

Apparatus and method for encapsulating electronic components in hardenable plastics

This invention is concerned with encapsulating electronic components in hardenable plastics by supporting the components on lead frame strips in cavities formed between two mold plates and introducing hardenable plastics into the cavities.

In, for example, the encapsulation of semiconductor devices or chips, it is common practice to provide lead frames in strip form. Each strip has chip support pads spaced along its length and leads extending lengthwise of the strip from adjacent each pad. A semiconductor chip is then supported on each pad and electrical connections are made from the various leads to each chip. The strip is then placed in a mold having a cavity for each chip. Plastics encapsulating material is forced into the mold to encapsulate each chip, a portion of the leads therefrom and electrical connections of the leads to the chip. Typical molds accommodate eight lead frame strips, each having ten lead frames thereon, so that 80 semiconductor devices may be encapsulated at one shot. Other molds can handle twelve strips of ten lead frames each for simultaneous encapsulation of 120 devices. The typical mold has first and second mold members. With the first mold member raised, the lead frame strips are positioned on the second mold member such that the components to be encapsulated are in registration with mold cavities formed in the second mold member, there being one cavity for each component. The first mold member which has a complementary cavity for each component is then lowered onto the second mold member. A main injection opening through one of the mold members communicates through feed runners extending the length of the strips with gate runners which branch off the feed runners and extend to each cavity. During molding, a suitable plastics in liquid form is injected through the main opening, to fill the feed runners, gates and mold cavities. After the plastics has hardened, the mold members are separated and the strips, with the encapsulated components thereon, are removed from the mold. To prevent damage to the devices as the mold members are separated, ejection pins are provided on at least one of the mold members to engage the encapsulated components and force them out of the mold cavities during mold separation. The molding process is then repeated with a new batch of lead frame strips and components supported thereon.

Although the known molds permit effective encapsulation, they have a number of disadvantages. A substantial amount of down time exists. Each time a mold is used, the cavities, runners and gates must be checked and cleaned out, since a clogged runner or gate or a partially filled cavity will prevent the next molding operation from being carried out successfully.

Time is also required to position each batch of lead frame strips in the mold prior to molding and to remove them from the cavities after molding. Additionally, it is customary to shut down for about an hour each day for a thorough cleaning of the molds. The mold members are expensive, and require a considerable amount of precision machining to form the many cavities and runners. They are difficult to clean and are relatively easy to damage during mechanical cleaning. Typically, the plastics which is used hardens upon polymerization so that the injected plastics which fills and hardens in the distribution system cannot be reused. Because of the extensive distribution systems of present molds, the ratio of plastics in the distribution system to that actually used for encapsulation is high and wastage substantial. Present molds are also expensive because of the ejection pin system. Typically, two ejection pins are provided to eject each encapsulated component from the cavity in which it is formed. Thus, for a 120 cavity mold, 24 ejection pins are required. Further, the pins cause surface deformation of the plastics where the pins engage the components, detracting from the appearance of the finished product and restricting space available for indicia.

As an example of the prior art, DE-A-1943210 discloses apparatus for encapsulating in hardenable plastics, electronic components carried by a lead frame strip, said apparatus comprising: first and second opposed mold plates each having a generally planar mold surface thereon, a cavity plate assembly removably positionable between said first and second mold plates for holding a lead frame strip and said components carried thereby in position relative to said mold plates, the cavity plate assembly having spaced apart generally planar outer surfaces, one of which is spaced away from the lead frame strip held by said cavity plate assembly and flush with the mold surface of said first mold plate and the other of which surfaces faces towards said mold surface of said second mold plate when said cavity plate assembly is positioned between said mold plates and said lead frame strip is held by said cavity plate assembly, said cavity plate assembly having openings therethrough from one outer surface thereof to the other surface thereof, said openings being in registration with said components carried by said lead frame strip and held by said cavity plate assembly, an injection opening through said first mold plate to the mold surface thereof, injector means for injecting fluid plastics through said injection opening and feed channels to the mold surface of said first mold plate.

The present invention improves on that prior art by providing that the cavity plate assembly holds said lead frame and components all

completely spaced away from said first mold plate when said cavity plate assembly is positioned between said mold plates and flush against said mold surface of said first mold plate, and in that feed runner means is formed in said mold surface of said first mold plate and gate means is formed solely by and between said first mold plate and said cavity plate assembly for fluidly communicating said injection opening with all of said openings of said cavity plate assembly when said one outer surface of said cavity plate assembly is positioned against said mold surface of said first mold plate.

The present invention is directed towards overcoming one or more of the above-mentioned disadvantages. Each mold member has a generally planar mold surface thereon, and a cavity plate assembly is removably positioned between the mold members for holding the components relative to the mold members and spaced from a first of the mold members, the cavity plate assembly having generally planar outer surfaces, one of which is engageable with the mold surface of the said first mold member and the other of which faces towards the mold surface of the second mold member when the cavity plate assembly is positioned between the mold members. The cavity plate assembly has openings therethrough from one outer surface thereof to the other outer surface thereof, the openings being arranged to register with the components which are to be encapsulated. An injection opening extending through the first mold member communicates by way of feed runner means with the openings of the cavity plate assembly when the one outer surface of the cavity plate assembly is positioned against the first mold member.

A number of advantages are obtained by this arrangement. Thus, the cost of the equipment is reduced since the mold surface of the second mold member is completely planar while the mold surface of the first mold member need have only the feed runner means machined therein. The risk of damage to the mold members during cleaning is also reduced as a result. The cavity plate assembly is also relatively inexpensive to make since the openings may be punched or stamped out and are therefore made more easily than blind cavities.

The speed of molding may also be reduced since a second cavity plate assembly may be made ready while the molding operation is processed with the first cavity plate assembly.

The invention also relates to the use of such a cavity plate assembly in a molding operation and provides a method of encapsulating in hardenable plastics, electronic components carried by a lead frame strip by use of a cavity plate assembly having planar outer surfaces and openings therethrough from one outer surface to the other, comprising positioning the cavity

plate assembly between planar mold surfaces of first and second mold plates with one of the outer surfaces of the cavity plate assembly flush against the mold surface of the first mold plate, holding the lead frame strip and components spaced from the first mold plate and with the components to be encapsulated in registration with the openings of the cavity plate assembly, forcing fluid plastics into the openings of the cavity plate assembly, allowing the plastics to harden, removing the cavity plate assembly from between the first and second mold plates and subsequently removing the encapsulated components from the cavity plate assembly, characterised in that the fluid plastics is forced laterally through feed runners formed in the mold surface of the first mold plate and outwardly from the first mold plate into the said openings through gate means formed solely by and between said first mold plate and said cavity plate assembly.

Embodiments of the invention will now be described by way of example only with reference to the accompanying drawings, wherein:

Fig. 1 illustrates a typical lead frame strip carrying components to be encapsulated;

Figs. 2 and 3 are top and side views of the lead frame strip of Fig. 1 after the components thereof have been encapsulated in hardenable plastics;

Fig. 4 illustrates in perspective the basic components of the mold of the present invention and their cooperation in use;

Fig. 5 is a sectional view, in elevation, of the mold of Fig. 4;

Fig. 6 is a perspective and progressively broken away view of the mold members and cavity plate assembly of Fig. 5.

Fig. 7 is a view of the bottom surface of the first mold plate with a broken away portion of the rack positioned thereagainst to illustrate the arrangement of the mold plate runners and cavity plate openings;

Fig. 8 is a perspective view of a portion of the cavity plate assembly after removal from the mold plates;

Fig. 9 is a sectional view, in elevation, of a modified embodiment of the present invention.

