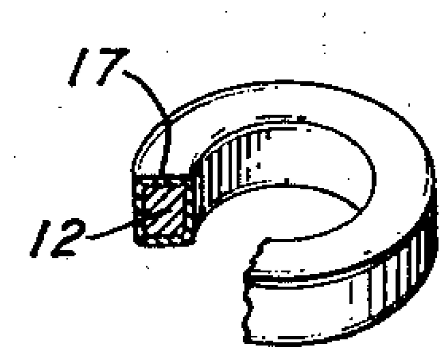
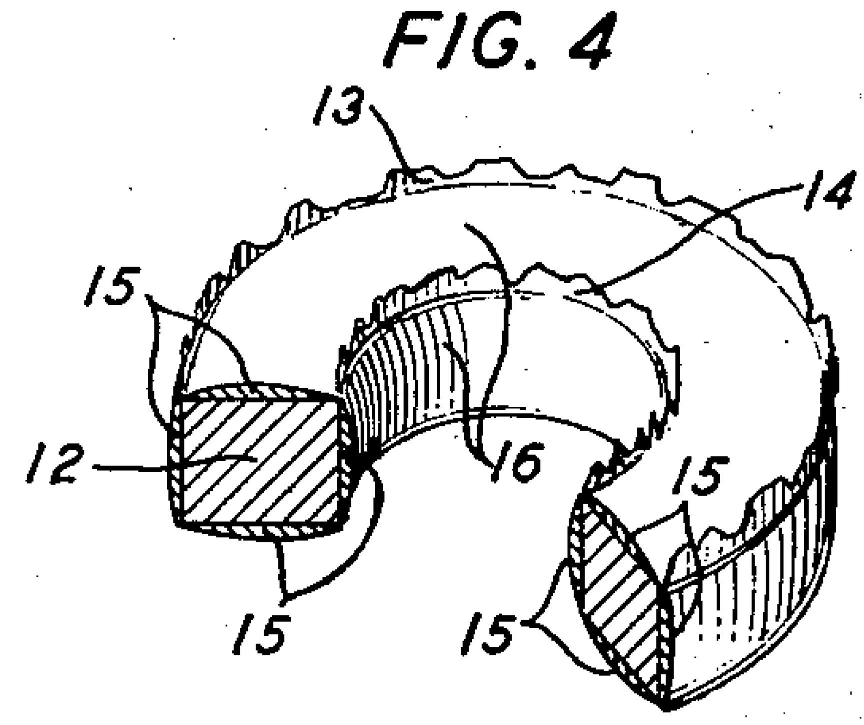


FIG. 4



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METHOD FOR OBTAINING SMOOTH WINDING SURFACES ON ROUGH MINIATURE CORES

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Filed May 17, 1962, Ser. No. 196,014
6 Claims. (Cl. 29—155.5)

This invention relates to a process for obtaining smooth surfaces on an initially rough miniature object and more specifically to a manufacturing process for obtaining a smooth winding surface on miniature magnetic cores for microcircuits.

In order to obtain the physical and magnetic properties desired in miniature magnetic devices, materials, such as ferrite, are used to compose the core. Because these materials are generally hard in nature, the existing manufacturing processes, used to form the material into the core shape, leave sharp and ragged edges. These edges must be removed or covered before the windings are applied to the core or the sharp edges will scrape the insulation from the wires as it is wound on the core, resulting in turn-to-turn short circuits, erratic performance of the magnetic device or possible failure of a system.

In devices wherein the diameter or length measurements of the core are equal to or greater than approximately one-quarter inch, it has been found that satisfactory winding surfaces may be obtained by providing a smooth disc or core-shaped mask that can be applied to the core to cover the sharp and ragged edges left by the manufacturing core-forming process. Numerous methods besides the one listed above find application when typical core dimensions are in excess of one-quarter inch.

When typical core dimensions are considerably less than one-quarter inch, e.g., 0.040 inch, truly miniature cores, such methods as taping, lacquering, providing auxiliary masks, tumbling or sandblasting or like processes, are economically unfeasible. Such methods besides being too expensive and slow, change the physical dimensions of the core; thereby objectionably reducing the winding space or altering the magnetic characteristics of the core. It is pointed out to further explain the application of this invention that as the core dimensions get smaller, roughness and irregularities, such as sharp edges, get larger in proportion to the core size. Loosely speaking, microscopic irregularities may become of major importance if core dimensions are reduced enough.

An object of the invention is to provide a manufacturing process for obtaining smooth surfaces on miniature objects or bodies.

A feature of the invention is the provision of a manufacturing process wherein areas of an object are automatically selected and subjected to an eroding process.

Another feature of the invention is the provision of a manufacturing process wherein the shortcomings of a liquid coating process are used to advantage in a subsequent eroding process.

A further feature of the invention is the provision of a manufacturing process wherein the characteristics of a liquid insulating material are used to complement a subsequent portion of the process.

As discussed above, the invention finds particular application in the manufacturing and finishing of miniature cores for microcircuits. It has been known to cover magnetic cores with successive coatings of lacquer, varnish or other like insulating materials until sharp edges are covered. These successive coatings have a tendency to collect on broad areas and in holes distorting the desired shape and increasing the wire winding difficulties because of the decrease in the dimensions of core holes due to the lacquer buildup. It has also been known to erode or abrade the sharp edges and corners from the core by

sandblasting, tumbling or other such processes. These processes have a tendency to erode broad areas or surfaces in preference to sharp edges. It has been found that after sufficient eroding to remove sharp or ragged edges, the core dimensions have been sufficiently altered, due to the erosion of the broad areas, to change the desired magnetic qualities.

