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MOLDED INSULATOR BASE HAVING EMBEDDED TERMINALS
AND METHOD OF FORMING THE SAME
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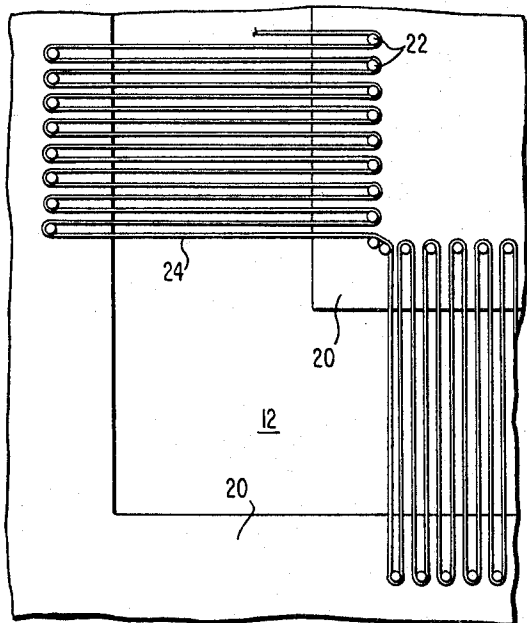


FIG. 1

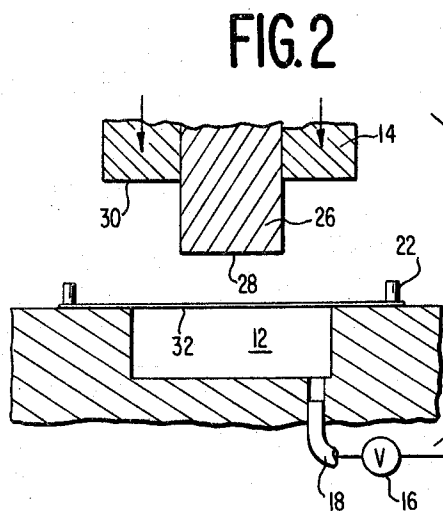


FIG. 2

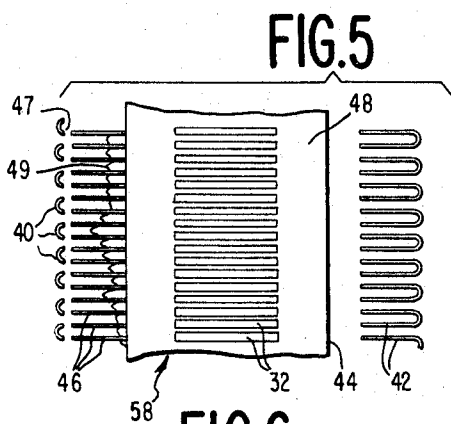


FIG. 3

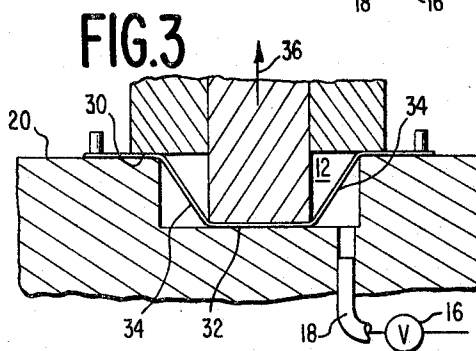


FIG. 4

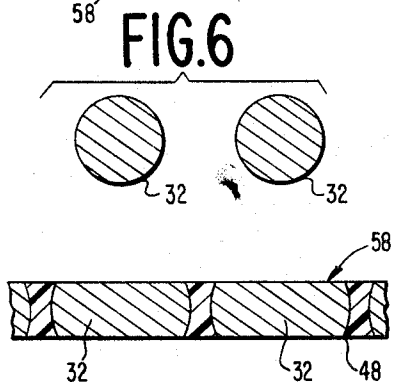


FIG. 5

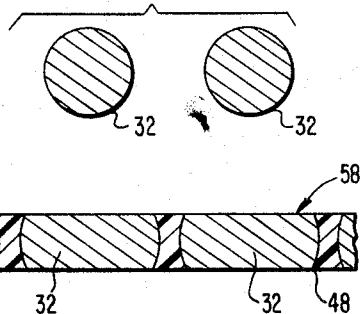
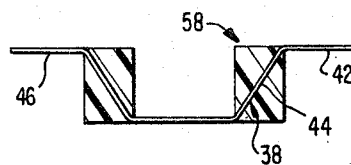