Although it has broader utility, the present invention may best be described with relation to its use with a typical lead frame strip 10 as illustrated in Fig. 1.

Such strip 10 is cut, stamped or formed in any conventional manner from a flat sheet of suitable conductive material, to have a plurality of consecutive and identical lead frames LF1—LF5 along its length. Although only five lead frames are illustrated, there may be as many as desired. The strip 10 has end bars 11 and 12 and a plurality of cross bars 13 spaced along the strip, each cross bar 13 having an integral support pad 14 thereon for supporting a suitable semiconductor chip (not shown). Each lead frame also includes cross bars 16 and 17

(14)

which support longitudinally extending leads 18 with their ends spaced closely adjacent to pad 14. In manufacture of the devices, an electrical component such as a semiconductor chip will be mounted on each of the pads 14 and appropriate electrical connections will be made from the ends of the leads 18 to the chips in a conventional manner.

Following this, the portions between the end and cross bars of each lead frame on which the components are supported are encapsulated in plastics to embed the semiconductor chips and lead connections thereto. Whether by use of prior art molds or the mold of the present invention, the strip 10 will appear substantially as shown in Figs 2 and 3 after the molding process, i.e., with the supported components thereof encapsulated in a plastics body 19 which extends outwardly from both sides of the plane of the strip 10.

After molding, the strip is severed midway between the plastics bodies 19, the end bars 11 and 12 are removed, and the cross bars 16 and 17 are severed between the leads 18 to electrically isolate the leads from each other.

Turning now to the mold of the present invention, the basic components thereof are shown in general in Fig. 4 and in more detail in Figs. 5-8. In general, the mold comprises a cavity plate assembly 20 on which a plurality of lead frame strips 10 are mounted, the assembly 20 being inserted between first and second, which in the illustrated embodiments are upper and lower, mold members 21 and 22 and then being removable therefrom after the encapsulation process.

Cavity plate assembly 20 comprises two open, rectangular rack frames 26 and 27 which support cavity plates 28 and 29 with their inner planar surfaces 31 and 32, respectively facing each other and with their outer planar surfaces 33 and 34, respectively, facing away from each other. The cavity plate 29 is provided with a plurality of index pins 36 projecting therefrom for engagement with suitable of the index holes along one of the end bars of strip 10 so that the strips may be positioned thereon. Two index pins may be used for an individual strip of ten lead frames. Preferably the index pins 36 will project from cavity plate 29 sufficiently far to enter registering index holes in the cavity plate 28 so that the cavity plates are held against relative lateral movement when the strips 10 are mounted therebetween. Cavity plate 29 has a plurality of openings 38 therethrough from its inner to outer surfaces, there being an opening 38 for each of the lead frame portions to be encapsulated, each opening 38 being in registration with one of such portions when the lead frame strips are mounted thereon. Cavity plate 28 likewise has a plurality of openings 39 therethrough from its inner to outer surfaces, there being an opening 39 for and in registration with each of the openings 38 of cavity plate 29 when the cavity plates are indexed together. Thus,

when the cavity plates are assembled together with lead strips flush against the inner surface of the cavity plates, each set of openings 38 and 39 will form a complete cavity which extends outwardly from both sides of the lead frame strip 10.

The lower mold member 22 comprises a mold base 41 having a lower mold plate 42 fixed thereto, mold plate 42 preferably having a planar surface 43 devoid of surface irregularities, mold plate 42 having a length, width and thickness such that the lower rack frame 27 may fit therearound with the outer planar surface 34 of cavity plate 29 flush against the flat planar surface 43 of mold plate 42. Index stubs 44 project upwardly from mold base 41 and fit into index holes 46 on the rack frame member 27 for lateral registration of the rack frame on the bottom mold center.

The upper mold member 21 includes an upper mold base 51 having an upper mold plate 52 fixed thereto, mold plate 52 having a downwardly facing planar mold surface 53 thereon. Mold plate 52 also has a length, width and thickness such that the upper rack frame member 26 may fit therearound with the outer surface 33 of cavity plate 28 flush against the mold surface 53 of mold plate 52.

An injection opening 56 is formed through the upper mold member 21 to the planar surface 53 of mold plate 52 and communicates with the feed runner system formed into surface 53, as best illustrated in Fig. 6. The particular cavity plate 28 shown in Fig. 6 has 200 openings 39 for simultaneous encapsulation of a like number of portions of strips 10 (e.g. twenty separate strips each with ten lead frames), with the openings arranged in pairs of spaced-apart parallel rows. For example, the two rows of openings 39 which are furthest to the right and which extend from top to bottom of the drawing would constitute a pair of parallel rows of openings. The next two rows to the left would constitute another pair of rows, and so forth. If desired, one may consider the two rows which are furthest to the right and which extend half-way down the drawing as a pair of rows, while the furthest right openings which extend from the half-way point to the bottom of the drawing may be considered as another pair of parallel rows of openings.

In any event, the upper mold surface 53 has formed therein cross feed runners 57 and lengthwise feed runners 58 all in communication with each other and the injection opening 56, there being a feed runner 58 for each pair of rows of openings 39, which feed runner extends between and parallel to the rows of openings. As will be noted in Figs 6 and 7, a shallow groove 61 is formed into the upwardly facing outer surface 33 of upper cavity plate 28 from each opening 39 in a row towards the centerline of the pair of rows. Thus, when the upper cavity plate 28 is flush against the upper mold plate 52 and held in indexed relation thereto, a

feed runner 58 in mold plate 52 will open downwardly into all of the grooves 61 from the openings in the pair of rows with which the feed runner is associated. Grooves 61 in the cavity plate 28 thus function as gate runners from feed runner 58 to the cavity plate openings.

For ease of manufacture, grooves 61 extend from each opening 39 in a row to the corresponding opening 39 in the other row of the pair of rows. However, it is not necessary to form them all the way across, since it is only necessary to extend them from the openings 39 a sufficient distance as to enable them to open upwardly to the feed runner 58 with which they are associated.

The width of feed runner 58, at the surface 53 of mold plate is related to the spacing between the openings 39 in the pair of rows with which it is associated so that the feed runner 58 will not open downwardly directly into the openings but will instead open downwardly and outwardly into the ends of the openings by way of the gate runner grooves. As brought out hereinafter, this arrangement will provide for an unblemished top surface of the hardened plastic bodies 19 formed in the cavity plate openings. If the feed runner 58 is centered exactly between the rows of openings, when the mold is closed, it can have a width approximately, but no greater than, the spacing between the rows. To reduce tolerance requirements, the width of the feed runner 58 is preferably made so that it is substantially less than the spacing between rows, so that the feed runner can be somewhat off-center to the rows and still communicate with the cavity plate openings only by way of the lateral grooves 61. The minimum width of the feed runners is, of course, limited by the need to provide sufficient flow capacity in the feed runners for molding. The side walls of the feed runners 57 and 58 slope upwardly towards each other so that hardened plastic therein may be easily ejected therefrom.

As shown in Fig. 5, the upper mold base 51 is provided with index stubs 62, downwardly biased by springs 63, which project downwardly from the mold base 51 for entry into index holes 64 (Fig. 4) in the upper rack frame 26 to secure the cavity plate assembly against lateral shifting relative to the mold plate 52. The upper mold base 51 is fixed to columns 66 of a vertically reciprocal frame 67 for movement towards and away from the lower mold member by conventional means not shown.

