

## RESISTANCE WELDING OF A FRAME AND A SUBSTRATE

The present invention relates to a method of connecting together a frame and a substrate formed from a dielectric material.

5

The present invention also relates to an assembly of a frame and a substrate formed from a dielectric material.

The present invention relates particularly, although by no means exclusively, to  
10 semi-conductor assemblies of the type which comprise an integrated circuit silicon chip, a substrate formed from a dielectric material, an electrical circuit printed or etched or otherwise deposited on the substrate, a plurality of electrical leads connecting the electrical circuit to the silicon chip, and a frame connected to the substrate and forming a boundary around the silicon chip.

15

It is known to connect together the frame and the substrate of semi-conductor assemblies with single or double sided adhesive tape. The selection of double sided tape or single sided tape is dependent upon the width of the frame. By way of example, if there is no space constraint between the edge of the substrate and the frame, single sided tape is more  
20 applicable due to the ease of attachment.

A disadvantage of the use of adhesive tape is that the adhesive properties deteriorate when the tape is exposed to operating temperatures of the order of 150°C for operating times at this temperature of about two hours. Such operating temperatures and  
25 operating times at these operating temperatures are routine operating conditions for semi-conductor assemblies. The consequence of the deterioration in adhesive properties is poor reliability of the semi-conductor assemblies.

An object of the present invention is to provide an alternative method of  
30 connecting together the frame and the substrate.

According to the present invention there is provided a method of connecting together a frame formed from a metal or an alloy and a substrate formed from a dielectric material and having one or more deposits of a metal or an alloy on a surface of the substrate,  
35 which method comprises:

(a) positioning together the frame and the substrate so that there is contact between the frame and at least one deposit on the substrate; and

5 (b) resistance welding together the frame and the substrate at the region(s) of contact between the frame and the deposit(s) on the substrate.

10 In the context of the present invention the term "resistance welding" is understood to mean applying an electric field to the assembly of the frame and the substrate to heat the regions of the deposit(s) and the frame that are in contact to soften or melt the metals/alloys in these regions so that there is mixing of the metals/alloys which produces one or more strong welds on cooling of the frame and the substrate.

The electric field may be applied by any suitable means.

15 The deposit(s) may be applied to the substrate by any suitable means.

It is preferred that the deposit(s) comprises copper, nickel or gold.

20 The deposit(s) may be of any suitable form.

It is preferred that the or each deposit be a bead of the metal or the alloy.

It is preferred that the substrate be a tape.

25 It is preferred that the tape be a polyimide tape.

30 According to the present invention there is also provided an assembly of a frame formed from a metal or an alloy and a substrate formed from a dielectric material which are connected together by one or more welds formed by resistance welding the metal/alloy of the frame and a metal/alloy of one or more deposits of the metal/alloy on the substrate.

It is preferred that the deposit(s) comprises copper, nickel or gold.

35 It is preferred that the or each deposit be a bead of the metal or the alloy.

It is preferred that the substrate be a tape.

It is preferred that the tape be a polyimide tape.

It is preferred that the assembly of the frame and the substrate be a component  
5 of a semi-conductor assembly.

It is preferred that the semi-conductor assembly comprise an electrical circuit on  
one or both surfaces of the substrate.

10 The present invention is described further with reference to the accompanying  
drawings, of which:

Figure 1 is a top plan view of a preferred embodiment of an assembly of a frame  
and a substrate connected together by welds formed by resistance welding in accordance with  
15 the present invention;

Figure 2 is a cross-section along the line A-A in Figure 1 before forming the  
welds;

20 Figure 3 is a cross-section along the line A-A in Figure 1 after forming the welds;

Figure 4 is a bottom plan view of the substrate prior to connecting together the  
substrate and the frame;

25 Figure 5 illustrates schematically two methods of forming the welds; and

Figure 6 is a plan view of the frame.

The assembly 3 of a frame 5 and a substrate 7 shown in the figures is a  
30 component of a semi-conductor assembly.

In this context, the semi-conductor assembly further comprises, by way of  
example, a plurality of electrical circuits 9 printed or etched onto both surfaces of the substrate  
7, an integrated circuit silicon chip (not shown) secured to the substrate 7, and electrical leads  
35 (not shown) electrically connecting the electrical circuits 9 and the silicon chip.