FIG. 6



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MOLDED INSULATOR BASE HAVING EMBEDDED TERMINALS AND METHOD OF FORMING THE SAME

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4 Claims. (Cl. 29—625)

This invention relates to an improved, molded, insulator base and more particularly to an insulator base having embedded therein a plurality of spaced, integrally formed, terminals and welding pads and a method of forming the same. The present invention has particular application to the manufacture of magnetic core planes and the like.

With the trend toward miniaturization, it is increasingly difficult to produce electrical and electronic equipment carrying a relatively large number of small size, closely spaced, preformed terminals wherein proper electrical insulation exists between the conductive terminals, while ensuring uniform current carrying capacity of the terminals. This is particularly so with regard to computers having storage systems involving conventional magnetic core planes. Such devices employ a great number of core frames formed of insulative material which act to support a great number of closely spaced, relatively thin wires which are strung across the open center of the core frame and act to hold circular magnetic core elements or the like and at the same time selectively complete appropriate electrical circuits for storing, reading and removing the information magnetically within the core plane.

Present concept cores planes conventionally use a punched terminal which, for illustration, may be .010 inch thick by .022 inch wide and approximately 1.125 inch long on .036 inch center lines. The punched terminal, which is embedded within the frame in a conventional molding operation, acts to provide the necessary exterior electrical connections to the wires stretched across the interior opening of the frame. The terminals during manufacture are so formed as to be connected by a selvage to form a strip of terminals of extended length in the order of 65 to 74 positions long. The terminal is generally formed to provide a weld pad which lies on the surface of the plastic frame after the terminal strip is integrally molded in a core frame by being positioned within a mold cavity prior to molding of the frame. The selvage is then broken away from the terminals, thus providing the desired electrical insulation between adjacent terminals and weld pads.

In order to stamp the terminals with the desired configuration, each stamping machine requires a die costing the neighborhood of \$10,000. In cases where duplicate tooling is required, the cost would be multiplied accordingly.

It is, therefore, a primary object of this invention to provide an improved, molded insulator carrying a plurality of spaced, integral terminals and welding pads, which may comprise a magnetic storage core frame, in which the terminals are formed and the welding pads coined simultaneously with the molding of the insulated base member.

It is a further object of this invention to provide an improved, insulative member carrying spaced, integral terminals and welding pads in which quality control may be more readily maintained, and in which the manufacturing expense is greatly reduced.

It is a further object of this invention to provide an improved, molded magnetic storage core frame in which the need for providing preformed, integral terminals and welding pads is completely eliminated.

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It is a further object of this invention to provide a method for forming a molded insulative base member carrying spaced, embedded, integral terminals and welding pads in which the size and relative spacing of the terminal members may be readily varied without requiring expensive modification of the molding apparatus.

The foregoing and other objects, features and advantages of the invention will be apparent from the following more particular description of a preferred embodiment of the invention, as illustrated in the accompanying drawing.

In the drawing:

FIGURE 1 is a top plan view of a portion of a molding apparatus which can be used for carrying out the method of the invention.

FIGURE 2 is a vertical section of portions of the molding apparatus showing an upper male punch for deforming the wire convolutions.

FIGURE 3 is a vertical sectional view of the portions of the molding apparatus shown in FIGURE 2, with the parts in a position corresponding to a later stage of the process.