The ejection means comprises an ejection pin retaining plate 68 mounted on bolts 69 for vertical movement relative to the upper mold member and biased downwardly by springs 71, plate 68 having a plurality of ejection pins 72 thereon which extend downwardly through the upper mold base 51 and upper mold plate 52 and into feed runners 57 and 58 at appropriate points along those runners. Suitable retainer pin lifting means are provided to lift plate 68 when

the mold is closed so that the pins are withdrawn from the feed runners. As for example, selected of index pins 62 may have an upward extension 73 which engages plate 68. Thus, when the mold is closed, index stub 62 will bear against the upper cavity plate 28 of rack 20 so that index stub 62 is moved upwardly relative to the upper mold member and so that its extension 73 holds ejection pin plate 68 above the upper mold member sufficiently to retract ejection pins 72 from the feed runners. When the mold frame 66 is subsequently moved upwardly, springs 63 and 71 will move index stubs 62 and ejection pins 72 downwardly relative to the upper mold so that the ejection pins 72 move into the feed runners 67 and 68.

Operation

After the lead frame strips 10 have had the semiconductor chips mounted on the pads 14 thereof and the electrical connections have been made between the leads and the chips, strips 10 with ten lead frames each are mounted on the lower cavity plate 29. After the lower cavity plate 28 is completely loaded, upper cavity plate 28 is mated therewith and the cavity plates are mounted in the rack frames 26 and 27.

With the upper mold member 21 vertically elevated, the loaded cavity frame assembly 20 is positioned on the lower mold member 22 with the bottom outer planar surface 34 of lower cavity plate 29 in flush contacting engagement with planar surface 43 of mold plate 42. The upper mold member 21 is then lowered so that the planar surface 53 of upper mold plate 52 comes into flush contacting engagement with the upper outer planar surface 33 of upper cavity plate 28.

A measured amount of suitable liquified plastic material is placed into injection opening 56. Plunger 76 is then forced downwardly to force the plastic to flow through the feed runners 57 and 58 in the upper mold plate 52 and above the upper surface of cavity plate 28 and then downwardly and outwardly through all of the gate openings 61 to fill all of the cavities formed by the registered openings 38 and 39 of the cavity plates. The inner surfaces 31 and 32 of the cavity plates adjacent each of the cavity plate openings are flush against end bars 11 and 12 and cross bars 16 and 17 of the lead frame strip 10 so that plastics flow laterally between the cavity plates is prevented.

The plastics material filling the feed runners and cavity plate openings will then polymerize at the elevated temperature of the mold members created by conventional heaters (not shown) which are disposed in the mold members.

After the plastics material has hardened, the upper mold member is raised, causing the ejection pins 72 to bear downwardly on the hardened plastic in the runners 58 and 59 so that the plastic runners are ejected therefrom.

With the upper mold member raised, cavity plate assembly 20 is removed from the lower mold member and set aside for cooling. Fig. 8 illustrates such removed cavity plate assembly, with the plastics bodies 19 filling the cavity plate openings, and with the plastic runner portion 77 which had filled the feed runner leading to the cavity plate openings, the plastics runner being attached to the ends of the plastics bodies 19 by the plastics in grooves 61. As is seen in Fig. 8, runner portion 77 has a circular deformation 78 on the upper surface thereof where it was engaged by an ejection pin 72. No such deformation is present on the upper surface of plastics bodies 19, since no ejection pins are required to separate the upper surface of the bodies 19 from the smooth surface 53 of upper mold plate 52 which formed such upper body surfaces.

With the cavity plate assembly 20 removed, mold plates 42 and 52 are then cleaned for the next molding operation. Since the mold surface 43 of lower mold plate 42 is completely flat, it may be very easily and rapidly wiped off and cleaned. Mold surface 53 of the upper mold plate 52 is likewise easily cleaned since the only surface irregularities are the relatively few elongated feed runners 57 and 58 formed thereinto.

After such cleaning, the mold members 21 and 22 are ready for another loaded cavity plate assembly 20 to be inserted for the next molding operation.

When the plastics in the first removed cavity plate assembly has cooled sufficiently, the runner 77 is broken away from the ends of the plastics bodies 19, the cavity plates 28 and 29 are separated and the lead frame strips 10 with the molded plastics bodies 19 comprising the encapsulated components thereon are removed. The removed strip is now as shown in Figs. 2 and 3. The upper and lower surface of the bodies 19 are completely unblemished since they have been formed by the flat surfaces of the upper and lower mold plates (52, 42) in registration with the cavity plate openings (38, 39). The only rough spot thereon is at the end thereof where the broken away feed runner 77 had been joined thereto.

The cavity plates 28 and 29 are then cleaned in preparation for the next use thereof. Since the detached cavity plates are relatively small, they may be easily cleaned in a conventional ultrasonic bath.

As may be seen from the foregoing, the present invention has a number of advantages. The initial equipment cost is reduced since the lower mold surface 43 is completely flat and the upper mold surface 53 has only the feed channels 57 and 58 machined thereinto. The cavity plates 28 and 29 are relatively inexpensive to make since the openings 38 and 39 go completely therethrough, thus enabling the openings to be formed by a stamping or punching operation, rather than having

bottomed cavities milled thereinto. Furthermore, since the upper and lower mold members 52 and 42 have smooth molding surfaces, save for the feed runners in the upper mold members, the likelihood of damage and need for replacement of these mold members is greatly reduced. Replacement is limited essentially to the racks 26, 27, and shipping costs for repaired or new cavity plates 28, 29 is considerably less than if the upper or lower mold members 52 or 42 were involved.

The present invention also enables a maximum number of components to be encapsulated for a given mold area. For the particular illustrated lead frame strips 10, the spacing of the openings in the cavity plates along the length of the strip is dictated by the dimensions of the strip itself, i.e. the spacing between the chip pads. In conventional molds, wherein mold cavities are formed into the upper and lower mold plates, the spacing cavities along any row is also dictated by the spacing between the chip pads, but there must be enough spacing between strips to provide room for a feed runner to extend along and between the strips, with gate runners then extending laterally from the feed runners to the cavities. In the present invention wherein the feed runner 58 is formed in the mold plate 52 and plastics material is injected into the cavity plate openings through an opening between the mold plate 52 and the upper surface of cavity plate 28, while the strip 10 is held against the lower surface of cavity plate 28, the strips 10 may be mounted in cavity plate assembly 20 side by side to each other, as shown in Fig. 6, so that the spacing between adjacent rows of openings is the minimum, namely about twice the width of one of the end bars 11 or 12 of the strip 10. As a consequence, the area of the cavity plate which is as equal to the areas of the upper and lower mold plates may be almost entirely covered with strips 10. For a given mold plate area, approximately twice as many strips 10 can be accommodated and operated upon at one time by the present invention as compared with prior art molds.

The feed runners 58, which extend along and between the pairs of openings can be made as small as necessary for flow purposes and thus will provide for minimum wastage. Since the strips 10 can be mounted side by side, the distance from the feed runners 58 to the cavity plate openings is very small and the amount of wastage in grooves 61 will be very greatly reduced from that which is wasted in the gate runners of conventional molds.

Costs of operation are also substantially reduced by the decrease in down time per cycle of operation, thereby allowing more molding cycles to be carried out per day. As brought out above, the amount of down time is decreased by the ease of cleaning of the mold plates and by the extended life of the mold plates. Additionally, when more than one cavity plate

(17)

assembly is used, a molding operation can be carried out with one cavity plate assembly while a previously used and removed assembly is cleaned and reloaded for reuse.