The frame 5 and the substrate 7 are connected together by a plurality of strong welds 17 that are formed by resistance welding.

As can best be seen in Figure 6, the frame 5 is rectangular in shape with sides 10 and ends 11 and alignment pin-holes 13 at each corner. The frame 5 is formed from any suitable metal, such as copper or any suitable alloy, such as stainless steel.

The substrate 7 is in the form of a flexible rectangular tape formed from polyimide or any other suitable dielectric material.

The substrate 7 also comprises a series of beads 27 of a metal or an alloy deposited on the undersurface of the substrate 7. The purpose of the metal/alloy beads 27 is to combine with the metal/alloy of the frame 5 to form the welds 17.

Figure 5 illustrates two of a number of possible options for resistance welding together the frame 5 and the substrate 7.

In accordance with the option shown on the left hand side of Figure 5, the substrate 5 is provided with a series of openings 29 which expose sections of the beads 27 and enable an electrode 31 of a pair of electrodes 31,33 to be positioned to extend through the openings 29 to contact the beads 27.

With this arrangement, when the substrate 7 is positioned on the frame 5 with the beads 27 contacting the frame 5, the electrodes 31,33 are then positioned as shown with the electrode 31 contacting the upper surface of the beads 27 and the electrode 33 contacting the undersurface of the frame 5, and then an electric field is applied and softens or melts the metals/alloys of the beads 27 and the frame 5 and forms the weld 17.

This sequence of steps is repeated depending on the number of welds 17 required.

In accordance with the option shown on the right hand side of Figure 5, the openings 29 are not required, and in order to form each weld 17 the electrodes 31,33 are positioned to contact the undersurface of the frame 5 and thereby form an electrical circuit which includes the beads 27.

Many modifications may be made to the preferred embodiments described above without departing from the spirit and scope of the present invention.



THE CLAIMS DEFINING THE INVENTION ARE AS FOLLOWS:

1. A method of connecting together a frame formed from a metal or an alloy and a substrate formed from a dielectric material and having one or more deposits of a metal or an alloy on a surface of the substrate, which method comprises:
  - (a) positioning together the frame and the substrate so that there is contact between the frame and at least one deposit on the substrate; and
  - (b) resistance welding together the frame and the substrate at the region(s) of contact between the frame and the deposit(s) on the substrate.
2. The method defined in claim 1 wherein the deposit(s) on the substrate comprises copper, nickel or gold.
3. The method defined in claim 1 or claim 2 wherein the deposit(s) comprises a bead or beads of the metal or the alloy.
4. The method defined in any one of the preceding claims wherein the substrate is a polyimide tape.
5. An assembly of a frame formed from a metal or an alloy and a substrate formed from a dielectric material which are connected together by one or more welds formed by resistance welding the metal/alloy of the frame and a metal/alloy of one or more deposits of the metal/alloy on the substrate.
6. The assembly defined in claim 5 wherein the deposit(s) on the substrate comprises copper, nickel or gold.
7. The assembly defined in claim 5 or claim 6 wherein the deposit(s) comprises a bead or beads of the metal or the alloy.
8. The assembly defined in any one of claims 5 to 7 wherein the substrate is a polyimide tape.

