

PLACEMENT MACHINE AND METHOD FOR BONDING COMPONENTS TO CONTACTS

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FIELD OF THE INVENTION

This invention relates to a placement machine and method for bonding components to contacts of a laser transparent or translucent substrate. The invention is particularly useful for but not necessarily limited to interconnect such as solder bonding, or otherwise, of electrical contacts of electrical components to pads of a laser transparent circuit board.

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BACKGROUND ART

It is well known to bond electrical components to circuit boards by the use of solder paste and reflowing techniques. However, such techniques may cause component misalignment defects due to vibrations caused by transporting a circuit board having pads on which the electrical components rest from a pick and place machine to a reflow oven. It is also known to use laser bonding as an alternative to reflowing techniques. One form of laser bonding is described in US patent issued under number US 4,970,365 in which leads are bonded to a substrate using a laser-assisted thermo-compression technique where laser energy is used to pulse heat at a fine-point capillary tip. The tip is placed in forced intimate contact with a superposed lead and pad. This technique is not suitable for all forms of surface mounted technology and does not necessarily overcome the problems of misalignment defects.

Another form of laser bonding technique is described in German patent identified by application number DE 195 04 967. The technique as described uses laser energy to bond contacts of

components to pads of the substrate. Unfortunately, this technique is not ideally suited to high production rates.

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SUMMARY OF THE INVENTION

It is an aim of the invention to overcome or alleviate at least one of the problems associated with solder bonding of electrical contacts to pads or contacts of a substrate or at least
10 provide the public with a useful alternative.

According to one aspect of the invention there is provided a placement machine for mounting and bonding components onto contacts of a laser translucent or laser transparent substrate,
15 said machine comprising:

a plurality of laser beam outlets associated with an abutment surface for abutting one surface of said substrate;

20 a laser energy generator operatively coupled to said outlets;

at least one placement means for placing one or more of said components onto another surface of said substrate opposite
25 said one surface;

a conveyor for conveying said substrate, said conveyor having at least a section that is movable towards said outlets;
and

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a controller for controlling movement of said conveyor section relative to said laser beam outlets to thereby provide abutment of said abutment surface to said one surface,

wherein said machine selectively provides laser energy
35 through said outlets whilst at least one of said components and said substrate are sandwiched between said outlets and said placement means.

Preferably, said controller may be adapted to control movement of said conveyor section relative to said outlets to provide alignment of said outlets to at least some of said contacts of said substrate.

Suitably, there may be a transparent or translucent cover mounted to said machine over said outlets, said cover providing said abutment surface.

Preferably, said cover may be removable from said machine.

The outlets may be bonded fibre optical tubes optically polished thereby forming said abutment surface.

Suitably, said outlets may be in the form of a matrix. Alternatively, said outlets may be in the form of a predetermined array wherein each of said outlets corresponds to one or more contacts of said substrate.

Preferably, there may be a cooling means for dissipating heat generated adjacent said outlets. The cooling means may be one or more air fans or alternatively cooling coils between some of said outlets.

According to another aspect of the invention there is provided a method for mounting and bonding components onto contacts of a laser translucent or laser transparent substrate, said method comprising the steps of:

controlling movement of said conveyor section relative to said laser beam outlets to thereby provide abutment of an abutment surface of said substrate to an abutment surface associated with laser beam outlets;

placing at least one component onto one or more contacts of said substrate, said placing being effected by a placement means; and

5 selectively supplying laser energy through one or more of said outlets and through said substrate to said contacts whilst said component and said substrate are sandwiched between said outlets and said placement means.

10 Suitably, said step of controlling is further characterised by aligning said contacts to said outlets.

BRIEF DESCRIPTION OF THE DRAWINGS

15 In order that the invention may be readily understood and put into practical effect, reference will now be made to preferred embodiments as illustrated with reference to the accompanying drawings in which:

20 FIG. 1 is a schematic representation of a placement machine in accordance with the present invention;

25 FIG. 2 is part of a cross-sectional view through AA of Figure 1 when bonding a component to a substrate; and

30 FIG. 3 illustrates part of a cross-sectional view of a second preferred embodiment of the present invention.

DETAILED DESCRIPTION OF PREFERRED EMBODIMENTS OF THE INVENTION

35 Referring to Figures 1 and 2, there is illustrated a placement machine 1 for mounting and bonding components 2 via contacts 3 onto contacts that are typically pads 4 of a laser

transparent substrate 5. The placement machine 1 comprises a conveyor 6 which as illustrated is formed from two parallel tracks 8 and 9 with associated substrate engagement members for engaging and transporting substrate 5 in direction identified by arrow W as would be apparent to a person skilled in the art.