The initial cost, and maintenance, of the mold is also substantially reduced by the fact that no ejection pins are needed for engagement with the molded plastics bodies 19, whereas two pins for each body 19 are needed in present molds. Thus, for a 200 cavity mold, 400 ejection pins are eliminated. In addition, the elimination of ejection pins to eject the molded housings eliminates the ejection pin deformation thereof, i.e., as shown at 78 on Fig. 8, thus improving the appearance of the finished product and allowing a greater unblemished surface for addition of markings thereon.

The present invention also enables the plastics bodies 19 to be easily marked during molding, if such is desired. In present molds, wherein bottomed cavities are formed in the mold surfaces, the bottom of each mold cavity would have to be separately engraved or embossed to form a marking on the housing molded therein. Once the mold cavity surfaces are so prepared, it is extremely difficult to provide for a change in marking.

In the present invention, a flat sheet can be prepared, with suitable markings engraved or embossed thereon, such markings being spaced apart for registration with the cavity plate openings. Such sheet can then simply be laid down on the bottom mold plate 42 so that the upper surface of the sheet becomes the bottom mold surface 43. When desired, such sheet can be removed so that the plastics bodies 19 will again be unmarked, or a different sheet with different markings can be substituted.

Fig. 9 illustrates two modifications of the present invention.

In the first modification, the cavity plate 28' differs from the previously described upper cavity plate 28 in that the upper surface thereof does not have any gate runner grooves 61 formed thereinto. The upper mold plate 52' differs from before in that the width of feed runners 58', at the mold surface of the mold plate, is made slightly greater than the spacing between the openings 39' of the rows with which the feed runner is associated so that the feed runner opens downwardly directly into each of the openings 39' through a restricted access gate opening 61' between the end of the opening 39' and the side of feed runner 58'.

This manner of injecting plastics material into the openings 39' by flowing the plastics material through the mold plate feed runner and then outwardly from the mold plate into the cavity plate openings has the advantage over the previously described form in that the grooves 61 in the cavity plate are eliminated, thus decreasing the cost of manufacture of the cavity plates. However, it does have the disadvantage in that, after hardening, the runner 77 is attached to the plastics bodies 19 at each

upper surface thereof, rather than to the ends of bodies 19 as previously described. As a consequence, when the runner 77 is broken off, the upper surface of the bodies 19 will have a small blemish thereon.

In the second modification illustrated in Fig. 9, cavity plate assembly 20' differs from the previously described assembly 20 in that only an upper cavity plate is used, in the cavity plate assembly, such upper cavity plate 28' however, having the openings 39' therethrough spaced apart from each other in the same manner as before. The lower mold plate 42' differs from before in that its mold surface 43' has formed downwardly thereinto cavities 38', one for each portion of strips 10 which are to be encapsulated.

In this embodiment, strips 10 are positioned on mold plate 42' by suitable index pins (not shown) which function for the same purpose as previously described index pins 36. Alternatively, such index pins could be fixed to the lower surface of cavity plate 28' (now one of the outer surfaces of rack 20') to secure strips 10 thereto, provided the index pins have a sufficiently tight fit in the index holes of the strips to retain the strips in place on the lower cavity plate surface. In either event, the cavity plate assembly 20' is positioned on the lower mold plate 42' after the strips have been mounted. Openings 39' of cavity plate 28' and cavities 38' of the lower mold plate 42' will then be in registration to form a complete cavity for each component to be encapsulated.

The molding process is the same as before. Liquified plastic is forced through feed runners 58' into each cavity of the pair of rows with which each feed runner is associated. After hardening, the plastic has hardened, the upper mold member is elevated and the plastic ejected from runners 58' by ejection pins 72 as previously described. Cavity plate assembly 20' is pried upwardly to remove the lower halves of the plastics bodies 19 from cavities 38' of the lower mold plate 42' and the cavity plate assembly rack is removed.

The upper mold plate 52' is cleaned as before, cavities 38' of the lower mold plate 42' are cleaned and the mold is ready for the next batch.

The second modification is not as advantageous as before in that the lower mold plate 42', with cavities 38' formed thereinto, is more expensive to machine, as compared to the manufacture of the lower cavity plate 29, and it is harder to clean. The down time is increased if the strips 10 are mounted directly on the lower mold plate 42' rather than being preloaded onto a cavity plate assembly.

However, this modification of Fig. 9 does have the previously described advantage associated with the cooperation between the upper mold plate 52' and upper cavity plate 28', namely the minimal spacing between strips 10, the elimination of gate runners, ease of cleaning

of the upper mold plate 52', elimination of ejection pins for the individual bodies 19, and so forth.

Either of the two modifications of Fig. 9 can be used alone in a modification of the apparatus shown in Figs. 4—8. For example, the two cavity plate arrangement of Figs. 4—8 could be modified as in Fig. 9 to provide for injection of plastic directly downwardly into the cavity plate openings. Likewise, the mold of Figs. 4—8 could be modified to use the single cavity plate assembly and cavitied lower mold plate arrangement of Fig. 9 while using the plastics distribution system of Figs. 4—8 wherein plastics is injected from feed runners 58 into the ends of the cavity plate openings by way of the gate grooves 61.

Industrial Applicability

The invention is particularly useful for encapsulating electronic components, specifically semiconductor devices and the like.

Other aspects, objectives and advantages of this invention can be obtained from a study of the drawings, the disclosure and the appended claims.

Claims

1. Apparatus for encapsulating in hardenable plastics, electronic components carried by a lead frame strip (10), said apparatus comprising: first and second opposed mold plates (52, 42) each having a generally planar mold surface (53, 43) thereon, a cavity plate assembly (20) removably positionable between said first and second mold plates for holding a lead frame strip (10) and said components carried thereby in position relative to said mold plates (52, 42), the cavity plate assembly (20) having spaced apart generally planar outer surfaces (33, 34), one of which (33) is spaced away from the lead frame strip (10) held by said cavity plate assembly (20) and flush with the mold surface (53) of said first mold plate (52) and the other (34) of which surfaces (33, 34) faces towards said mold surface (43) of said second mold plate (42) when said cavity plate assembly (20) is positioned between said mold plates and said lead frame strip (10) is held by said cavity plate assembly (20), said cavity plate assembly (20) having openings (38, 39) therethrough from one outer surface (33) thereof to the other surface (34) thereof, said openings (38, 39) being in registration with said components carried by said lead frame strip (10) and held by said cavity plate assembly (20), an injection opening (56) through said first mold plate (52) to the mold surface (53) thereof, injector means (76) for injecting fluid plastics through said injection opening (56) and feed channel means (57, 58, 61) to the mold surface (53) of said first mold plate (52), characterised in that the cavity plate assembly (20) holds said lead frame strip (10) and components all

completely spaced away from said first mold plate (52) when said cavity plate assembly (20) is positioned between said mold plates (52, 42) and flush against said mold surface (53) of said first mold plate (52), and in that feed runner means (57, 58) is formed in said mold surface (53) of said first mold plate (52) and gate means (61) is formed solely by and between said first mold plate (52) and said cavity plate assembly (20) for fluidly communicating said injection opening (56) with all of said openings (38, 39) of said cavity plate assembly (20) when said one outer surface (33) of said cavity plate assembly (20) is positioned against said mold surface (53) of said first mold plate (52).

2. Apparatus as claimed in claim 1, characterised in that the cavity plate assembly (20) has a plurality of spaced-apart rows of the said openings (38, 39) therethrough, and said feed runner means (57, 58) include at least one feed runner (58) extending parallel to and between one such row and the next and being in fluid communication with the openings (38, 39) of the rows with which it is associated.

