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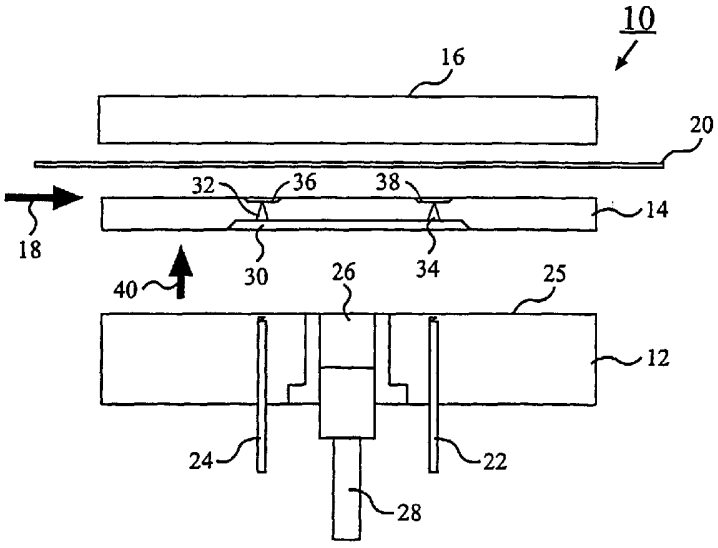
(54) **Title:** TRANSFER MOLDING MACHINE WITH FEATURES FOR ENHANCED CULL REMOVAL



(57) **Abstract:** A transfer molding machine (10) with an injection mold plate (12). The injection mold plate has ejection pins (22,24) for ejecting a cull in a first direction (40). Each of the ejection pins (22,24) has a sprue abutment (50) with a notch (52). The notch is oriented to enable dislodging of the cull in a second direction (54), substantially normal to the first direction (40) and away from the sprue abutment (50). A method (100) for cull removal by transfer molding machine (10) upon curing a molding ends with the cull being moved out of the transfer molding machine (10) using a movable bar (200) with stubs (202).

WO 03/000479 A2

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TRANSFER MOLDING MACHINE WITH FEATURES FOR ENHANCED CULL REMOVAL

Field of the Invention

The present invention relates to mold assemblies. In particular, this invention relates to a transfer molding machine with features for enhanced cull removal.

Background of the Invention

Transfer molding machines with molds that form mold cavities are known in the art. Such transfer molding machines are used in a molding process to form moldings that are shaped according to the mold cavities. Molds typically include at least two mold plates that are clamped together during part of the molding process. A mold compound in a molten state is then injected into the mold cavities. When sufficient time has elapsed to cure the mold compound, the mold plates are separated to allow ejection of a molding formed with the mold compound.

The mold compound is typically channeled during transfer from a mold pot to a mold cavity using one or more runners. Consequently, when mold plates forming the mold cavity separates, mold compound within the runners or at interfaces between the runners and the mold pot is also cured but forms an undesired molding. Such an undesired molding is commonly referred to as a cull.

Removal of culls from a transfer molding machine is necessary so that another molding cycle can take place. However, such removal can be tedious and therefore slows down production throughput of moldings by the transfer molding machine. Furthermore, cull removal should not cause the cull to break off into smaller pieces or debris. Such smaller cull pieces or cull debris adversely affect subsequent moldings by the transfer molding machine or may even cause stoppages in the production of the subsequent moldings.

In addition to the above, cull removal is typically a problem for existing transfer molding machines that mold by direct gating. Generally, direct gating results in a cull being formed that has one or more protrusions known as sprues. Such sprues may entangle with each other or with parts of the transfer molding machine during removal. Consequently, removal of culls in direct gate molding is limited by the presence of sprues.

Therefore, a need clearly exists for a transfer molding machine with features that enhance cull removal and thereby increase the production throughput of moldings by the transfer molding machine. Such features should also enable cull removal from the transfer molding machine for culls having sprues formed as a result of direct gate molding.

Brief Summary of the Invention

The present invention seeks to provide a transfer molding machine and a method for cull removal by the transfer molding machine upon curing a molding.

