MOLDED STIFFENER FOR FLEXIBLE CIRCUIT MOLDING

BACKGROUND OF THE INVENTION

(1 FIELD OF THE INVENTION

This invention relates to the formation of molded stiffeners which are formed at the same time molded circuit elements are formed.

(2) DESCRIPTION OF THE RELATED ART

The processing of molded flexible circuit assemblies requires the use of stiffeners to provide adequate rigidity of the flexible assembly during processing. This invention describes the use of a molded stiffener to accomplish the required rigidity.

U. S. Pat. No. 5,635,671 to Freyman et al. describes encapsulation of an electronic device using injection molding with a two piece mold using a degating region having a material chosen such that the material in

the degating region forms a weak bond with the encapsulant used.

U.S. Pat. No. 5,506,756 to Haley describes a ball grid array package containing an integrated circuit die that is directly mounted to either a heat sink or a printed circuit board.

U.S. Pat. No. 5,241,133 to Mullen, III et describes a leadless pad array chip carrier package. A semiconductor device is electrically wire bonded and attached with conductive adhesive to a metallized pattern on a printed circuit board.

UMMARY O THE NVENT ON

qu d

Mo ed

emen rme pe tha

d aneous y ch

op h hme

hmen nd ap qu ed

d he h

how umbe

d pe Th

eme bu

men yp nd ded

emb

g pe he

mb dd

h ch

he the

and omp

ob

od ng ed wh ch

d d ona

he ch

It is another principle objective to this invention to provide molded flexible circuits which include molded stiffeners and do not require additional stiffeners to be attached.

These objectives are achieved by using a mold section to form flexible circuit elements on a flexible tape. The mold section includes circuit element cavities, a stiffener cavity, mold runner cavities, and a molding compound cull block. Uncured molding compound is placed in the molding compound cull block and flowed through the mold runner cavities into the circuit element cavities and the stiffener cavity The molding compound is cured and the mold section removed leaving molded circuit elements and stiffeners formed on the flexible tape. The molded circuit elements, which will be explained in more detail later, include a circuit die and wiring.

The molded stiffeners provide adequate stiffening for subsequent processing operations and no additional stiffeners are required. The molded stiffeners can be used in the processing and are removed when the molded circuit elements are removed from the flexible tape.

BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1 shows a top view of a conventional flexible circuit assembly with a stiffener attached.

Fig. 2 shows a cross section view of a conventional flexible circuit assembly with a stiffener attached.

Fig. 3 shows a bottom view of a mold section used to form the flexible circuit assembly with stiffeners of this invention

Fig. 4 shows a top view of the flexible circuit assembly with a molded stiffener of this invention.

Fig. 5 shows a cross section view of the flexible circuit assembly with a molded stiffener of Fig. 4 along line 5-5' of Fig. 4.

Fig. 6 shows a cross section view of the flexible circuit assembly with a molded stiffener of Fig. 4 along line 6-6 of Fig. 4

Fig. 7 shows a cross section view of a first example of a circuit element on a flexible tape.

Fig. 8 shows a cross section view of a second example of a circuit element on a flexible tape.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

Refer now to Figs. 3-6 for a detailed description the preferred embodiments of the molded flexible circuit assembly of this invention. Fig. 3 shows a bottom view of a mold section 25 which will be used to mold circuit elements and stiffeners for the molded flexible circuit assembly. The mold section 25 has a molding compound cull block 21, a first mold runner cavity 19, a stiffener cavity 17, second mold runner gate cavities 15, and circuit element cavities 11. The molding compound is a material such as a compacted powder in a semicured state which is later cured using time and temperature. Injection molding is described in a Patent Application (ST-98-001 entitled "A DISPOSABLE MOLD RUNNER GATE FOR SUBSTRATE BASED ELECTRONIC PACKAGES", Serial Number 09/080,106, Filed May 18, 1998, and assigned to the same assignee which is incorporated herein by reference

As shown in Fig. 4 the molding compound is then cured using time and temperature, such as between about 125°C and 190°C for between about one and two minutes. The section is then removed leaving cured molding compound to form a first mold runner 20, a stiffener 18, second mold runners 16, and molded circuit elements 12 formed on the flexible tape 10. Any cured molding compound residue, and

ıy run ex

em

ow an amp

ow mo

ˈg umh cu em exam

mo an an

mo ct on he rn

eme ny umbe

eeded

Mo d cu me

med he pe en

d emb an

add qu ed Th mo ed cu

eme ha ed ha ng ched

he an an ha ho rmed he

b ap d pen ed pa cu cu

emen qn cu as emb ha

pp ed by he mo ed

uh ıg ope ng

pe chme cu he

pe

Fig. 4 shows four molded circuit elements 12 on a segment of the flexible tape 10 however more or fewer molded circuit elements 12 and be formed on a segment of flexible tape 10 and processed as a group. Fig. 5 shows a cross section of the flexible circuit assembly along the line 5-5' of Fig. 4 showing molded circuit elements 12 on a segment of flexible tape 10 with no additional stiffener attached to the flexible tape 10. Fig. 5 does not show the wiring and circuit dies of the molded circuit elements. Figs. 7 and 8 show more detail of examples of molded circuit elements and will be described later. Fig. 6 shows a cross section of the flexible circuit assembly along the line 6-6' of Fig. 4 showing a molded stiffener 18 on a segment of flexible tape 10 with no additional stiffener attached to the flexible tape 10