3. Apparatus as claimed in claim 2, characterised in that the or each feed runner (58) is formed in the mold surface (53) of the first mold plate (52) and has a width no greater than the spacing between the rows of said openings (38, 39) with which it is associated, and each of said openings is connected to a respective gate runner groove (61) formed in the said outer surface (33) of the cavity plate assembly (20) and in fluid communication with the feed runner (58) associated with that opening when the cavity plate assembly (20) is positioned flush against the first mold plate (52).

4. Apparatus as claimed in claim 2, characterised in that the or each feed runner (58) is formed in the mold surface (53) of the first mold plate (52) and has a width slightly greater than the spacing between the rows of openings (38, 39) with which it is associated to provide communication from the feed runner (58) directly into the openings when the cavity plate assembly (20) is positioned flush against the first mold plate (52).

5. Apparatus as claimed in any preceding claim, characterised in that the portions of the mold surface (53) of the first mold plate (52) adjacent the feed runner means (57, 58) and covering the cavity plate assembly (20) are uninterruptedly flat.

6. Apparatus as claimed in any preceding claim, characterised in that ejection pin means (72) extends through the first mold plate (52) and only into the feed runner means (57, 58).

7. Apparatus as claimed in any preceding claim, characterised in that the cavity plate assembly (20) includes first and second cavity plates (28, 29) each having planar inner and outer surfaces (31—34), said cavity plates (28, 29) being matable with the inner surfaces (31, 32) thereof facing each other, each cavity plate



18

of the upper mold plate 52', elimination of ejection pins for the individual bodies 19, and so forth.

Either of the two modifications of Fig. 9 can be used alone in a modification of the apparatus shown in Figs. 4—8. For example, the two cavity plate arrangement of Figs. 4—8 could be modified as in Fig. 9 to provide for injection of plastic directly downwardly into the cavity plate openings. Likewise, the mold of Figs. 4—8 could be modified to use the single cavity plate assembly and cavitied lower mold plate arrangement of Fig. 9 while using the plastics distribution system of Figs. 4—8 wherein plastics is injected from feed runners 58 into the ends of the cavity plate openings by way of the gate grooves 61.

Industrial Applicability

The invention is particularly useful for encapsulating electronic components, specifically semiconductor devices and the like.

Other aspects, objectives and advantages of this invention can be obtained from a study of the drawings, the disclosure and the appended claims.

Claims

1. Apparatus for encapsulating in hardenable plastics, electronic components carried by a lead frame strip (10), said apparatus comprising: first and second opposed mold plates (52, 42) each having a generally planar mold surface (53, 43) thereon, a cavity plate assembly (20) removably positionable between said first and second mold plates for holding a lead frame strip (10) and said components carried thereby in position relative to said mold plates (52, 42), the cavity plate assembly (20) having spaced apart generally planar outer surfaces (33, 34), one of which (33) is spaced away from the lead frame strip (10) held by said cavity plate assembly (20) and flush with the mold surface (53) of said first mold plate (52) and the other (34) of which surfaces (33, 34) faces towards said mold surface (43) of said second mold plate (42) when said cavity plate assembly (20) is positioned between said mold plates and said lead frame strip (10) is held by said cavity plate assembly (20), said cavity plate assembly (20) having openings (38, 39) there-through from one outer surface (33) thereof to the other surface (34) thereof, said openings (38, 39) being in registration with said components carried by said lead frame strip (10) and held by said cavity plate assembly (20), an injection opening (56) through said first mold plate (52) to the mold surface (53) thereof, injector means (76) for injecting fluid plastics through said injection opening (56) and feed channel means (57, 58, 61) to the mold surface (53) of said first mold plate (52), characterised in that the cavity plate assembly (20) holds said lead frame strip (10) and components all

completely spaced away from said first mold plate (52) when said cavity plate assembly (20) is positioned between said mold plates (52, 42) and flush against said mold surface (53) of said first mold plate (52), and in that feed runner means (57, 58) is formed in said mold surface (53) of said first mold plate (52) and gate means (61) is formed solely by and between said first mold plate (52) and said cavity plate assembly (20) for fluidly communicating said injection opening (56) with all of said openings (38, 39) of said cavity plate assembly (20) when said one outer surface (33) of said cavity plate assembly (20) is positioned against said mold surface (53) of said first mold plate (52).

2. Apparatus as claimed in claim 1, characterised in that the cavity plate assembly (20) has a plurality of spaced-apart rows of the said openings (38, 39) therethrough, and said feed runner means (57, 58) include at least one feed runner (58) extending parallel to and between one such row and the next and being in fluid communication with the openings (38, 39) of the rows with which it is associated.

3. Apparatus as claimed in claim 2, characterised in that the or each feed runner (58) is formed in the mold surface (53) of the first mold plate (52) and has a width no greater than the spacing between the rows of said openings (38, 39) with which it is associated, and each of said openings is connected to a respective gate runner groove (61) formed in the said outer surface (33) of the cavity plate assembly (20) and in fluid communication with the feed runner (58) associated with that opening when the cavity plate assembly (20) is positioned flush against the first mold plate (52).

4. Apparatus as claimed in claim 2, characterised in that the or each feed runner (58) is formed in the mold surface (53) of the first mold plate (52) and has a width slightly greater than the spacing between the rows of openings (38, 39) with which it is associated to provide communication from the feed runner (58) directly into the openings when the cavity plate assembly (20) is positioned flush against the first mold plate (52).

5. Apparatus as claimed in any preceding claim, characterised in that the portions of the mold surface (53) of the first mold plate (52) adjacent the feed runner means (57, 58) and covering the cavity plate assembly (20) are uninterruptedly flat.

6. Apparatus as claimed in any preceding claim, characterised in that ejection pin means (72) extends through the first mold plate (52) and only into the feed runner means (57, 58).

7. Apparatus as claimed in any preceding claim, characterised in that the cavity plate assembly (20) includes first and second cavity plates (28, 29) each having planar inner and outer surfaces (31—34), said cavity plates (28, 29) being matable with the inner surfaces (31, 32) thereof facing each other, each cavity plate



19

(28, 29) having openings (38, 39) therethrough, the openings (38) of one (29) cavity plate being in registration with the openings (39) of the other cavity plate (28) to form the openings through the cavity plate assembly (20) when the cavity plates (28, 29) are mated together.

8. Apparatus as claimed in claim 7, characterised in that the cavity plate assembly (20) includes means for holding at least one lead frame strip (10) in engagement with and between the inner surfaces (31, 32) of the first and second cavity plates (28, 29), and with the components to be encapsulated being in registration with the cavity plate openings (38, 39) and wherein the mold surface (43) of the second mold plate (42) is uninterruptedly flat.

9. Apparatus as claimed in any of claims 1 to 7, characterised in that the cavity plate assembly (20') has the further function of holding at least one lead frame strip (10) between said other outer surface (34) of the cavity plate assembly (20') and the mold surface (43') of the second mold plate (42') when the cavity plate assembly (20') is positioned between the first and second mold plates (52', 42'), and in that the planar mold surface (43') of the second mold plate (42') has a cavity (38') formed therein for and in registration with each opening (39') through the cavity plate assembly (20').

