United States Patent

Boysen et al.

[15] **3,691,493**

[45] **Sept. 12, 1972**

[54] **COIL PLATE ASSEMBLY**

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[73] Assignee: **Allen-Bradley Company,** Milwaukee, Wis.

[22] Filed: **Sept. 30, 1971**

[21] Appl. No.: **185,102**

[52] **U.S. Cl.** **336/65,** 336/96, 336/192, 336/208

[51] **Int. Cl.**.....**H01f 15/02,** H01f 27/30

[58] **Field of Search**.....336/65, 96, 192, 198, 208

[56] **References Cited**

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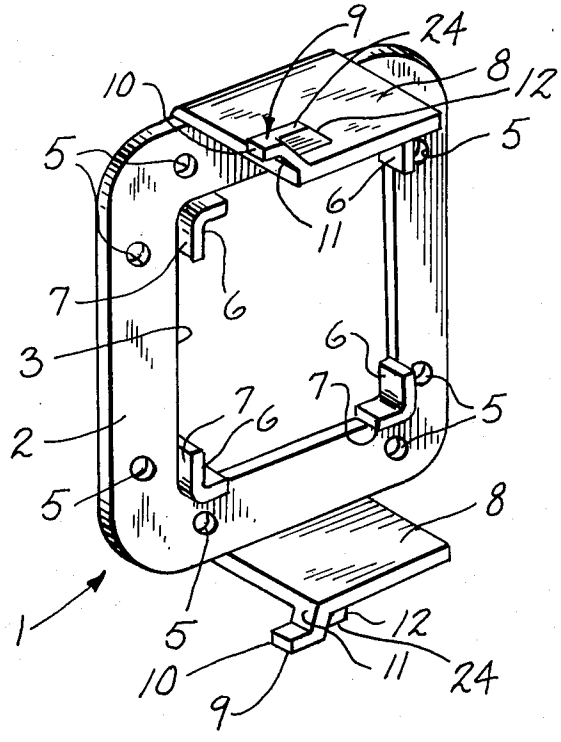
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Primary Examiner—Thomas J. Kozma
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[57] **ABSTRACT**

A coil plate assembly having a pair of coil plates with an electrical coil interposed therebetween to position the coil in a molding die for encapsulation in an insulating material. The coil plates each have a pair of side shrouds extending alongside the coil and a boss is formed on the remote end of each shroud. A terminal clasp encircles each pair of bosses of adjacent shrouds to connect the shrouds of the two plates together. In addition, the terminal clasps are electrically connected to the coil and extend outward from the coil plates to act as terminals for making connection in a circuit.