FIGURE 4 is a sectional view of one side of an insulative core frame after removal from the mold.

FIGURE 5 is a semidiagrammatic bottom plan view of a portion of one side of the core frame shown in FIGURE 4 after trimming the terminal leads.

FIGURE 6 is an enlarged cross-section of a pair of the wires prior to coining to form the welding pads.

FIGURE 7 is an enlarged cross-section at right angles to the mid-portion of the molded core frame shown in FIGURE 4.

In general, the present invention relates to a method of forming a molded magnetic storage core frame having spaced, embedded integral terminals and welding pads molded therein by winding a metal wire about a series of pins or bosses extending along the edges of an open mold cavity to produce a series of spaced wire convolutions across an open end of the cavity. A male punch member, which may form a part of the upper movable mold member, moves into the open end of the mold cavity to displace the intermediate portions of the wire convolutions and coins them against the inner wall of the mold cavity to produce welding pad areas of reduced thickness and increased width. Subsequently, an insulative plastic material fills the mold cavity to embed the intermediate portions of the wire and form the molded core frame having exposed welding pads areas along one surface of the molded core frame. The extreme ends of the wire convolutions are subsequently trimmed to produce outwardly projecting, spaced terminals extending exteriorly away from the molded core frame.

The present invention is described in conjunction with the manufacture of core planes and the like involving an insulative, molded core frame carrying embedded, integral, spaced terminals and welding pads; however, the use of the present invention in the manufacture of a core plane is illustrative of only one area to which the present invention has application. The techniques of the present invention may be advantageously applied to the more general field of electrical and electronic equipment and in particular, to devices employing printed circuits and the like requiring elongated insulative base members which carry closely spaced, relatively small electrical terminals, with or without welding pads or like enlarged contact areas.

Referring to FIGURES 1 and 2, there is shown a lower or base mold 10 which is provided with a rectangular mold cavity 12 adapted to receive plastic insulative material to form, in the illustrative case, a rectangular, magnetic information storage core frame 58 having a central opening therein.

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One prior method of producing a molded core frame carrying the required spaced integrally formed terminals and welding pads utilizes molding chambers, such as a stationary female molding member and an upper, movable molding member which is moved downwardly to produce a closed mold cavity. The mold cavity is then filled with molten plastic material. Prepunched terminal members are positioned within the mold cavity prior to molding, with the terminals being connected by a selvage to form a strip. After molding, the selvage is broken away from the terminals to effect the desired insulative spacing between the integral terminal and welding pads extending transversely across the plastic core frame throughout the length of the frame.

In the improved method of the present invention, the molding apparatus, as indicated in the drawing, is modified in two ways. First, on either side of the mold cavity 12, on the upper surface 20 of the bottom or lower mold member 10, there are provided a plurality of evenly spaced pins or bosses 22 of uniform diameter which extend upwardly away from the mold surface 20. Instead of using the preformed terminal members, the integral terminals and welding pads are replaced by relatively inexpensive metal wire which may, for instance, be formed of copper, the wire being of a uniform diameter, for instance, .016 inch. The wire 24 is wrapped in serpentine fashion around the spaced pins 22 to form a series of convolutions extending across and above the open mold cavity 12 in the manner shown in FIGURES 1 and 2. As indicated, the wire 24 stretches in serpentine or convoluted fashion across the mold cavity with the exception of the corners to form the desired series of spaced integral, embedded terminals and welding pads.

The second major modification of the molding apparatus consists in the provision of a male punch 26 which may form a central portion of an upper molding member 14 and, therefore, may be moved relative to the main section of the upper mold 14 to a fixed position. Thus, the bottom surface 28 of the male punch 26 approaches on downward movement the bottom surface of the cavity 12 to a distance less than the diameter of the wire. In this position, the outer ends of the surfaces 30 are in sealed relationship with the upper surface 20 of the bottom mold member, except for small spaces between the wire 24.