Accordingly, in one aspect, the present invention provides a transfer molding machine comprising:

at least one mold plate having at least one ejection pin for ejecting at least one cull off from the at least one mold plate in a first direction, each of the at least one ejection pin having a sprue abutment,

wherein the sprue abutment comprises a notch, the notch being oriented to enable dislodging of the at least one cull in a second direction away from the sprue abutment, the second direction being substantially normal to the first direction.

In another aspect, the present invention provides a method for cull removal by the transfer molding machine upon curing a molding, the method comprising the steps of:

separating a plurality of mold plates to degate the molding from at least one gate of one or more of the plurality of mold plates;

ejecting at least one cull, associated with the molding, in a first direction using at least one ejection pin having a sprue abutment with a notch; and

dislodging the at least one cull in a second direction away from the sprue abutment, the second direction being substantially normal to the first direction and based upon orientation of the notch.

Brief Description of the Drawings

A preferred embodiment of the present invention will now be more fully described, by way of example, with reference to the drawings of which:

FIG. 1 is a simplified cross-sectional view of a transfer molding machine in accordance with a preferred embodiment of the present invention;

FIG. 2A, FIG. 2B and FIG 2C are, respectively, an isometric view, a plan view and a side view of a sprue abutment of an ejection pin of the transfer molding machine of FIG. 1;

FIG. 3 is a cross-sectional side view of a tapered cavity of the transfer molding machine of FIG. 1;

FIG. 4 is a flowchart of a method for cull removal by the transfer molding machine of FIG. 1;

FIG. 5 is a side view of the transfer molding machine of FIG. 1 showing a cull removing member;

and

FIG. 6A, FIG. 6B and FIG 6C are, respectively, a front view, a side view and a bottom view of the cull removing member.

Detailed Description of the Drawings

A transfer molding machine and a method for cull removal by the transfer molding machine upon curing a molding in accordance with a preferred embodiment of the invention are described. In the following description, details are provided to describe the preferred embodiment. It shall be apparent to one skilled in the art, however, that the invention may be practiced without such details. Some of these details may not be described at length so as not to obscure the invention.

There are many advantages of the invention. One advantage of the invention is that the transfer molding machine forms culls. Such culls are less likely to break into debris. Thus, cull removal is enhanced by the invention to thereby alleviate production stoppages caused by removal of cull debris.

Another advantage of the invention is that the transfer molding machine provides for one or more ejection pin. In addition to ejecting a cull, such ejection pins comprise features that enable the cull to be formed for easier degating from a molding and dislodging from a mold plate compared with existing transfer molding machines.

A further advantage of the invention is that the transfer molding machine provides for automated cull removal for culls having sprues formed as a result of direct gate molding. Hence, entangling of such culls within the transfer molding machine is alleviated.

Referring now to FIG.1, a simplified cross-sectional view of a transfer molding machine 10 is shown in accordance with the preferred embodiment of the present invention. The transfer molding machine 10 comprises a transfer mold plate 12, an intermediate mold plate 14 and a complementary mold plate 16.

Products that require molding are conveyed in a throughput direction, indicated by an arrow 18, through the transfer molding machine 10. Such products can be, for example, semiconductor dies (not shown) disposed on a tape 20.

The transfer mold plate 12 has at least one ejection pin of which two ejection pins 22,24 are illustrated in FIG. 1. The ejection pins 22,24 protrudes out of a surface 25 of the transfer mold plate 12 when ejecting a cull. A mold compound (not shown) is injected from a mold pot 26 using a transfer plunger 28. The transfer plunger 28 pushes the mold compound from the mold pot 26 into a cull cavity 30 formed on the intermediate mold plate 14.

The intermediate mold plate 14 also has two tapered cavities 32,34. The tapered cavities 32,34 respectively couples the cull cavity 30 to two mold cavities 36,38 of the intermediate mold plate 14.