9 Claims, 8 Drawing Figures



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Fig. 1

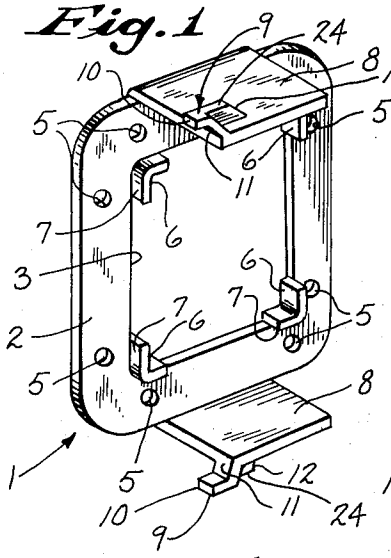


Fig. 2

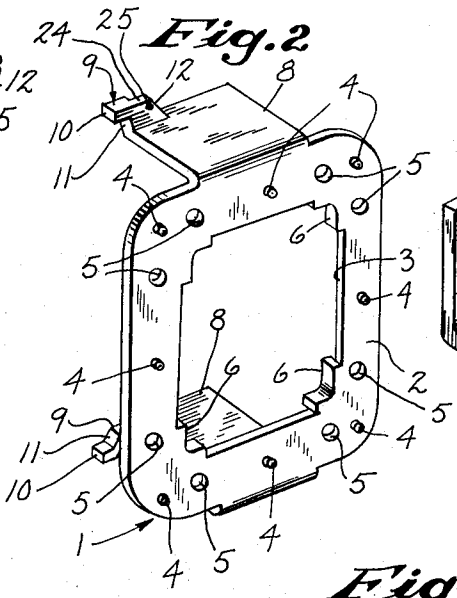


Fig. 3

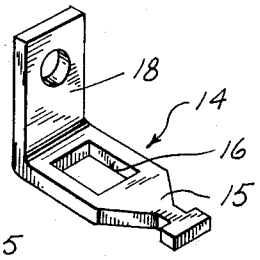


Fig. 4

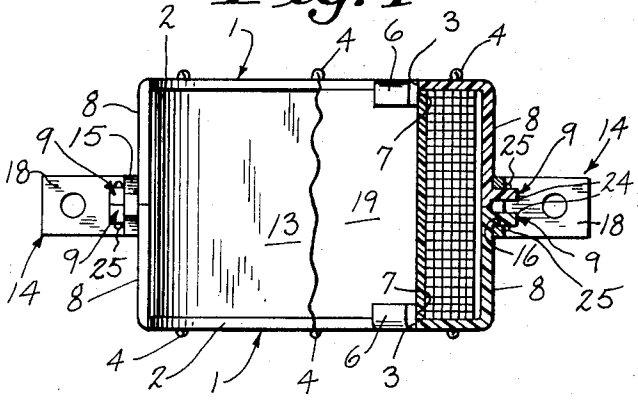


Fig. 5

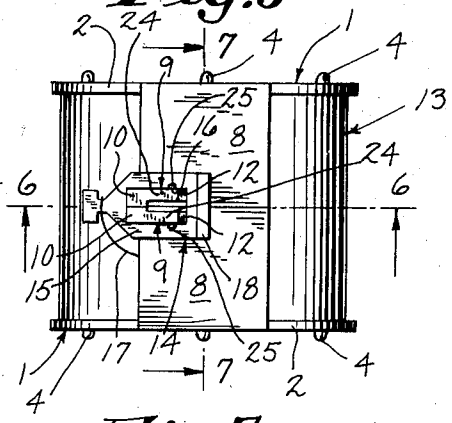


Fig. 6

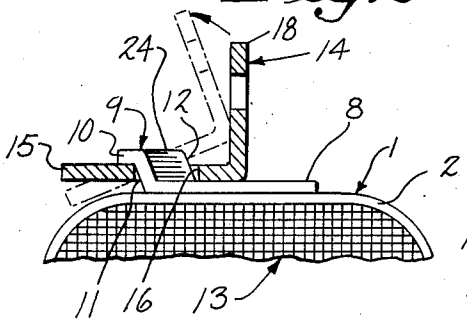


Fig. 7

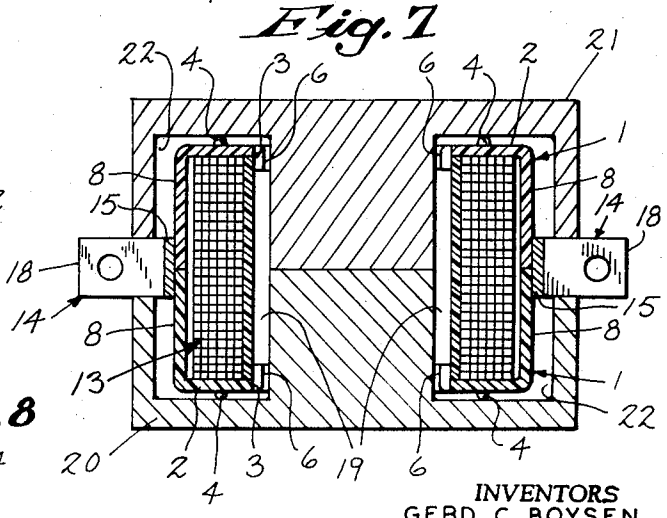
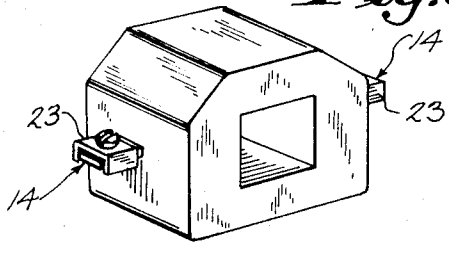


Fig. 8



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COIL PLATE ASSEMBLY

BACKGROUND OF THE INVENTION

It is of advantage to encapsulate electrical coils in molding material to protect the individual turns and to minimize the shifting of turns in response to magnetic forces. Appearance is also greatly improved by the encapsulating of wound coils in resinous materials, and it has now become a common practice to cover coils with molding material. To properly position a wound coil within a molding die cavity during the encapsulation process, so as to cover the coil with a uniform coating, some form of positioning of the coil within the molding die is required. The space between the coil and the cavity walls must be maintained in the presence of the flow of the molding material, and uneven pressures that are occasioned by the material flow.