10. A method of encapsulating in hardenable plastics, electronic components carried by a lead frame strip (10) by use of a cavity plate assembly (20) having planar outer surfaces (33, 34) and openings (38, 39) therethrough from one outer surface (33) to the other (34), comprising positioning the cavity plate assembly (20) between planar mold surfaces (53, 43) of first and second mold plates (52, 42) with one (33) of the outer surfaces (33, 34) of the cavity plate assembly (20) flush against the mold surface (53) of the first mold plate (52), holding the lead frame strip (10) and components spaced from the first mold plate (52) and with the components to be encapsulated in registration with the openings (38, 39) of the cavity plate assembly (20), forcing fluid plastics into the openings (38, 39) of the cavity plate assembly (20), allowing the plastics to harden, removing the cavity plate assembly (20) from between the first and second mold plates (52, 42) and subsequently removing the encapsulated components from the cavity plate assembly (20), characterised in that the fluid plastics is forced laterally through feed runners (57, 58) formed in the mold surface (53) of the first mold plate (52) and outwardly from the first mold plate (52) into the said openings (38, 39) through gate means (61) formed solely by and between said first mold plate (52) and said cavity plate assembly (20).

11. A method as claimed in claim 10, characterised by the further step of mounting the components on the cavity plate assembly

(20) prior to positioning the cavity plate assembly (20) between the first and second mold plates (52, 42).

12. A method as claimed in claim 11, characterised by the further step of placing the other mold surface (43) of the cavity plate assembly (20) flush against the mold surface of the second mold plate (42) when positioning the cavity plate assembly (20) between the first and second mold plates (52, 42).

13. A method as claimed in any of claims 10 to 12, characterised in that after allowing the plastics to harden and before removing the cavity plate assembly (20), the first and second mold plates (52, 42) are moved relatively away from each other, and only the hardened plastics in the feed runners (57, 58) of the first mold plate (52) are engaged to force the engaged plastics from the feed runners (57, 58) as the first and second mold plates (52, 42) are moved relatively away from each other.

14. A method as claimed in any of claims 10 to 13, characterised in that, following the removal of the cavity plate assembly (20) from between the mold plates (52, 42), a second identical cavity plate assembly (20) with further components is positioned between the mold plates (52, 42) and the claimed procedure repeated with respect thereto.

Patentansprüche

1 Vorrichtung zur Einkapselung elektronischer Bausteine, die von einem Leitungsrahmenstreifen (10) gehalten werden, in härtbaren Kunststoff, wobei die Vorrichtung enthält: eine erste und eine zweite gegenüberliegende Formplatte (52, 42), jede mit einer allgemein ebenen Formplattenfläche (53, 43), eine zwischen die erste und die zweite Formplatte herausnehmbar einsetzbare Muldenplatteneinheit (20) zum Halten eines Leitungsrahmenstreifens (10) und der Bauteile, die hierdurch in eine bestimmte Stellung in Bezug auf die Formplatten (52, 42) gebracht werden, wobei die Muldenplatteneinheit (20), von einander getrennte, allgemein ebene äußere Oberflächen (33, 34) besitzt, von denen die eine (33) in einem Abstand vom Leitungsrahmenstreifen (10) von der Muldenplatteneinheit (20) gehalten wird und mit der Formplattenfläche (53) der ersten Formplatte (52) bündig liegt, und von denen die andere (34) der Oberflächen (33, 34) zu der Formplattenfläche (43) der zweiten Formplatte (42) gerichtet ist, wenn die Muldenplatteneinheit (20) zwischen die Formplatten gesetzt und der Leitungsrahmenstreifen (10) durch die Muldenplatteneinheit (20) gehalten wird, und die Muldenplatteneinheit (20) Durchgangsöffnungen (38, 39) von ihrer einen Oberfläche (33) zu ihrer anderen Oberfläche (34) hat, die Öffnungen (38, 39) übereinstimmen mit den durch den Leitungsrahmenstreifen (10) getragenen und durch die Mulden-



20

plattenheit (20) gehaltenen Bauelementen, eine Einspritzöffnung (56) durch die erste Formplatte (52) zu ihrer Formplattenfläche (53), Spritzeinrichtungen (76) zum Einspritzen von flüssigem Kunststoff durch die Einspritzöffnung (56) und Zuführungskanäle (57, 58, 61) zu der Formplattenfläche (53) der ersten Formplatte (52), dadurch gekennzeichnet, daß die Muldenplatteneinheit (20) den Leitungsrahmenstreifen (10) und die Bauelemente vollständig mit Abstand von der ersten Formplatte (52) hält, wenn die Muldenplatteneinheit (20) zwischen die Formplatten (52, 42) gesetzt ist und bündig mit der Formplattenfläche (53) der ersten Formplatte (52) liegt und daß Zuführungskanäle (57, 58) in der Formplattenfläche (53) der ersten Formplatte (52) und Durchgänge (61) nur durch die erste Formplatte (52) und Muldenplatteneinheit (20) und zwischen diesen zur durchfließbaren Verbindung der Einspritzöffnung (56) mit allen Öffnungen (38, 39) der Muldenplatteneinheit (20) ausgebildet sind, wenn die eine äußere Oberfläche (33) der Muldenplatteneinheit (20) gegen die Formplattenfläche (53) der ersten Formplatte (52) gesetzt ist.

2. Vorrichtung nach Anspruch 1 dadurch gekennzeichnet, daß die Muldenplatteneinheit (20) eine Vielzahl von einander getrennten Reihen von Durchgangsöffnungen (38, 39) hat und zu den Zulaufkanälen (57, 58) wenigstens einen Zulaufkanal (58) gehört, der parallel und zwischen einer solchen Reihe und der nächsten verläuft und in Verbindung mit den Öffnungen (38, 39) der Reihen steht, denen er zugeordnet ist.

3. Vorrichtung nach Anspruch 2 dadurch gekennzeichnet, daß jeder Zulaufkanal (58) in der Formplattenfläche (53) der ersten Formplatte (52) ausgebildet ist und eine Breite hat, die nicht größer als der Abstand zwischen den Reihen der Öffnungen (38, 39) ist, denen er zugeordnet ist, und jede der Öffnungen mit einem zugehörigen Durchgang (61) verbunden ist, der in der äußeren Oberfläche (33) der Muldenplatteneinheit (20) gebildet ist und in Verbindung mit dem Zulaufkanal (58) steht, der der Öffnung zugeordnet ist, wenn die Muldenplatteneinheit bündig gegen die erste Formplatte (52) gesetzt ist.

4. Vorrichtung nach Anspruch 2 dadurch gekennzeichnet, daß jeder Zulaufkanal (58) in die Formplattenfläche (53) der ersten Formplatte (52) geformt ist und eine Breite hat, die wenig größer als der Abstand zwischen den Reihen von Öffnungen (38, 39) ist, mit denen er verbunden ist, um einen Zufluß von dem Zulaufkanal (58) direkt in die Öffnungen vorzusehen, wenn die Muldenplatteneinheit gegen die erste Formplatte (52) gesetzt ist.

5. Vorrichtung nach einem der vorangegangenen Ansprüche, dadurch gekennzeichnet, daß die Teile der Formplattenfläche (53) der ersten Formplatte (52), die den Zulaufkanälen (57, 58) benachbart sind und die Muldenplatteneinheit (20) bedecken, unterbrechungsfrei eben sind.

6. Vorrichtung nach einem der vorangehenden Ansprüche, dadurch gekennzeichnet, daß Auswerferstifte (72) sich durch die erste Formfläche (52) und nur in die Zulaufkanäle (57, 58) hinein erstrecken.

7. Vorrichtung nach einem der vorangehenden Ansprüche, dadurch gekennzeichnet, daß die Muldenplatteneinheit (20) eine erste und eine zweite Muldenplatte (28, 29) umfaßt, die ebene innere und äußere Oberflächen (31 bis 34) haben, daß die Muldenplatten (28, 29) mit ihren einander zugekehrten inneren Oberflächen (31, 32) zusammenpassen, jede Muldenplatte (28, 29) Durchgangsöffnungen (38, 39) hat und die Öffnungen (38) der einen Muldenplatte (29) mit Öffnungen (39) der anderen Muldenplatte (28) übereinstimmen, um Durchgangsöffnungen durch die Muldenplatteneinheit (20) zu bilden, wenn die Muldenplatten (28, 29) zusammengepaßt sind.