The molded stiffeners 18 are formed at the same time the mold runners and molded circuit elements 12 are formed and do not add any processing steps or complexity. The molded stiffeners 18 can be removed from the molded circuit elements 12 at the same time the mold runners are removed after the processing of the molded circuit elements has been completed. The removal of the molded stiffeners 18 does not add any processing steps or complexity to the removal of the mold runners, since the final package form does not normally include mold runners.

Refer now to Figs. 7 and 8 for a description of some particular examples of molded circuit elements 12.

7 shows a first example of a molded circuit element 12 having a circuit die 30 attached to the flexible tape 10. The flexible tape 10 is a flexible material such as polyimide or the like. Copper pads 34 are formed on the opposite side of the flexible tape from the circuit die 30

bonds using a material such as gold wire 32 are bonded to the circuit die 30 and to the copper pads 34 through via holes 40 in the flexible tape 10. Solder balls 36 are attached to the copper pads 34 through a solder mask 38 formed of a material not wettable by the solder. The circuit die 30 and gold wire 32 are encapsulated in a molded encapsulant using the molding process described earlier.

Fig. 8 shows a second example of a molded circuit element 12 having a circuit die 30 attached to the flexible tape 10. The flexible tape 10 is a flexible material such as polyimide or the like. Via holes 41 is formed in the flexible tape 10 and copper pads 35 are formed on both sides and in the via holes 41 of the flexible tape 10. Wire bonds using a material such as gold wire 32 are bonded to the circuit die 30 and to the copper pads 35. Solder balls 36 are attached to the copper pads 35 through a solder mask 39 formed of a material not wettable by the solder. The circuit die 30 and gold wire 32 are encapsulated in a molded

encapsulant using the molding process described earlier.

These examples have used particular designs of mold sections and molded circuit elements. It will be readily apparent to those skilled in the art that different mold section designs and molded circuit element designs can also be used as long as the designs includes a molded stiffener

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

CLAIMS

1. A method of molding flexible circuit elements, comprising:

providing a mold section having a molding compound cull block, a first mold runner cavity connected to said molding compound cull block, a stiffener cavity connected to said first mold runner cavity, a number of circuit cavities, a number of second mold runner cavities connected to said first mold runner cavity wherein each of said second mold runner cavities is connected to one of said circuit cavities;

providing a flexible tape;

providing a number of circuit die attached to said flexible tape;

providing a molding compound;

placing said mold section on said flexible tape covering said circuit die;

placing said molding compound in said molding compound cull block of said mold section;

flowing said molding compound through said first mold runner cavity and said second mold runner cavities into said circuit cavities, covering said circuit die, and said stiffener cavity;

curing said molding compound thereby forming flexible circuit elements and stiffeners on said flexible tape; and

removing said mold section.

h d mp

he ed

Th hod h ng ompound

p pow d

he thod he d ape

mi p

The hod d b pe

rmed

he

ompo me and emp

h d wh b pe has

d d and h omp

rmed d d

d

he od wh d b ap ha

ond and ho be ween d

d d ond and the omp

d f d

9. The method of claim 1 wherein no additional means of stiffening said flexible tape is used.

10. The method of claim 1 further comprising separating said flexible circuit elements, including said circuit die, into individual said circuit elements and removing said first mold runners, said second mold runners, and said stiffeners from each of said flexible circuit elements.

ABSTRACT OF THE DISCLOSURE

MOLDED STIFFENER FOR FLEXIBLE CIRCUIT MOLDING

A molded flexible circuit assembly and method of forming a molded flexible circuit assembly which use a molded stiffener, and do not require any additional type of stiffener, are described. A molded stiffener is formed on a flexible tape at the same time molded encapsulation units formed to encapsulate circuit die which are attached to the flexible tape. The molded stiffeners provide adequate rigidity for processing of the molded flexible circuit assembly. When the stiffeners are no longer needed they are removed at the same time the mold runners are removed. No additional processing steps are required for either the formation or removal of the molded stiffeners.