At the present, some positioning means for coils are formed of a pair of support plates between which the coil is interposed, and the plates have protrusions that bear against cavity walls with a snug enough fit to hold the coil properly positioned throughout the molding process. The plates are connected together by locking elements that are completely covered by the encapsulating material, and separate and distinct terminals are employed that protrude from the completed, encapsulated coil, to serve as means for making electrical connection. In addition to necessarily being electrically connected to the coil, these terminals must also have some type of connecting relationship with the support plates to fix them in a proper position during the encapsulation process. Such a prior structure is shown in U.S. Pat. No. 3,544,937 dated Dec. 1, 1970, and the present invention provides an improved departure from the coil support disclosed in that patent.

SUMMARY OF THE INVENTION

The present invention relates to a coil supporting plate assembly particularly useful for positioning an electrical coil in a molding die cavity during encapsulation, and it more particularly resides in a pair of coil support plates having panels on opposite ends of the coil with coil alignment means to hold the coil in a fixed position with respect to the plates, side shrouds, that continue integrally from the panels and overlie the coil sides, protruberances formed on the side shrouds, and terminals that clasp the protruberances of adjacent shrouds together to hold the parts assembled.

A preferred form of the invention has a pair of support plates with central apertures that conform to and are aligned with the central opening of the associated coil. Alignment lugs are mounted on the periphery of the apertures that protrude into the coil core to maintain the coil in proper registry with the plates, and the plates have small protruding pins that engage cavity walls. This engagement holds the coil assembly in place during molding. To maintain the coil plates in assembled relation with the coil preliminary to, and during, encapsulation, novel use is made of the terminals. They not only function for making electrical connection, but they also clasp the coil plates in a firm, assembled relation. In doing so, the terminals also position themselves. A simplified structure thus results that does not require extra, or complicated parts for making a pre-assembly prior to the encapsulating process. Means that are separate from the terminals for holding the coil supporting plates and coil in pre-assembled relation are thus eliminated.

It is an object of this invention to provide a coil supporting plate assembly that can readily be assembled to position a coil within a molding die cavity for encapsulation to establish the desired degree of coverage of encapsulating material about the assembly.

It is a further object to provide a coil supporting plate assembly that is coupled together by dual purpose locking means that are electrically connected to the coil and protrude from the encapsulated coil assembly to act as terminals for electrically connecting the coil into a circuit.

The foregoing and other objects and advantages of the invention will appear from the following description. In the description reference is made to the accompanying drawings, which form a part hereof, and in which there is shown by way of illustration, and not of limitation, a specific form in which the invention may be embodied. Such embodiment does not represent the full scope of the invention, but rather the invention may be employed in a variety of embodiments, and reference is made to the claims herein for interpreting the breadth of the invention.

BRIEF DESCRIPTION OF THE DRAWINGS

FIGS. 1 and 2 are perspective views of two coil plates which form a part of this invention,

FIG. 3 is a perspective view of a terminal forming a part of the invention,

FIG. 4 is a front view partially in section of the coil plates of FIGS. 1 and 2 and of a pair of terminals as in FIG. 3 all assembled in a pre-assembly with a coil,

FIG. 5 is a side view of the assembly of FIG. 4,

FIG. 6 is an enlarged fragmentary view in section taken through the plane 6—6 indicated in FIG. 5,

FIG. 7 is a view in section taken through the plane 7—7 in FIG. 3, and showing the pre-assembly in a molding die for encapsulation, and

FIG. 8 is a perspective view of a completed, encapsulated coil embodying the invention.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring now to the drawings, FIGS. 1 and 2 are perspective views of two identicaL coil plates 1 that mirror one another. Each plate 1 has a substantially rectangular end panel 2 which has a large central aperture 3. As shown in FIG. 2, there are a number of short pins 4 projecting from the outer face of each end panel 1, which function to bear against the walls of a cavity of a molding die. Each end panel 2 also has a plurality of small openings 5 through which molding material may flow during an encapsulation process.