The proposed invention includes a novel combination of the two above processes wherein the disadvantages of the liquid coating process are accented and taken advantage of in the eroding process. The proposed process comprises the application to a miniature object, such as a magnetic core, of a highly diluted liquid, electrically insulating material. The liquid insulating material is highly diluted to accent the surface tension effect of the liquid by reducing the viscosity of the material. Such reduction of viscosity encourages the liquid material to pull away from and expose sharp or ragged corners and edges. The resulting liquid coating is cured to a resilient condition so that it is neither tacky nor brittle. The prepared core is then subjected to an eroding process such as sandblasting, shot-peening or the like. Due to the selective covering and the resilient condition of the coating, the sharp edges and corners are exposed to the eroding process and the broad areas are protected from the same by the coating. After rounding of the sharp edges and corners by the eroding process, a second application of a liquid electrically insulating material is applied to the core which completely envelops the rounded core and provides a smooth electrically insulating coating. Upon a second curing process wherein the second liquid coating is completely dried, the miniature core is ready for the wire winding operation.

The invention will be more clearly understood from the following detailed description, when read in conjunction with the drawing, in which:

FIG. 1 is an isometric view of a lattice or ladder type magnetic core;

FIG. 2 is an isometric view of a circular core indicating in an exaggerated manner two ragged or sharp edges left by the core-forming process;

FIG. 3 is a sectioned isometric view of a circular core after subjection to my process;

FIG. 4 is an enlarged view of a portion of a circular core after the first coating process but before the erosion process.

The lattice core shown in FIG. 1 is presented to exemplify the field to which my process finds greatest application. Typical thickness dimensions of the webs **10** and the stringers **11** are approximately 0.040 inch. Typical dimensions of the rectangular openings of the lattice are approximately 0.040 by 0.060 inch. The entire length of such a structure, depending on how many windings and webs are needed, can be much less than one inch.

A circular core **12** is included in each of the FIGS. 2, 3, and 4 to explain the proposed process. FIG. 2 sets forth a circular core with two rough edges **13** and **14** that are left from the core-forming process. Removal of these edges **13** and **14** is mandatory for proper performance of the magnetic circuit.

My process comprises the application to the core by such means as brushing, spraying or dipping of a first coating **15** of liquid insulating material such as lacquer, varnish, or other similar materials as shown in FIG. 4. The coating **15** is diluted to decrease the surface tension of the liquid by decreasing its viscosity, thereby causing the liquid coating **15** to pull away from and expose the sharp edges **13** and **14** and to collect on the broad surfaces **16** of the core. The coated core is then cured or dried until the coating **15** has a resilient condition and is neither brittle nor tacky. Such a physical condition of the coating **15** is necessary for the eroding operation that follows. If the coating **15** is brittle, the eroding process will chip away the coating, exposing the broad surfaces **16** to the eroding process and if the coating is tacky, particles used in the eroding process will adhere to the coating, causing a detrimental buildup.

The prepared core, as shown in FIG. 4, is then subjected to an eroding process such as sandblasting, shot-peening, tumbling and the like, which removes the exposed sharp edges **13** and **14** but does not erode the broad areas **16** due to the automatic selection of the first diluted liquid coating **15**. The disadvantages accented and produced by the dilution of the liquid applied in the first coating **15** produce an automatic selective exposure and protection to the core **12** which is used to advantage in the subsequent eroding process.

After the eroding process, a second coating **17** of liquid insulating material is applied to the core **12** as shown in FIG. 3. The second coating completely envelops the core **12** covering the first coating **15** and the rounded edges left by the eroding process and providing a smooth winding surface. After curing of the second coating **17**, the core appears as shown in FIG. 3.

It is obvious that the invention is not limited to the specific application illustrated herein but can be employed by those skilled in the art in many ways too numerous to mention. Such use is within the scope of the appended claims.

What is claimed is:

1. A method for obtaining smooth surfaces on rough miniature objects having broad surfaces and sharp projections comprising applying a liquid material to said objects, said material having a surface tension of appropriate magnitude so that the resulting coating on the objects pulls away from said sharp projections and collects on said broad surfaces of said objects, curing said material to form a coating on said surfaces that is neither brittle nor tacky, subjecting the prepared objects to erosion to remove the exposed sharp projections, and forming from a second liquid material a uniform electrically insulating coating on said objects that covers the broad surfaces and the rounded edges left by the erosion process.

2. A method according to claim **1** wherein said liquid materials are electrically insulating materials.

3. A method for obtaining smooth surfaces on miniature objects having rough portions and smooth portions comprising applying a first curable liquid material to said objects, the latter being highly diluted so that the resulting coating on said objects pulls away from said rough portions and coats said smooth portions because of the reduced surface tension of the liquid, curing said material to form a resilient coating on said smooth portions, subjecting said objects to an abrading process to remove said rough portions, applying a second curable liquid material to said objects resulting in a uniform insulating coating that covers the broad surfaces and the rounded edges left by the abrading process and curing said second liquid material.

4. A method according to claim **3** wherein said first and second liquid materials are self-hardening and electrically insulating materials.

5. The method of selectively reducing rough portions of the surface of a miniature object without reduction of the remaining surface that comprises applying to the body a coating of liquid materials of sufficiently low surface tension to recede from and thereby leave exposed said rough portions while covering the remainder of the body, curing the coating to a resilient, nontacky condition; eroding away the exposed rough portions, applying a protective coating to the body, and completely curing the latter coating.

6. The method set forth in claim **1** wherein said second mentioned coating is cured to at least a resilient condition.

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