8. Vorrichtung nach Anspruch 7 dadurch gekennzeichnet, daß die Muldenplatteneinheit (20) Mittel enthält zum Halten wenigstens eines Leitungsrahmenstreifens (10) im Eingriff mit und zwischen den inneren Oberflächen (31, 32) der ersten und zweiten Muldenplatte (28, 29), mit den zu umhüllenden Bauteilen in Ausrichtung mit den Öffnungen (38, 39), wobei die Formplattenfläche (43) der zweiten Formplatte (42) ununterbrochen eben ist.

9. Vorrichtung nach einem der Ansprüche 1 bis 7 dadurch gekennzeichnet, daß die Muldenplatteneinheit (20') die weitere Funktion hat, wenigstens einen Leitungsrahmenstreifen (10) zwischen der äußeren Oberfläche (34) der Muldenplatteneinheit (20') und der Formplattenfläche (43') der zweiten Formplatte (42') zu halten, wenn die Muldenplatteneinheit (20') zwischen die erste und zweite Formplatte (52', 42') gesetzt ist, und daß die ebene Formplattenfläche (43') der zweiten Formplatte (42') eine in sie geformte Mulde (38') besitzt, die in ihr für jede und in Ausrichtung mit jeder Durchgangsöffnung (39') durch die Muldenplatteneinheit (20') ausgebildet ist.

10. Verfahren zum Einkapseln von elektronischen Bauelementen, die von einem Leitungsrahmenstreifen (10) getragen werden, in härtembarem Kunststoff mittels einer Muldenplatteneinheit (20), die ebene äußere Oberflächen (33, 34) und Durchgangsöffnungen (38, 39) von einer äußeren Oberfläche (33) zur anderen (34) besitzt, umfassend das Einsetzen der Muldenplatteneinheit (20) zwischen oberen Formplattenflächen (53, 43) einer ersten und zweiten Formplatte (52, 42) mit dem Anlegen der einen (33) der äußeren Oberflächen (33, 34) der Muldenplatteneinheit (20) plan gegen die Formplattenfläche (53) der ersten Formplatte (52), mit Halten des Leitungsrahmenstreifens (10) und der Bauelemente im Abstand von der ersten Formplatte (52) mit den einzuhüllenden Bauelementen in Übereinstimmung mit den Öffnungen (38, 39) der Muldenplatteneinheit (20), das Einpressen von flüssigem Kunststoff in die



2

Öffnungen (38, 39) der Muldenplatteneinheit (20), dem Härten des Kunststoffs, der Entfernung der Muldenplatteneinheit (20) zwischen der ersten und der zweiten Formplatte (52, 42) und darauf der Entfernung der umhüllten Bauelemente von der Muldenplatteneinheit (20), dadurch gekennzeichnet, daß der flüssige Kunststoff in seitlicher Richtung durch Zulaufkanäle (57, 58), die in der Formplattenfläche (53) der ersten Formplatte (52) gebildet sind, und heraus aus der ersten Formplatte (52) in besagte Öffnungen (38, 39) durch Durchgänge (61), die nur durch und zwischen der ersten Formplatte (52) und der Muldenplatteneinheit (20) ausgebildet sind, gepreßt wird.

11. Verfahren nach Anspruch 10 gekennzeichnet durch den weiteren Schritt, die Bauelemente an der Muldenplatteneinheit (20) vor dem Einsetzen der Muldenplatteneinheit (20) zwischen die erste und die zweite Formplatte (52, 42) anzubringen.

12. Verfahren nach Anspruch 11 gekennzeichnet durch den weiteren Schritt, die andere Formplattenfläche (43) der Muldenplatteneinheit (20) plan gegen die Formplattenfläche der zweiten Formplatte (42) zu setzen, wenn die Muldenplatteneinheit (20) zwischen die erste und die zweite Formplatte (52, 42) gesetzt wird.

13. Verfahren nach einem der Ansprüche 10—12, dadurch gekennzeichnet, daß nach dem Härten des Kunststoffs und vor der Entfernung der Muldenplatteneinheit (20) die erste und die zweite Formplatte (52, 42) auseinanderbewegt werden und nur der harte Kunststoff in den Zulaufkanälen (57, 58) der ersten Formplatte (52) ergriffen wird, um den ergriffenen Kunststoff aus den Zulaufkanälen (57, 58) zu drücken, wenn die erste und die zweite Formplatte (52, 42) auseinanderbewegt werden.

14. Verfahren nach einem der Ansprüche 10—13, dadurch gekennzeichnet, daß nach dem Entfernen der Muldenplatteneinheit (20) zwischen den Formplatten (52, 42) eine zweite identische Muldenplatteneinheit (20) mit weiteren Bauelementen zwischen die Formplatten (52, 42) eingesetzt und das beanspruchte Verfahren wiederholt wird.

Revendications

1. Appareil pour enrober dans des matières plastiques durcissables des composants électroniques portés par une bande (10) de cadres de montage, ledit appareil comprenant: des première et seconde plaques opposées (52, 42) de moule ayant chacune une surface sensiblement plane (53, 43) de moule, un ensemble (20) à plaques à cavités pouvant être positionné de manière amovible entre lesdites première et seconde plaques de moule pour maintenir une bande (10) de cadres de montage et lesdits composants qu'elle porte en position par rapport auxdites plaques (52, 42) de moule, l'ensemble (20) à plaques à cavités présentant

des surfaces extérieures (33, 34) sensiblement planes, espacées, dont l'une (33) est espacée de la bande (10) de cadres de montage maintenue par ledit ensemble (20) à plaques à cavités et affleurant la surface (53) de moule de ladite première plaque (52) de moule et dont l'autre (34) desdites surfaces (33, 34) fait face à ladite surface (43) de moule de ladite seconde plaque (42) de moule lorsque ledit ensemble (20) à plaques à cavités est positionné entre lesdites plaques de moule et que ladite bande (10) de cadres de montage est maintenue par ledit ensemble (20) à plaques à cavités, ledit ensemble (20) à plaques à cavités ayant des ouvertures (38, 39) qui le traversent d'une première surface extérieure (33) à son autre surface (34), lesdites ouvertures (38, 39) étant en alignement avec lesdits composants portés par ladite bande (10) de cadres de montage et maintenus par ledit ensemble (20) à plaques à cavités, une ouverture (56) d'injection traversant ladite première plaque (52) de moule jusqu'à sa surface (53) de moule, un injecteur (76) étant destiné à injecter une matière plastique fluide par ladite ouverture (56) d'injection et des canaux d'alimentation (57, 58, 61) vers la surface (53) de moule de ladite première plaque (52) de moule, caractérisé en ce que l'ensemble (20) à plaques à cavités maintient ladite bande (10) de cadres de montage et les composants tous totalement à l'écart de ladite première plaque (52) de moule lorsque ledit ensemble (20) à plaques à cavités est positionné entre lesdites plaques (52, 42) de moule et affleure contre ladite surface (53) de moule de ladite première plaque (52) de moule, et en ce que des canaux d'alimentation (57, 58) sont formés dans ladite surface (53) de moule de ladite première plaque (52) de moule et une entrée (61) est formée uniquement par et entre ladite première plaque (52) de moule et ledit ensemble (20) à plaques à cavités pour établir une communication fluide de ladite ouverture (56) d'injection avec toutes lesdites ouvertures (38, 39) dudit ensemble (20) à plaques à cavités lorsque ladite première surface extérieure (33) dudit ensemble (20) à plaques à cavités est positionnée contre ladite surface (53) de moule de ladite première plaque (52) de moule.