As most clearly seen in FIGS. 1, 2 and 4, each panel 2 has a set of four inwardly projecting alignment lugs 6 that are located at the corners of its aperture 3. Each alignment lug 6 turns around a corner of the aperture 3 to have a generally L-shaped appearance, and each lug 6 is also offset from the periphery of the aperture 3, so that the outer faces 7 of the lugs 6 are co-planar with the aperture periphery. Each coil plate 1 also has a pair of side shrouds 8. These shrouds turn at right angles from the end panels 1 in an inward direction and have a generally rectangular appearance. Each shroud 8 has

an integral boss 9 formed at a corner remote from the end panel 2.

Each boss 9 os of a complex configuration that protrudes above the outer surface of its associated side shroud 8 and is particularly characterized by a lip 10 that is raised above and overhangs beyond an edge of the shroud 8. As most clearly shown in FIG. 6, there is a front inclined face 11 beneath the lip 10, and a rear inclined face 12 at the opposite end of the boss 9 which parallels the front inclined face 11. Each boss 9 is further characterized in appearance, when viewed from a position as in FIG. 5, as being generally "L" shaped in outline with a thin rib 24 extending rearward from the lip 10. The inclined face 12 forms the rear edge of the rib 24, and a nib like catch 25 protrudes from one side of the rib 24. When the two coil plates 1 are brought up against each other, as in FIG. 5, the bosses 9 of abutting shrouds 8 match with one another to present a rectangular outline with the ribs 24 of the two bosses 9 forming two opposite sides of the rectangle. The nib like catches 25 face outward from the rectangular configuration, and the ribs 24 are spaced from one another with a gap therebetween, so that they can be flexed toward one another.

As illustrated in FIGS. 4 and 5, the coil plates 1 are designed to overlie the ends of an electrical coil 13, with the side shrouds 8 extending alongside opposite sides of the coil 13. The remote end of each shroud 8 abuts with the like end of an opposite shroud 8 of the other plate 1, to thereby form a frame around the coil 13. This frame is to act as a support for the coil 13 when the sub-assembly being described is inserted into a mold cavity. The bosses 9 of two abutting shrouds 8 are juxtaposed and thereby define a composite member on each side of the assembly.

Two juxtaposed bosses 9 are secured together by a terminal clasp 14 that serves as a locking means. Such a terminal clasp 14 is shown in FIG. 3, and has a clasp portion 15 with rectangular opening 16 in which a pair of juxtaposed bosses 9 are snugly received, so as to be clamped together. When a pair of bosses 9 are thus encircled by a terminal clasp 14 on each side of the assembly, the plates 1 are joined with one another to snugly cradle the coil 13. Each terminal clasp 14 is electrically connected to an end wire 17 of the coil 13, and each terminal clasp 14 also has a connection end 18 which extends radially outward of the coil 13 for connecting the coil into a circuit.

Referring now to FIG. 6, which is an enlarged section view of the terminal clasp 14 and one of the bosses 9, it can be seen that the clasp 14 is placed in position with a part thereof under the lip 10. The clasp 14 is then pivoted to have the clasp portion 15 seated flat upon the shrouds 8, in which position the rectangular opening 16 of the clasp 15 fits snugly about the bosses 9 to firmly hold all parts in position. The pivoting motion is facilitated by the provision of the inclined faces 11 and 12 of the bosses 9. Referring again to FIG. 5, as the terminal clasp 14 pivots, it engages the catches 25 on the rear corners of the bosses 9. Due to the gap between the ribs 24, the rear corners of the ribs 24 on which the nib like catches 25 are formed are deflected inward to allow the clasp portion 15 of the terminal clasp 14 to pass over the catches 25. Thereupon, the bosses 9 resume their natural shape and the catches 25 act to hold the clasp portion 15 in place.

The coil 13 is wound around a hollow forming core 19, as seen in FIGS. 4 and 7. Then the coil plates 1 are positioned around the coil 13 the alignment lugs 6 extend into the hollow core 19 with a snug fit to hold the coil 13 in a fixed position with respect to the plates 1. Also, the periphery of the plate aperture 3 matches with the opening of the core 19.

Turning now to FIG. 7, there is illustrated the insertion of the coil supporting sub-assembly within a molding die comprising a lower die member 20 and an upper die member 21 which cooperate to define a mold cavity 22. When the coil supporting sub-assembly 10 is placed within the cavity 22 the die contact pins 4 of the plates 1 engage cavity walls to vertically space the assembly parts from the die surfaces. In order to provide longitudinal registration of the sub-assembly within the cavity 22, the bosses 9 engage the cavity side walls. The thickness of the encapsulating coating is thereby controlled.