(FIGURE 3 IS SUGGESTED FOR PUBLICATION)

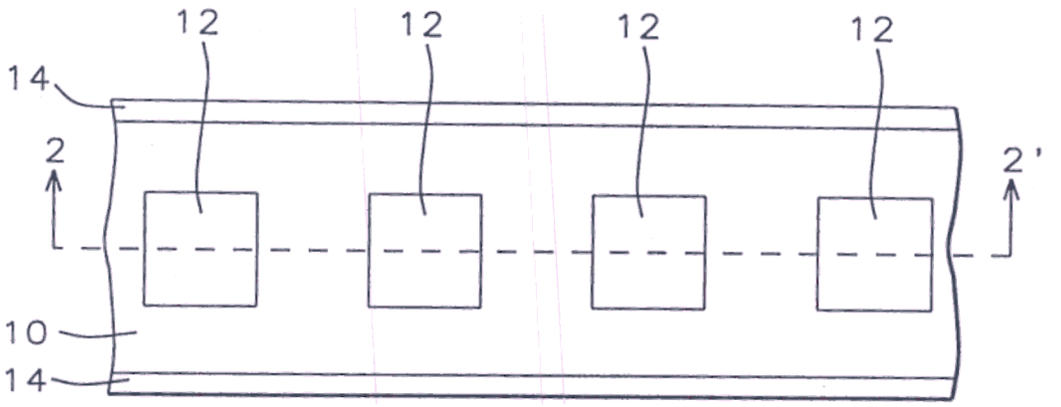


FIG. 1 – Prior Art

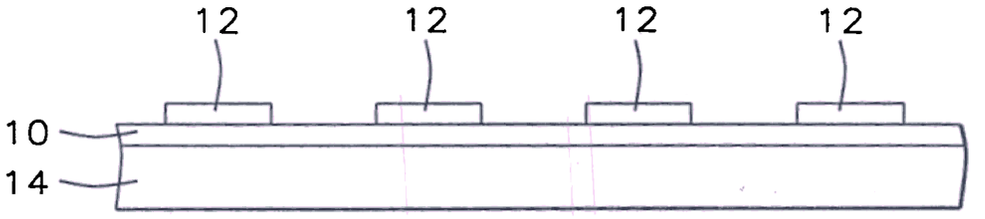


FIG. 2 – Prior Art

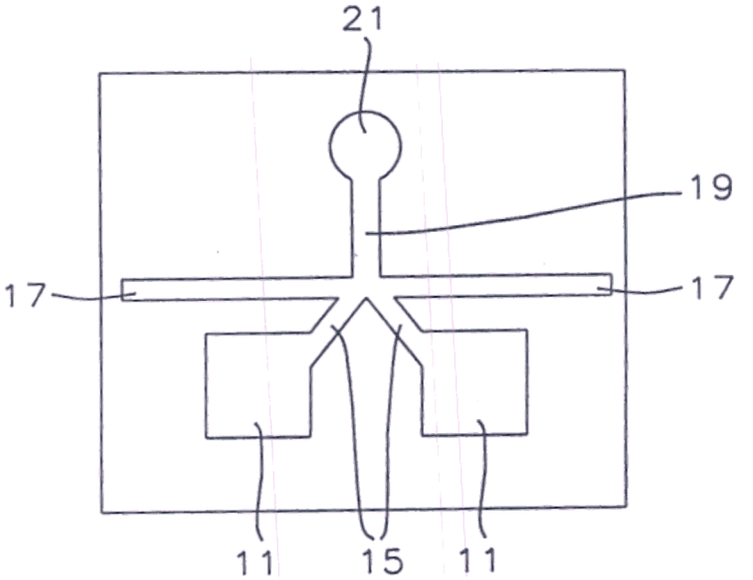


FIG. 3

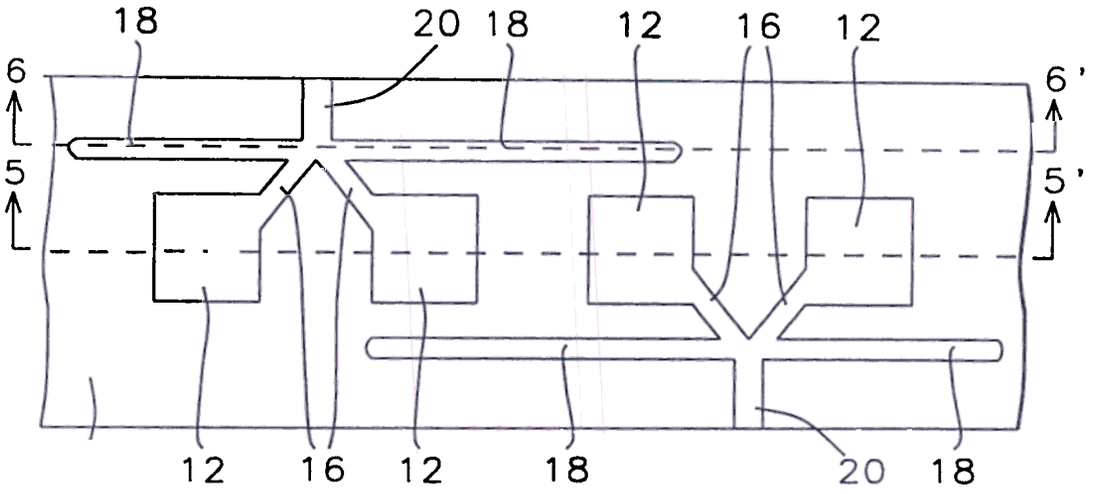


FIG. 4