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TITLE: RESISTANCE WELDING OF A FRAME AND A SUBSTRATE

ABSTRACT

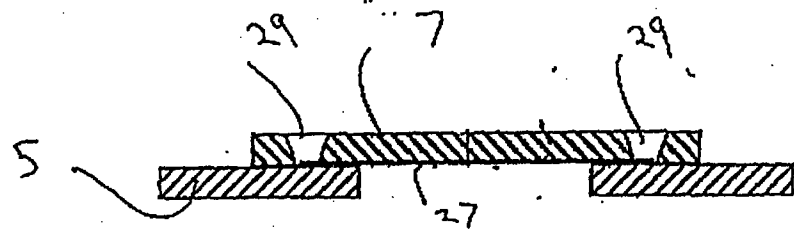
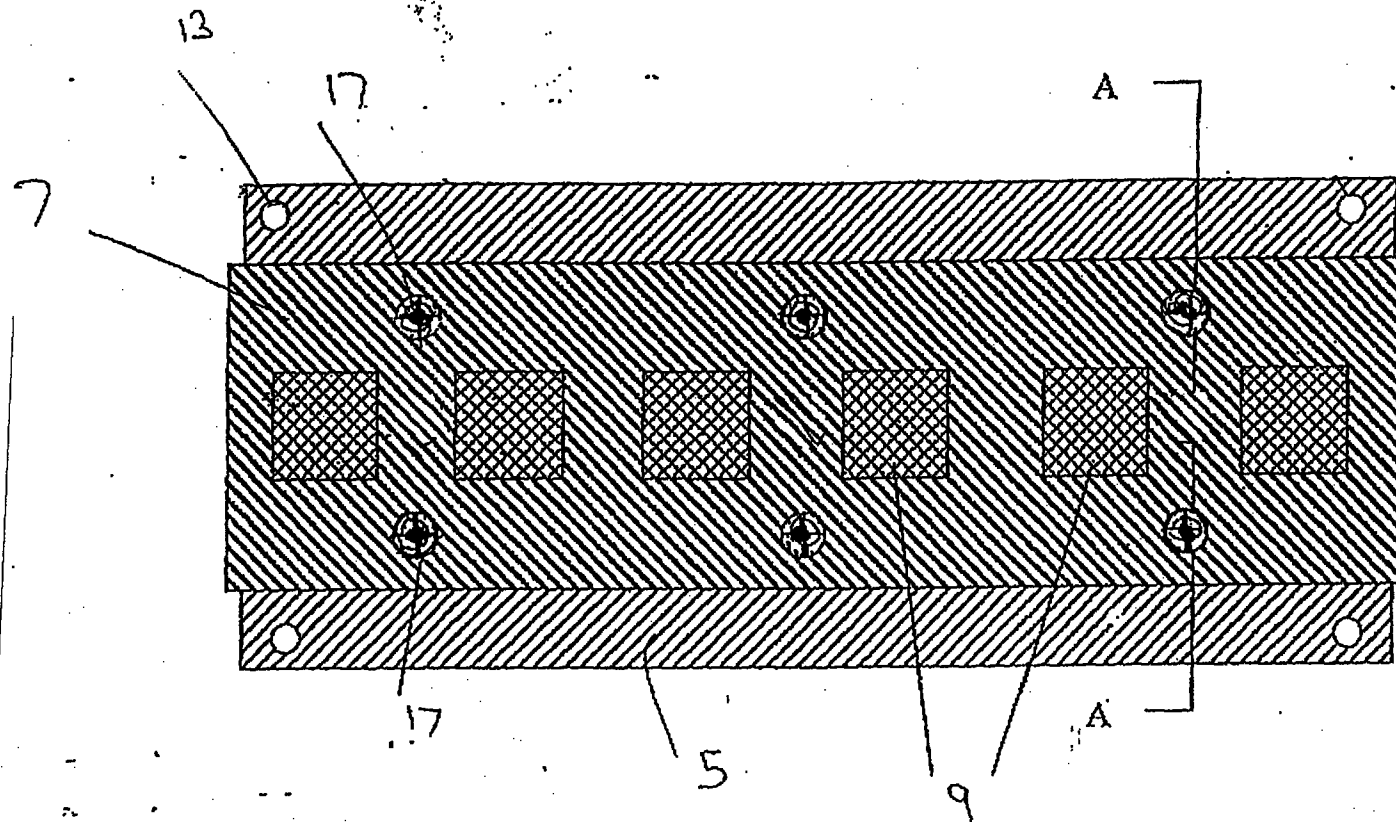
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10 A method of connecting together a frame (5) and a substrate (7) and an assembly of the frame (5) and the substrate (7) are disclosed. The frame (5) is formed from a metal or an alloy and the substrate (7) is formed from a dielectric material. The substrate (7) also comprises one or more deposits (27) of a metal or an alloy. The method comprises positioning together the frame (5) and the substrate (7) so that there is contact between the frame (15) and at least one of the deposits (27) and thereafter resistance welding together the frame (5) and the substrate (7) at the region(s) of contact.