2. Appareil selon la revendication 1, caractérisé en ce que l'ensemble (20) à plaques à cavités comporte plusieurs rangées espacées desdites ouvertures (38, 39), et lesdits canaux d'alimentation (57, 58) comprennent au moins un canal d'alimentation (58) s'étendant parallèlement à et entre l'une de ces rangées et la rangée suivante et en communication fluide avec les ouvertures (38, 39) des rangées auxquelles il est associé.

3. Appareil selon la revendication 2, caractérisé en ce que le ou chaque canal (58) d'alimentation est réalisé dans la surface (53) de moule de la première plaque (52) de moule et présente une largeur qui n'est pas supérieure



à l'écartement des rangées desdites ouvertures (38, 39) auxquelles il est associé, et chacune desdites ouvertures est reliée à une gorge respective (61) de canal d'entrée formée dans ladite surface extérieure (33) de l'ensemble (20) à plaques à cavités et en communication fluide avec ledit canal d'alimentation (58) associé à cette ouverture lorsque l'ensemble (20) à plaques à cavités est positionné à fleur contre la première plaque (52) de moule.

4. Appareil selon la revendication 2, caractérisé en ce que le ou chaque canal (58) d'alimentation est formé dans la surface (53) de moule de la première plaque (52) de moule et présente une largeur l'égèrement supérieure à l'écartement des rangées d'ouvertures (38, 39) auxquelles il est associé pour établir une communication directe du canal (58) d'alimentation dans les ouvertures lorsque l'ensemble (20) à plaques à cavités est positionné à fleur contre la première plaque (52) de moule.

5. Appareil selon l'une quelconque des revendications précédentes, caractérisé en ce que les parties de la surface (53) de moule de la première plaque (52) de moule adjacentes aux canaux d'alimentation (57, 58) et recouvrant l'ensemble (20) à plaques à cavités sont plates de façon ininterrompue.

6. Appareil selon l'une quelconque des revendications précédentes, caractérisé en ce que des broches d'éjection (72) s'étendent à travers la première plaque (52) de moule et pénètrent uniquement dans les canaux d'alimentation (57, 58).

7. Appareil selon l'une quelconque des revendications précédentes, caractérisé en ce que l'ensemble (20) à plaques à cavités comprend des première et seconde plaques (28, 29) à cavités ayant chacune des surfaces intérieure et extérieure planes (31—34), lesdites plaques (28, 29) à cavités pouvant être accouplées, leurs surfaces intérieures (31, 32) étant tournées face à face, chacune des plaques (28, 29) à cavités étant traversée par des ouvertures (38, 39), les ouvertures (38) d'une première plaque (29) à cavités étant en alignement avec les ouvertures (39) de l'autre plaque à cavité (28) pour former les ouvertures traversant l'ensemble (20) à plaques à cavités lorsque les plaques (28, 29) à cavités sont accouplées.

8. Appareil selon la revendication 7, caractérisé en ce que l'ensemble (20) à plaques à cavités comprend des moyens destinés à maintenir au moins une bande (10) de cadres de montage en contact avec et entre lesdites surfaces intérieures (31, 32) des première et seconde plaques (28, 29) à cavités, les composants à enrober étant en alignement avec les ouvertures (38, 39) des plaques à cavités et la surface (43) de moule de la seconde plaque (42) de moule étant plate de façon ininterrompue.

9. Appareil selon l'une quelconque des revendications 1 à 7, caractérisé en ce que

l'ensemble (20') à plaques à cavités a pour autre fonction de maintenir au moins une bande (10) de cadres de montage entre ladite autre surface extérieure (34) de l'ensemble (20') à plaques à cavités et la surface (43') de moule de la seconde plaque (42') de moule lorsque l'ensemble (20') à plaques à cavités est positionné entre les première et seconde plaques (52', 42') de moule, et en ce qu'une cavité (38') est formée dans la surface plane (43') de moule de la seconde plaque (42') de moule en alignement avec chaque ouverture (39') traversant l'ensemble (20') à plaques à cavités.

10. Procédé pour enrober dans des matières plastiques durcissables des composants électroniques portés par une bande (10) de cadres de montage au moyen d'un ensemble (20) à plaques à cavités ayant des surfaces extérieures planes (33, 34) et traversé par des ouvertures (38, 39) d'une première surface extérieure (33) à l'autre (34), consistant à positionner l'ensemble (20) à plaques à cavités entre des surfaces planes (53, 43) de moule de première et seconde plaques (52, 42) de moule, une première (33) des surfaces extérieures (33, 34) de l'ensemble (20) à plaques à cavités affleurant contre la surface (53) de moule de la première plaque (52) de moule, à maintenir la bande (10) de cadres de montage et des composants espacés de la première plaque (52) de moule, les composants étant enrobés en alignement avec les ouvertures (38, 39) de l'ensemble (20) à plaques à cavités, à forcer des matières plastiques fluides dans les ouvertures (38, 39) de l'ensemble (20) à plaques à cavités, à permettre aux matières plastiques de durcir, à retirer l'ensemble (20) à plaques à cavités d'entre les première et seconde plaques (52, 42) de moule et à retirer ensuite les composants enrobés de l'ensemble (20) à plaques à cavités, caractérisé en ce que la matière plastique fluide est forcée latéralement par des canaux (57, 58) d'alimentation formés dans la surface (53) de moule de la première plaque (52) de moule et vers l'extérieur de la première plaque (52) de moule dans lesdites ouvertures (38, 39) par l'intermédiaire d'entrées (61) formées uniquement par et entre ladite première plaque (52) de moule et ledit ensemble (20) à plaques à cavités.

11. Procédé selon la revendication 10, caractérisé par l'autre étape consistant à monter les composants sur l'ensemble (20) à plaques à cavités avant le positionnement de l'ensemble (20) à plaques à cavités entre les première et seconde plaques (52, 42) de moule.

12. Procédé selon la revendication 11, caractérisé par l'autre étape qui consiste à placer l'autre surface (43) de moule de l'ensemble (20) à plaques à cavités à fleur contre la surface de moule de la seconde plaque (42) de moule lors du positionnement de l'ensemble (20) à plaques à cavités entre les première et seconde plaques (52, 42) de moule.

13. Procédé selon l'une quelconque des



23

23

0 007 762

24

revendications 10 à 12, caractérisé en ce que, après que le matériau plastique a pu durcir et avant que l'ensemble (20) à plaques à cavités soit retiré, les première et seconde plaques (52, 42) de moule sont déplacées afin d'être éloignées l'une de l'autre, et seules les matières plastiques durcies dans les canaux (57, 58) d'alimentation de la première plaque (52) de moule sont prises pour retirer à force les matières plastiques prises des canaux (57, 58) d'alimentation lorsque les première et seconde

plaques (52, 42) de moule sont éloignées l'une de l'autre.

5 14. Procédé selon l'une quelconque des revendications 10 à 13, caractérisé en ce que, après l'enlèvement de l'ensemble (20) à plaques à cavités d'entre les plaques (52, 42) de moule, un second ensemble identique (20) à plaques à cavités, avec d'autres composants, est positionné entre les plaques (52, 42) de moule et le procédé revendiqué est répété avec ce second ensemble.

15

20

25

30

35

40

45

50

55

60

65

13