The male punch 26 acts to deform the serpentine wire passing across the mold cavity by coining the central section 32 of the wire segments to produce the welding pads. The method in which the wire is deformed and coined is apparent when viewing FIGURES 2, 3 and 4. As a result of relative movement between the male punch 26 carried by the upper mold member and the female mold member 10, the punch 26 enters the mold cavity 12. The bottom surface 28 of the punch 26 upon contacting the central section 32 of the wire, when moved in the direction of the arrows, FIGURE 2, causes the central section to move downwardly, stretching the wire and forming the diagonal portions 34, while at the same time coining the central sections 32 and changing their cross-sectional configuration from the normal circular cross-section to a cross-section having flattened upper and lower surfaces of increased width and decreased thickness. The punch 26 effects non-elastic stretching of the wire without severing the same to form the diagonal portions 34, and since elongation of the central sections of the wire occurs, the diameter of the wire sections or portions in this area diminishes. Conventional copper wire inherently has the properties necessary to allow this type of deformation. This results in the production of a relatively wide welding pad portion, as indicated best when viewing FIGURE 7.

After deformation, in a preferred form of the apparatus shown, the male punch member 26 and the main section of the upper mold 14 remain stationary, while valve 16 is opened to allow plastic insulative material, from a source

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not shown, to flow through conduit 18 to the molding cavity 12. After the molding material has hardened, there has been produced a molded, U-shaped, core frame 58 having integrally formed, spaced terminal members and welding pads 38, as indicated in the cross-sectional view of FIGURE 4.

Reference to FIGURE 5 indicates the subsequent steps in completing the core frame for actual use. In order to provide electrically separated, integral terminals and welding pads, the portions of the wire 40 in contact with the spaced pins 22 of the bottom mold are severed at the extreme outer ends of the assembly, as shown at 47. Subsequently, the inner terminal members 42 are severed adjacent to the inner edge 44 of the core frame, while the outer terminal members 46 are left protruding for purposes of allowing appropriate electrical connections to be made to the spaced, insulated welding pad sections 32, which are exposed on the bottom surface 48 of the core frame 58. Any flash 49 between the terminal members 46 can be removed by an air-grit blast. Alternatively, the formation of flash can be prevented by upward projections or bosses on surface 20 adjacent the edge of cavity 12. In the finished core frame, as indicated in FIGURE 5, the weld pads act as welding surfaces for electrical circuit attachment to the individual core windings (not shown) which are stretched across the interior of the frame. The interior terminals 42 are thus not needed and the exterior terminals 46 may be used after removal of the curved joining sections 40 or may be trimmed to any desired length to allow appropriate connections to be made to circuits exterior of the core frame.

Instead of leaving the central punch 26 of the upper mold 14 stationary, it can be retracted into the upper mold, after the wire portions 32 have been formed and before casting begins, to reduce the depth of the cavity of U-shaped cross-section, of the core frame 58. For example, the punch can be retracted until its end face 28 is flush with the bottom surface 30 of the upper mold, in which case the core frame will be rectangular in cross-section.

It is readily apparent that the present invention combines both the terminal forming and coining operations with a molding operation to achieve a single step process in producing an insulative base member carrying embedded, integral spaced terminals preferably having enlarged welding areas exposed along one or more surfaces of the insulative base member. Electrical contact is thus achieved through plastic parts without the expense of procuring separately fabricated inserts, such as punched and preformed terminals. This method of the present invention is not intended to be limited to terminals requiring weld parts or coined areas but is meant to include all possible applications where multiple contacts or terminals are included in a plastic part, in spaced, insulative fashion. The method of the present invention is highly versatile in that minor changes may be made to the molding apparatus to produce variable spacing and/or size of the terminal members to be integrally molded within the insulative frame or base. Also, since the area throughout the wire is constant, regardless of the coin shape produced by the combined punching and molding operation, the subsequent welding techniques are not complicated by terminal members having sections of differing cross-sectional area. Further, in the apparatus shown in FIGURES 2 and 3, the relative positioning of the punch member 26 with respect to the bottom surface of the mold cavity 12 is capable of producing a coined section of the wire having differing thicknesses and widths. Thus, the configuration of the coin portion or segment of the wire may be readily changed by a minor relative positioning or shaping of the male punch member 26. Further, while the male punch 26 is shown as being relatively movable with respect to the upper mold forming member 14, the punch may be integral with mold member 14, thus forming a completed molded insulative frame 58 with a rectangular

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recess adjacent the rear surface of coined section 32 of the embedded terminal 38.