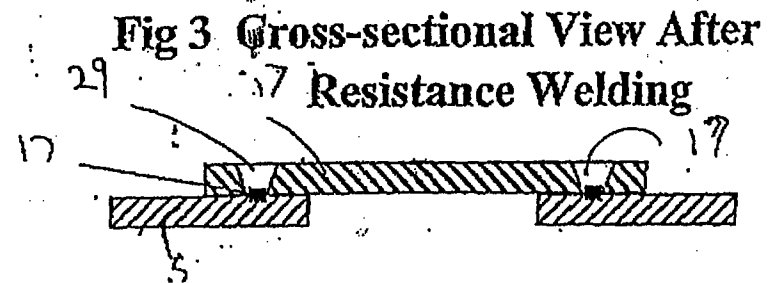
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**Fig 1 Plan View of Material Structure**



**Fig 2 Cross-sectional View A-A**



**Fig 3 Cross-sectional View After Resistance Welding**

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Fig 4 Bottom View of Polyimide Tape

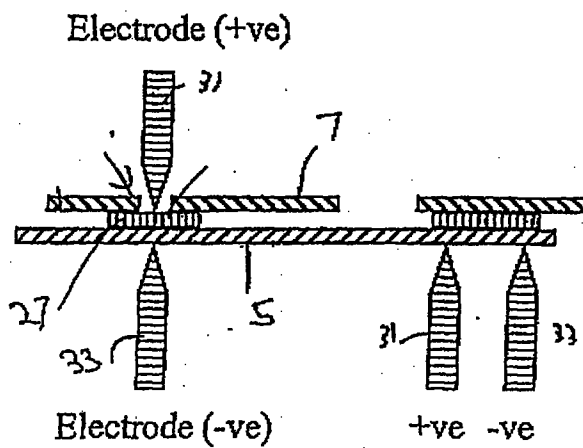
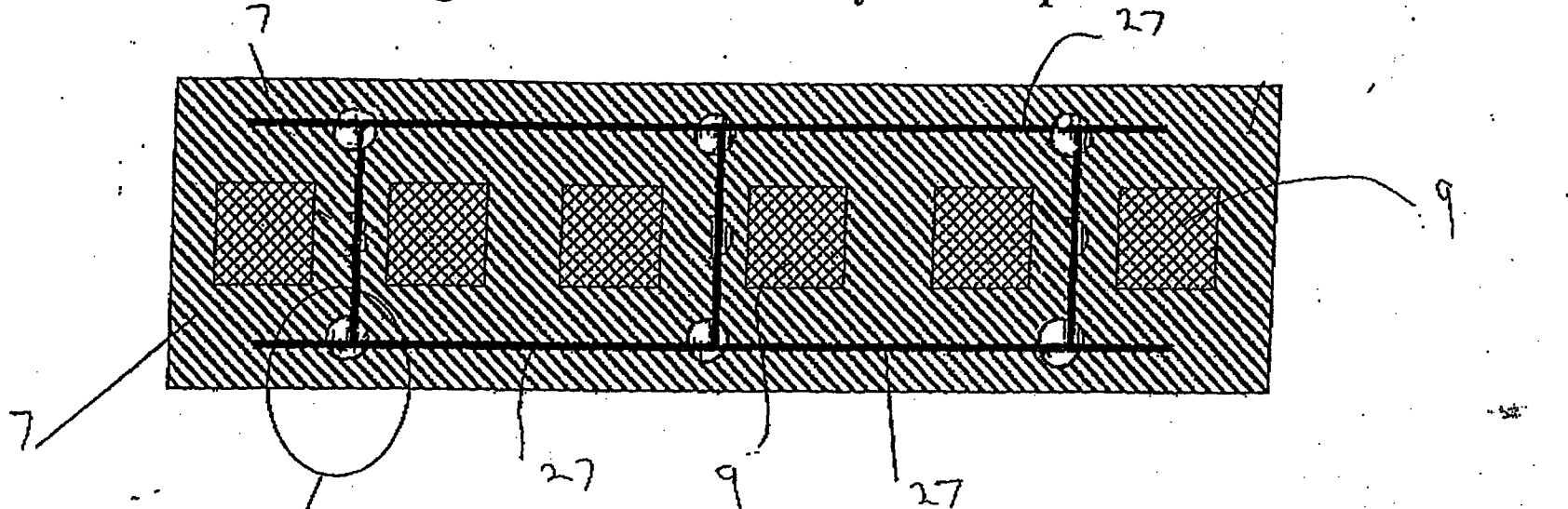