It is to be noted that the ejection pins 22,24 are for ejecting a cull off from the transfer mold plate 12 in a first direction indicated by an arrow 40 upon forming a molding with the mold compound. In describing the preferred embodiment, the ejection pin 22 and the tapered cavity 34 are illustratively used as examples to describe details respectively associated therewith.

Referring now to FIGs. 2A to 2C, the ejection pin 22 has a sprue abutment 50 that comprises a notch 52. The notch 52 is oriented to enable dislodging of a cull in a second direction indicated by an arrow 54 away from the sprue abutment 50. The second direction is substantially normal to the first direction.

The notch 52 comprises a first surface 56 that is obliquely oriented relative to the throughput direction (indicated by the arrow 18) of the transfer molding machine 10 as illustrated in FIG. 2B. The first surface 56 is inclined at an angle 57 of about fifteen to twenty degrees with respect to a longitudinal axis 58 of the ejection pin 22 as illustrated in FIG. 2C.

The notch 52 further comprises an end surface 59 and a second surface 60. The end surface 59 and the second surface 60 are aligned in planes that are substantially normal to the first direction (indicated by the arrow 40).

It is to be noted that a cull formed upon curing a molding with the transfer molding machine 10 has sprues with end portions (not shown) that abut the sprue abutment 50 of each of the ejection pins 22,24. Each of such end portions complementarily abuts the sprue abutment 50 and therefore has opposing notches to the notch 52.

Details of the tapered cavity 34 and the mold cavity 38 are shown in the cross-sectional side view of FIG. 3 (not to scale). The tapered cavity 34 comprises a sprue gate 70 positioned within a gate portion 72 of the mold cavity 38. The gate portion 72 has a gate depth 74 for excess mold compound that may remain after degating. The gate depth 74 is not more than 0.2mm. A gate land 76 is also indicated at an end portion of the tapered cavity 34. The gate land 76 has a height 78 of not more than 0.1mm.

Use of the transfer molding machine 10 for cull removal upon curing a molding is effected by a method 100 illustrated with the flowchart of FIG. 4.

After starting at step 102, the method 100 proceeds to step 104 in which the transfer mold plate 12, the intermediate mold plate 14 and the complementary mold plate 16 are separated. Separating these mold plates 12,14,16 degates a molding (not shown) from the sprue gates of the tapered cavities 32,34.

It is to be noted that in the separating step 104, the notch 52 retains a cull by complementarily engaging sprues (not shown) that are formed from curing mold compound remaining in the cull cavity 30, the tapered cavities 32,34 and the notch 52 of the sprue abutment 50. The notch 52 therefore helps in degating the cull from the molding.

Thereafter, the cull is ejected at step 106 in the first direction (indicated by the arrow 40) using the ejection pins 22,24. Ejecting requires the ejection pins 22,24 to be projected out from the transfer mold plate 12 to thereby expose the notch 52 above the top surface 25. As the cull is ejected, each of the ejection pins 22,24 continues to abut to a sprue (not shown) at the sprue abutment 50.

The method 100 ends with step 108 in which the cull is dislodged in the second direction (indicated by the arrow 54) away from the sprue abutment 50. As shown in FIGs. 2A and 2B, the second direction is substantially normal to the first direction (indicated by the arrow 18) and based upon orientation of the notch 52.

The dislodging step 108 comprises pushing the cull away from the sprue abutment 50 in the second direction using a cull removing member. In the preferred embodiment, the cull removing member is a movable bar 200 shown illustratively in a side view of the transfer molding machine 10.Using the movable bar 200, the dislodging step 108 comprises aligning the movable bar 200 with the cull for the pushing.

Details of the movable bar 200 are shown in FIGs. 6A, 6B and 6C. The movable bar 200 has a plurality of stubs 202 that pushes a cull at, for example, runner portions that connect adjacent sprues. Such a pushing action provides a force that dislodges each sprue from each of the sprue abutment 50 in the direction of arrow 54.

It will be appreciated that although one preferred embodiment has been described in detail, a person skilled in the art can make various modifications and improvements without departing from the scope of the present invention.