The placement machine 1 also comprises a plurality of laser beam outlets 10 and a laser energy generator 11 operatively coupled to the outlets 10 by fibre optical cables 12. There is a placement means in the form of a pick and place member 13 for placing contacts 3 of components 2 onto pads 4 of substrate 5.

The placement machine 1 also includes a controller 14 coupled to drives (not shown) for controlling movement of a conveyor 6 relative to the laser beam outlets 10 to thereby provide alignment of the outlets with the pads 4 as well as providing abutment of one surface 15 of substrate 5. In this regard, the alignment is controlled by assistance of signals being sent from an optical position sensor 16 coupled to controller 14 as would be apparent to a person skilled in the art.

As illustrated, there is a transparent cover 17 removably mounted to the machine over the outlets 10 which form a matrix however, in another form the outlets 10 may be a pre-determined array wherein each of the outlets 10 corresponds to one or more contacts of said substrate 5.

To assist in cooling of the heat generated at the outlets 10, there is provided an air fan 18 positioned to blow cooling air over the outlets 10. However, referring to Figure 3 an alternative embodiment is illustrated which is similar to placement machine 1 except that outlets 10 form a platen of bonded optical fibre tubes which are optically polished to form an abutment surface for abutting surface 15 of substrate 5. Furthermore, between some of outlets 10 there are cooling coils 19 for providing cooling.

Referring back to FIGs. 1 and 2, in use, a substrate 5 conveyed along conveyor 6 in direction W until it reaches an area above the outlets 10. Optical position sensor 16 provides signals to controller 14 in order to assist in aligning pads 4 to the laser beam outlets 10 as will be apparent to a person skilled in the art. In this regard, conveyor 6 is movable along an axis X transverse to direction W which thereby assists in alignment of pads 4 to outlets 10. Machine 1 then controls movement of a section of conveyor 6 relative to the laser beam outlets 10 to thereby provide abutment of surface 15 to cover 17. Pick and place member 13, controlled by controller 14, then places a component onto substrate 5 such that contacts 3 abut onto pads 4 of the substrate 5, the pads 4 being on a surface 20 which is opposite to surface 15. Laser energy is then selectively supplied at a predetermined intensity and wavelength through the outlets 10 and through substrate 5 to the pads 4 whilst the placed component 2 and substrate 5 are sandwiched between the outlets 10 and pick and place member 13. As a result, the pads 4 and contacts 3 heat and weld together or alternatively an interconnect such as solder applied to pads 4 may melt causing bonding of pads 4 to contacts 3.

Further to the above, the sandwiching of component 2 and substrate 5 between the outlets 10 and pick and place member 13 during bonding is effected with a compressive force as illustrated by arrows F. This force, applied during bonding, assists in reducing or eliminating bonding defects that may otherwise occur. The placing of further components 2 onto substrate 5 is then repeated whilst the surface 15 abuts cover 17. If cover 17 becomes dirty it can be removed, cleaned and then repositioned on machine 1.

If the embodiment of FIG. 3 is used Machine 1 controls movement of a section of conveyor 6 relative to the laser beam outlets 10 to thereby provide abutment of surface 15 to the abutment surface of the optical fibre tubes. Cover 17 has the

advantage of preventing dust or dirt from clogging outlets 10, which if clogged would have to be cleaned or re-polished.

Advantageously, the present invention overcomes or
5 alleviates at least one of the problems associated with
misalignment defects, primarily due to vibrations, that can occur
in prior art mounting and bonding of components to circuit
boards or other substrates. This is primarily achieved by
providing laser bonding whilst each component is sandwiched
10 between the outlets 10 and the pick and place member 13.
Accordingly, bonding is effected whilst the pick and place
member 13 holds the component 5 in place and can therefore
relatively high production rates can be achieved.