Once the coil sub-assembly is properly positioned within the mold cavity 22, molten encapsulating material is injected into the cavity to flow about the assembly and through the openings 5 to entirely impregnate the coil 13, and to form a molded shape in accordance with the cavity design. The finished product, when removed from the cavity 22, may then have an appearance as in FIG. 8.

As can be seen, the connection ends 18 of the terminal clasps 14 extend from opposite sides of the final product, and a terminal clamp 23 may be secured on each end 18.

By employing the terminal clasps 14 to serve the dual functions of first, holding the coil supporting sub-assembly together before encapsulation, and, second, serving as terminals after encapsulation, the assembly of the present invention uses a minimum of parts. Also, the parts may be rapidly and easily assembled simply by hooking the terminal clasps 14 over the bosses 9, thus coupling the coil plates 1 to one another.

Although a support assembly for a single coil has been shown and described herein as a preferred embodiment of the present invention, it should be understood that the invention is not so limited and may be readily adapted to support two or more coils for encapsulation.

We claim:

1. In a coil plate assembly for a coil having opposite ends and an opening extending between the ends, the combination comprising:

a pair of coil plates between which the coil is disposed, such plates each having:

an open center panel portion lying over an end of the coil with the open center overlying the coil opening,

alignment lugs extending from the panel portion into the coil opening to position the panel portion with the coil,

a pair of side shrouds at opposite margins of the panel portion that turn and extend alongside coil sides, and that have outer ends that abut shrouds of the other coil plate, and

a protruberance at the outer end of each side shroud that is positioned adjacent a protruberance of an abutting side shroud of the other coil plate; and

a pair of terminals, each having a clasp portion encircling adjacent protruberances of abutting side shrouds to capture the same in position, and a projecting extremity for making connection in a circuit.

2. A coil plate assembly as in claim 1 in which each of said protruberances has an overhanging lip and a catch, and each terminal clasp portion slides under the lip and is held in place by the catch to temporarily maintain the parts in position.

3. A coil plate assembly as in claim 1 wherein the assembly is encapsulated in a molding material.

4. In a coil plate assembly to position a coil in a molding die cavity for encapsulation in an insulating material, the combination comprising:

a pair of coil plates between which the coil is disposed; each plate including:

an end panel lying over the coil end,

die contact means on the end panel to space said assembly from die cavity walls,

a pair of side shrouds at opposite ends of the panel and each extending alongside of the coil, and

a boss formed on one end of each side shroud for spacing said assembly from the sidewalls of said cavity; and

a pair of locking means each embracing the bosses of the shrouds on one side of the coil to connect the coil support plates together, which means are electrically connected with the coil ends and have terminal portions which project outward from the coil plates.

5. A coil plate assembly as in claim 4 in which the shrouds of one plate extend toward the shrouds of the other plate to abut against one another, and the locking means comprises a clasp portion with an opening in which the bosses of the abutting shrouds are received, and a projection that extends outward from the shrouds.

6. A coil plate assembly as in claim 4 in which each end panel has a central aperture and alignment means which align said coil with the panel.

7. A coil plate assembly as in claim 6 in which the alignment means comprises a plurality of lugs that protrude from the periphery of each panel aperture to extend partially into said coil.

8. In a coil plate assembly for positioning a coil in a die cavity for encapsulation in an insulating material, the combination comprising:

a pair of coil plates between which the coil is disposed, and each having a center panel with two side members that extend alongside the coil to abut with side members of the other coil plate, each side member has a boss at a remote end that protrudes above said side member with a front inclined face, an opposite rear inclined face, and a lip above said front face, and bosses of two abutting side members match with one another to define a generally rectangular outline; and

a pair of terminal clasps, each electrically connected to the coil and each having a clasp portion with a rectangular opening that conforms to the outline of two matching bosses, and a connection end, said clasp portion is adapted to hook under the lips of two matching bosses and pivot down the opposite inclined faces of said matching bosses to seat flat upon the side members associated with said matching bosses, snugly clamping the matching bosses together, said connection end extends outward from said side members and serves as a terminal for connecting said coil into a circuit.

9. A coil plate assembly as in claim 8 in which each boss has a flexible rib at a rear corner and has a catch protruding from the flexible rib, and the ribs of said matching bosses are spaced from one another to allow the ribs to be slightly deflected inward as the clasp portion of the terminal clasp engages and slides over the catches of the matching bosses while pivoting down upon the side members, said catches thereafter maintaining the terminal clasp in place.

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