Claims

1. A transfer molding machine comprising:

at least one mold plate having at least one ejection pin for ejecting at least one cull off from said at least one mold plate in a first direction, each of said at least one ejection pin having a sprue abutment,

wherein said sprue abutment comprises a notch, said notch being oriented to enable dislodging of said at least one cull in a second direction away from said sprue abutment, said second direction being substantially normal to said first direction.

2. The transfer molding machine of Claim 1, wherein said notch comprises a first surface, said first surface being obliquely oriented relative to a throughput direction of said transfer molding machine.

3. The transfer molding machine of Claim 2, wherein said notch further comprises a second surface, said second surface being aligned in a plane, said plane being substantially normal to said first direction.

4. The transfer molding machine of Claim 1, wherein said at least one mold plate comprises a transfer mold plate.

5. The transfer molding machine of Claim 1, wherein said at least one mold plate comprises a complementary mold plate.

6. The transfer molding machine of Claim 1, wherein said transfer molding machine further comprises at least one intermediate mold plate having at least one tapered cavity.

7. The transfer molding machine of Claim 6, wherein each of said at least one tapered cavity has a gate angle ranging from fifty-five degrees to sixty-degrees.

8. The transfer molding machine of Claim 6, wherein each of said at least one tapered cavity has a gate land.

9. The transfer molding machine of Claim 6, wherein said at least one intermediate mold plate comprises has a gate portion with a gate depth for excess mold compound.

10. The transfer molding machine of Claim 1, wherein said transfer molding machine further comprises cull removing means for removing said at least one cull.

11. The transfer molding machine of Claim 10, wherein said cull removing means comprises a movable bar.

12. The transfer molding machine of Claim 11, wherein said movable bar comprises at least one stub.

13. A method for cull removal by a transfer molding machine upon curing a molding, said method comprising the steps of:

separating a plurality of mold plates to degate said molding from at least one gate of one or more of said plurality of mold plates;

ejecting at least one cull, associated with said molding, in a first direction using at least one ejection pin having a sprue abutment with a notch, said at least one ejection pin being associated with at least one of said plurality of mold plates;

and

dislodging said at least one cull in a second direction away from said sprue abutment, said second direction being substantially normal to said first direction and based upon orientation of said notch.

14. The method of Claim 13, wherein said dislodging step comprises the step of pushing said at least one cull away from said sprue abutment in said second direction.

15. The method of Claim 14, wherein said dislodging step further comprises the step of aligning a movable bar of said transfer molding machine with said at least one cull for said pushing step.