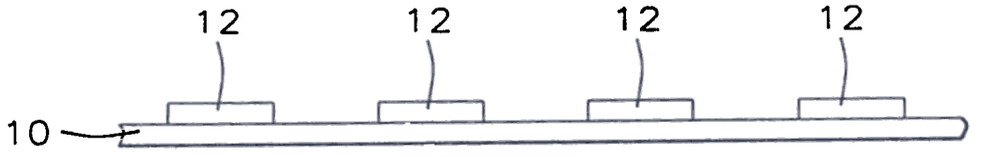


FIG. 5

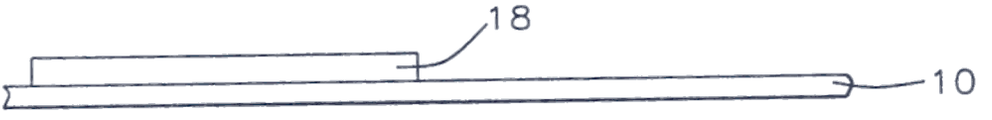
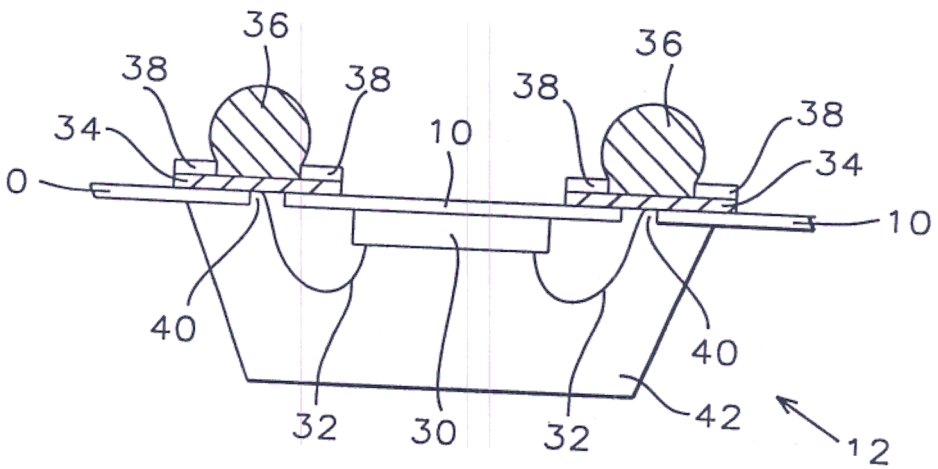


FIG. 6


36
38
38
36
38
38
34
10
34
0
10
40
40
32
30
32
42
12

IG 7

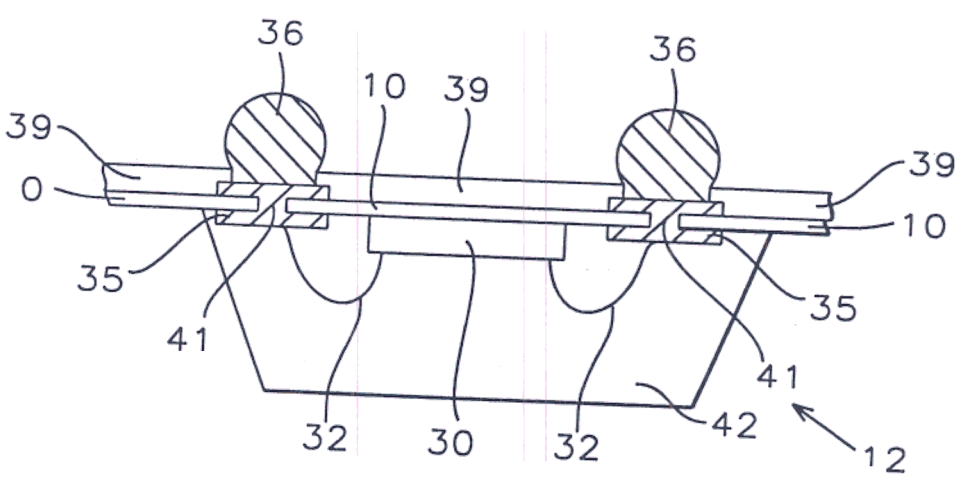

36
10
39
36
39
39
0
10
35
35
41
41
32
30
32
42
12

FIG 8