Fig 5 Two Types of Resistance Welding Overview

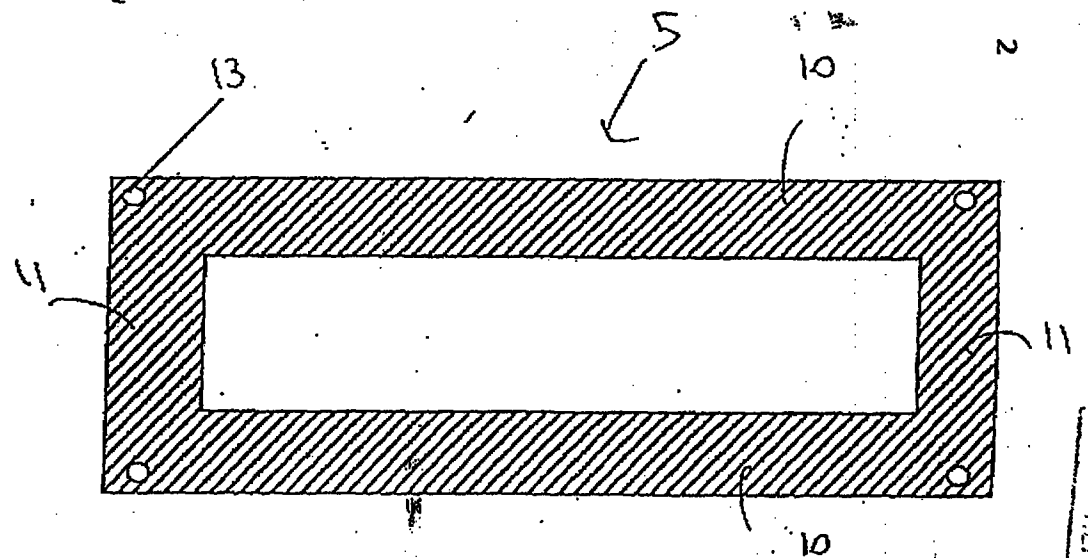


Fig 6 Plan View of Metal Frame

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## ABSTRACT

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Fig 3

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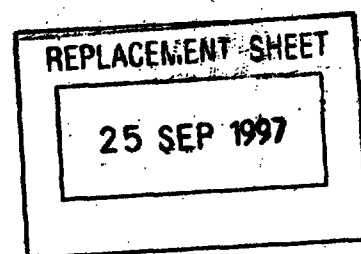