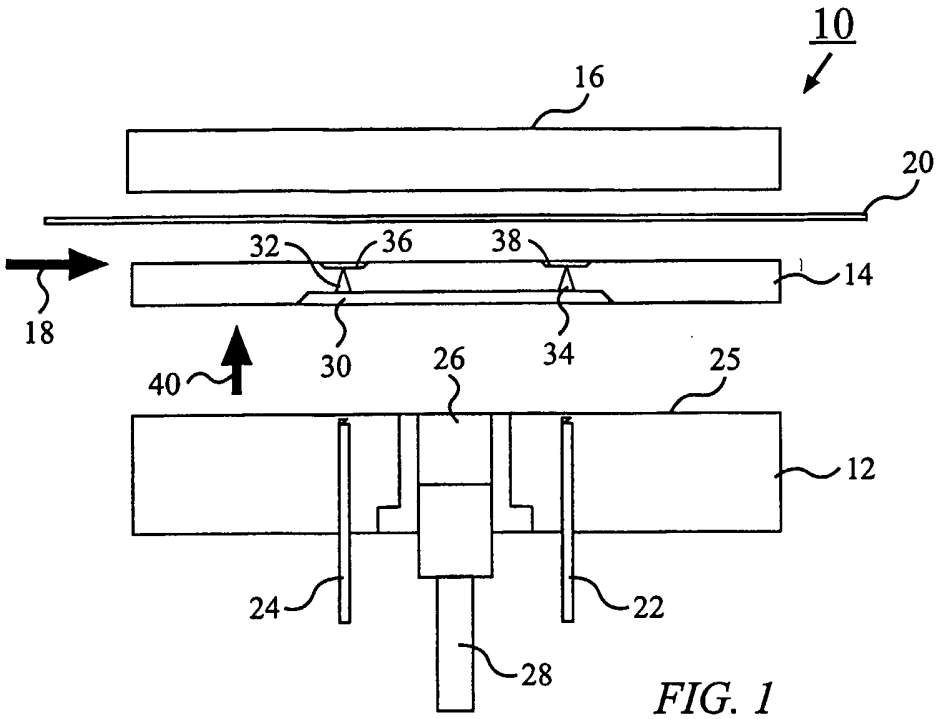

FIG. 1

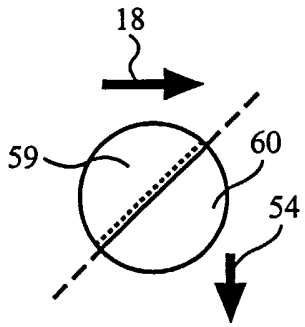

FIG. 2B

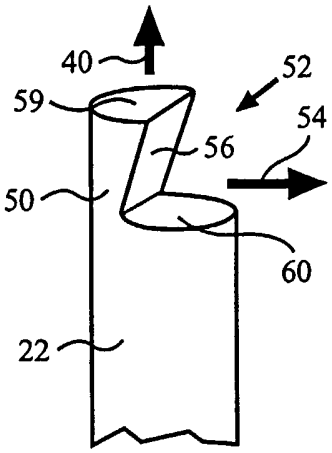

FIG. 2A

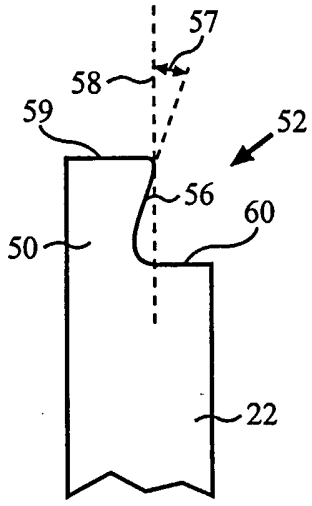

FIG. 2C

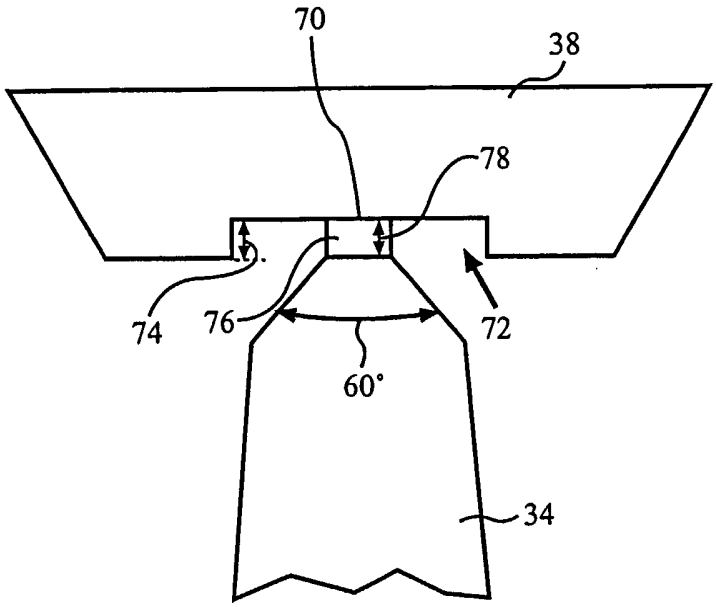

FIG. 3

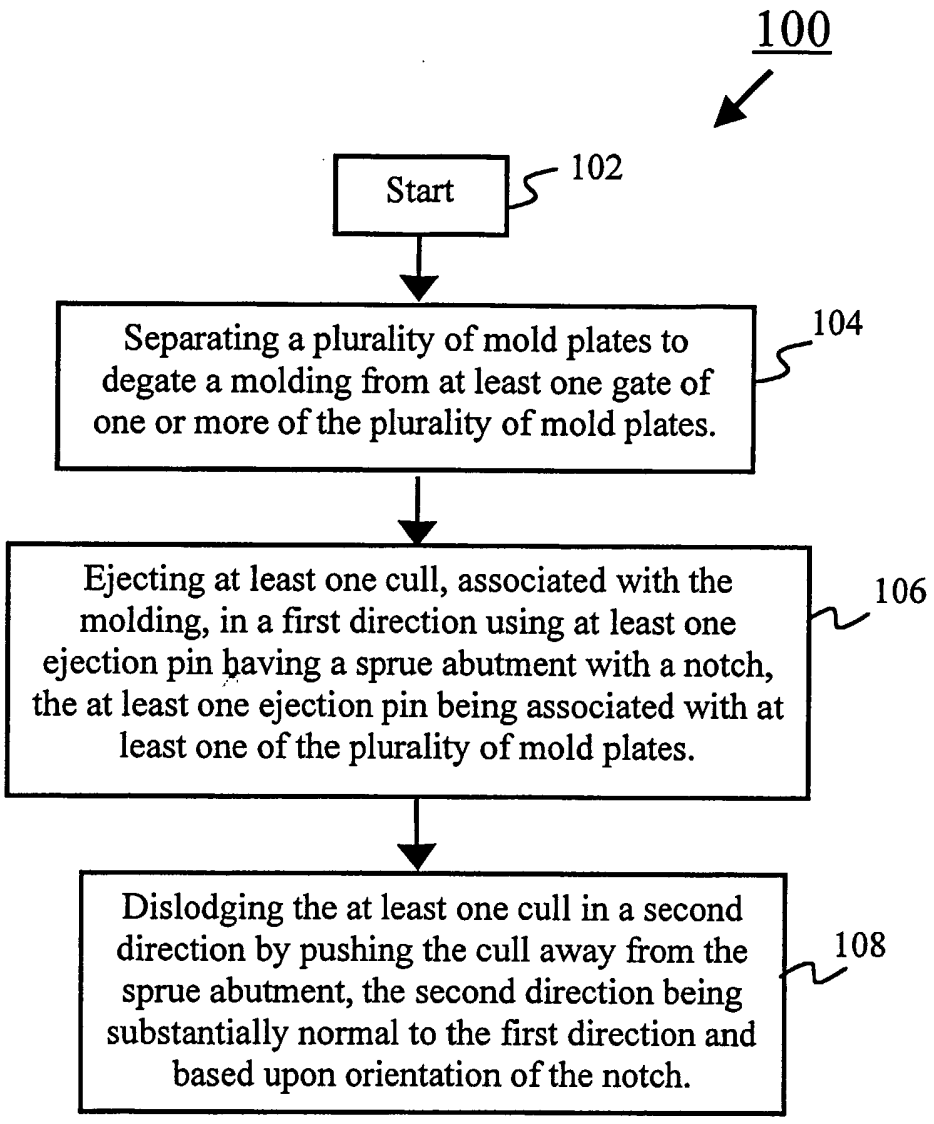
100
Start
102
Separating a plurality of mold plates to degate a molding from at least one gate of one or more of the plurality of mold plates.
104
Ejecting at least one cull, associated with the molding, in a first direction using at least one ejection pin having a sprue abutment with a notch, the at least one ejection pin being associated with at least one of the plurality of mold plates.
106
Dislodging the at least one cull in a second direction by pushing the cull away from the sprue abutment, the second direction being substantially normal to the first direction and based upon orientation of the notch.
108