While the invention has been particularly shown and described with reference to a preferred embodiment thereof, it will be understood by those in the art that various changes in form and details may be made therein without departing from the spirit and scope of the invention.

What is claimed is:

1. A method of forming a molded insulative base member having spaced, embedded, integral terminals and welding pads molded therein comprising: forming a series of metal wire convolutions across an open mold cavity, displacing the intermediate portions of said wire convolutions into said cavity and coining said intermediate portions by flattening them against said cavity wall, and filling said mold cavity with plastic insulative material to embed said intermediate portions of said wires within said base member with the outer surface of said intermediate portion exposed along one surface of said molded base member to provide a welding pad area, cooling said plastic material to solidify the same, removing the molded assembly and severing the outer ends of said wire convolutions exterior of said molded base member to provide spaced, insulated terminals.

2. The method of forming a molded insulative base member having spaced, embedded terminals molded therein comprising the sequential steps of: winding a metal wire into a series of convolutions about pins spaced longitudinally on either side of an open mold cavity, moving into said open cavity a male punch member having a smaller cross-section than said cavity, to non-elastically displace intermediate portions of said wire convolutions within said cavity maintaining the punch member in contact with said non-elastically deformed intermediate portions while filling said cavity with plastic insulative material to embed said intermediate portions within said molded base member, cooling said plastic material to solidify the same, removing said molded base member from said mold cavity and punch member and severing the outer ends of said wire convolutions to form a series of spaced protruding terminal leads exteriorly of said molded base member.

3. The method of forming a molded insulator base having spaced, embedded, integral terminals and welding pads molded therein comprising: winding a metal wire about a series of pins spaced on either side of an open

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mold cavity to produce a series of wire convolutions across said mold cavity, displacing the intermediate portions of said wire convolutions into said cavity and coining the same by pressing said intermediate portions against the inner wall of said cavity to form said welding pad areas, filling said cavity with plastic insulative material to embed said portions of said wires therein, cooling said plastic material to solidify the same, removing the molded assembly and severing the ends of said wire convolutions exterior of said molded base member to provide exposed welding pad surfaces along one surface of said molded base member and a series of spaced, outwardly extending terminals exterior of said molded base member.

4. A method of forming a molded core frame having spaced, embedded, integral terminals and welding pads molded therein comprising: winding a metal wire on a series of pins extending along the edges of an open mold cavity to produce a series of wire convolutions across the open end of said mold cavity, displacing the intermediate portions of said wire convolutions into said cavity and squeezing said portions against the inner wall of said cavity to produce welding pad areas of reduced thickness and increased width, filling said mold cavity with insulative plastic material to embed said intermediate portions of said wires therein, cooling said plastic material to solidify the same, removing said molded, core frame from said mold cavity and severing the ends of said wire convolutions exterior of said molded base member to produce exposed welding pad areas along one surface of said molded core frame and outwardly projecting, spaced terminals extending exteriorly away from one side of said molded core frame.

References Cited

UNITED STATES PATENTS

2,344,647	3/1944	Simmons	29—155.5X
2,853,764	9/1958	De Michele	29—155.62
3,042,999	7/1962	Page et al.	29—155.5
3,133,981	5/1964	Seele	264—261
3,148,439	9/1964	Showalter	29—155.54
3,218,694	11/1965	Wood	29—155.5
3,259,974	7/1966	Gehl	29—527

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