Fig 1 Plan View of Material Structure

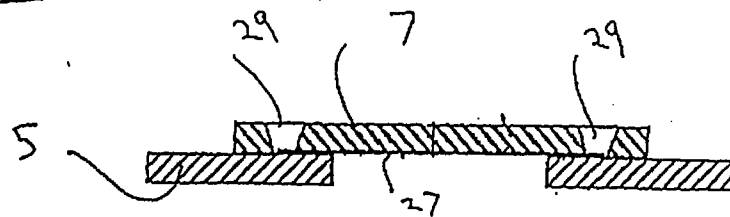
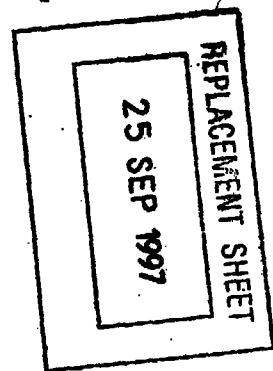
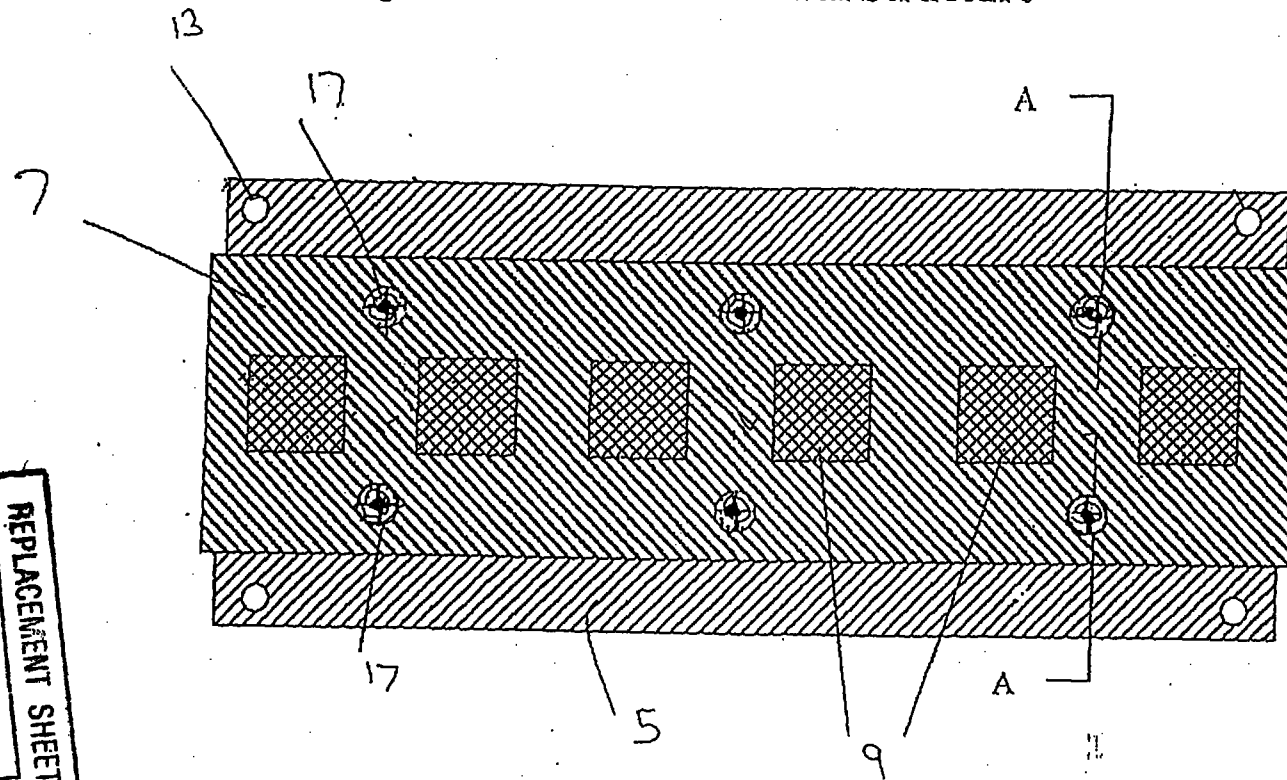