FIG. 4

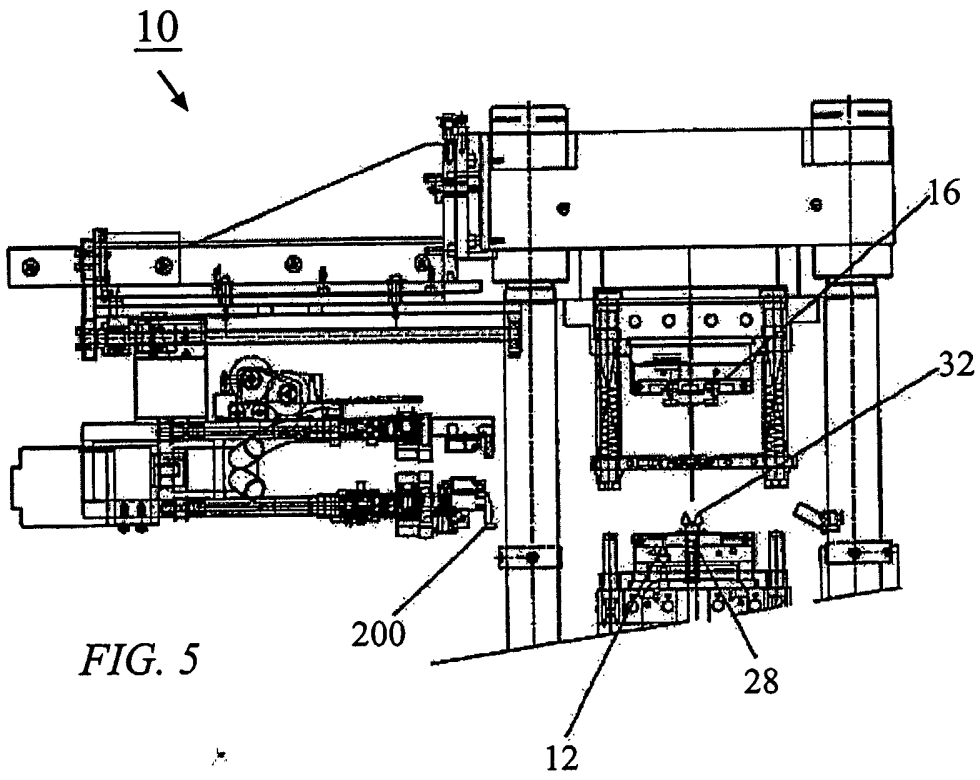

FIG. 5

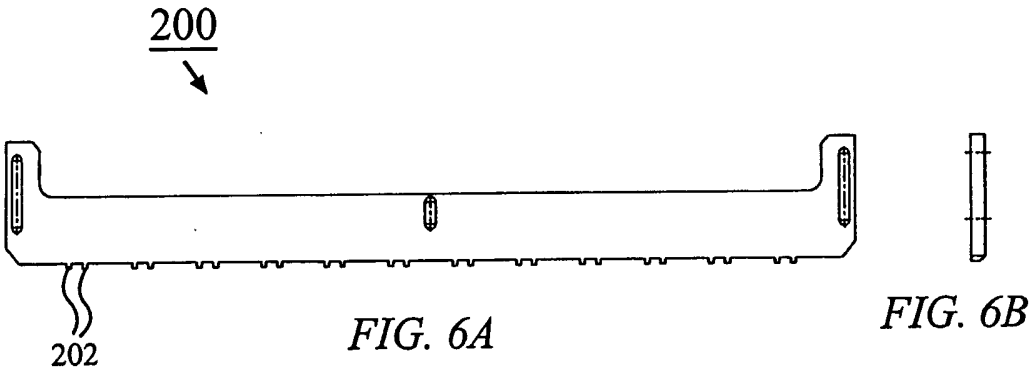

FIG. 6A

FIG. 6B

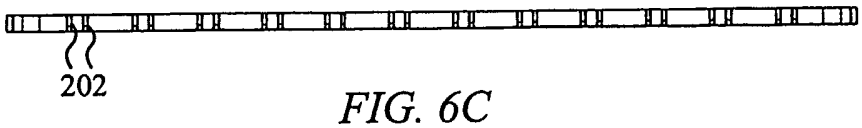

FIG. 6C