Fig 2 Cross-sectional View A-A

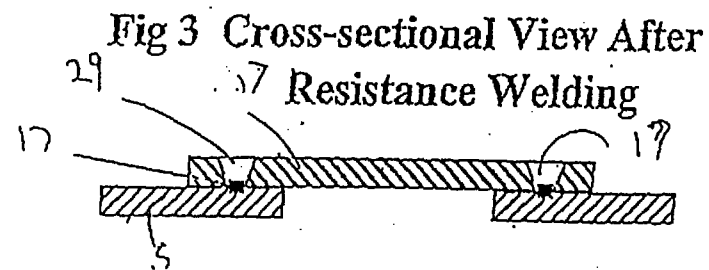


Fig 3 Cross-sectional View After Resistance Welding

Fig 4 Bottom View of Polyimide Tape

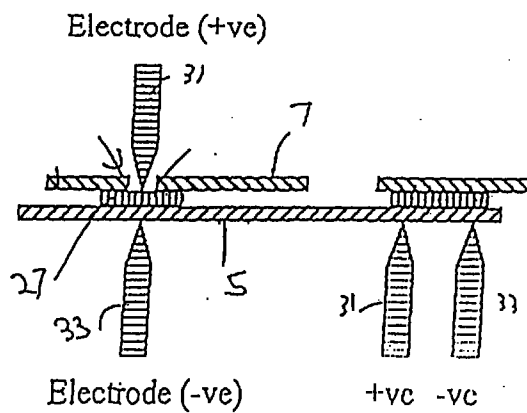
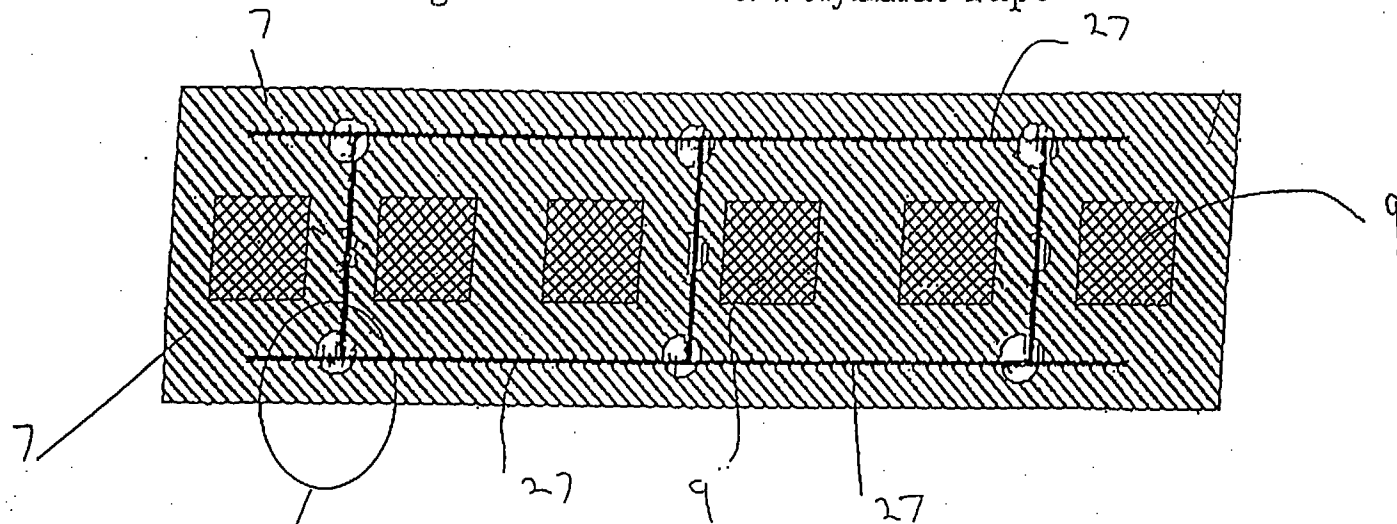


Fig 5 Two Types of Resistance Welding Overview

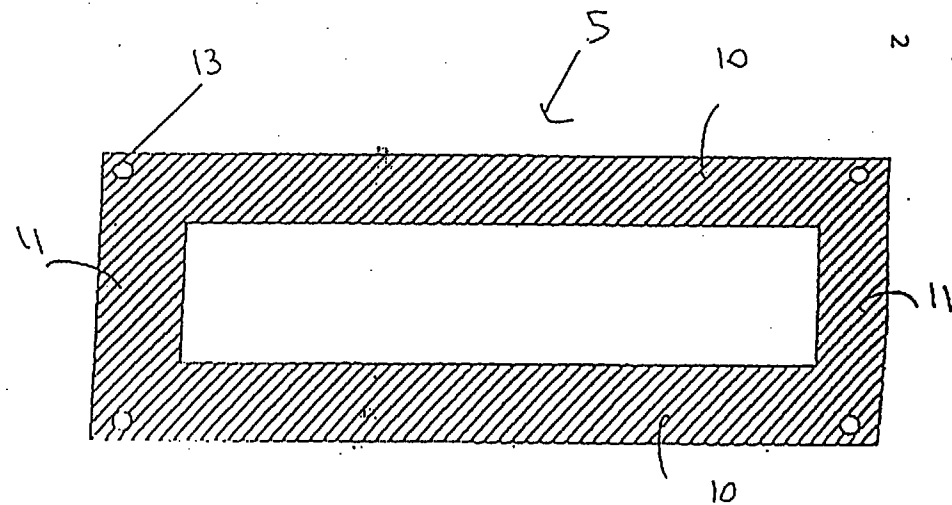


Fig 6 Plan View of Metal Frame