15 Although the invention has been described with
reference to preferred embodiments, it is to be understood that
the invention is not restricted the embodiments described
herein. For example, the conveyor could be a robot arm or any
other conveying means and the substrate could be a printed
20 circuit board or a flexible film substrate as will be apparent to a
person skilled in the art.

**WE CLAIM:**

1. A placement machine for mounting and bonding components onto contacts of a laser translucent or laser transparent substrate, said machine comprising:

a plurality of laser beam outlets associated with an abutment surface for abutting one surface of said substrate;

a laser energy generator operatively coupled to said outlets;

at least one placement means for placing one or more of said components onto another surface of said substrate opposite said one surface;

a conveyor for conveying said substrate, said conveyor having at least a section that is movable towards said outlets; and

a controller for controlling movement of said conveyor section relative to said laser beam outlets to thereby provide abutment of said abutment surface to said one surface,

wherein said machine selectively provides laser energy through said outlets whilst at least one of said components and said substrate are sandwiched between said outlets and said placement means.

2. A placement machine as claimed in claim 1, wherein said controller is adapted to control movement of said conveyor section relative to said outlets to provide alignment of said outlets to at least some of said contacts of said substrate.

3. A placement machine as claimed in claim 2, wherein there is a transparent or translucent cover mounted to said machine over said outlets, said cover providing said abutment surface.



4. A placement machine as claimed in claim 3, wherein said cover is removable from said machine.
5. A placement machine as claimed in claim 2, wherein
5 said outlets are bonded fibre optical tubes optically polished thereby forming said abutment surface.
6. A placement machine as claimed in any one of claims 1 to 5, wherein said outlets are in the form of a matrix.
- 10 7. A placement machine as claimed in any one of claims 1 to 5, wherein said outlets are in the form of a pre-determined array and wherein each of said outlets corresponds to one or more contacts of said substrate.
- 15 8. A placement machine as claimed in any one of claims 1 to 7, wherein there is a cooling means for dissipating heat generated adjacent said outlets.
- 20 9. A method for mounting and bonding components onto contacts of a laser translucent or laser transparent substrate, said method comprising the steps of:
- controlling movement of said conveyor section relative to
25 said laser beam outlets to thereby provide abutment of an abutment surface of said substrate to an abutment surface associated with laser beam outlets;
- placing at least one component onto one or more contacts of
30 said substrate, said placing being effected by a placement means; and
- selectively supplying laser energy through one or more of
said outlets and through said substrate to said contacts whilst
35 said component and said substrate are sandwiched between said outlets and said placement means.



THIS SHEET HAS BEEN
REPLACED

10. A method for mounting and bonding components onto contacts of a laser translucent or laser transparent substrate as claimed in claim 9, wherein said step of controlling is further characterised by aligning said contacts to said outlets.

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11. A placement machine substantially as described herein with reference to and as illustrated by the accompanying drawings.

10 12. A method for mounting and bonding components onto contacts of a laser translucent or laser transparent substrate substantially as described herein with reference to and as illustrated by the accompanying drawings.

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This Sheet Has Been Replaced



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PLACEMENT MACHINE AND METHOD FOR BONDING COMPONENTS TO CONTACTS

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ABSTRACT OF THE DISCLOSURE

10 A placement machine (1) for mounting and bonding components
(2) onto contacts of a laser translucent or laser transparent
substrate (5). The machine (1) has an array of laser beam
outlets (10) associated with an abutment surface for abutting
one surface of the substrate (5). A laser energy generator (11) is
15 operatively coupled to the outlets (10) and there is a pick and
place member (13) for placing one or more of the components
(2) on contacts of the substrate (5). There is a conveyor (6) for
conveying the substrate (5), the conveyor (6) has a section that
is movable towards the outlets (10) and a controller (14) is
20 provided to control movement of the conveyor section relative to
laser beam outlets (10) to thereby provide abutment of the
abutment surface to the one surface of the substrate. The
machine (1) selectively provides laser energy through the outlets
(10) whilst at least one of the components (2) and the substrate
(5) are sandwiched between the outlets (10) and the pick and
25 place member.

Figure 1 accompanies this abstract.

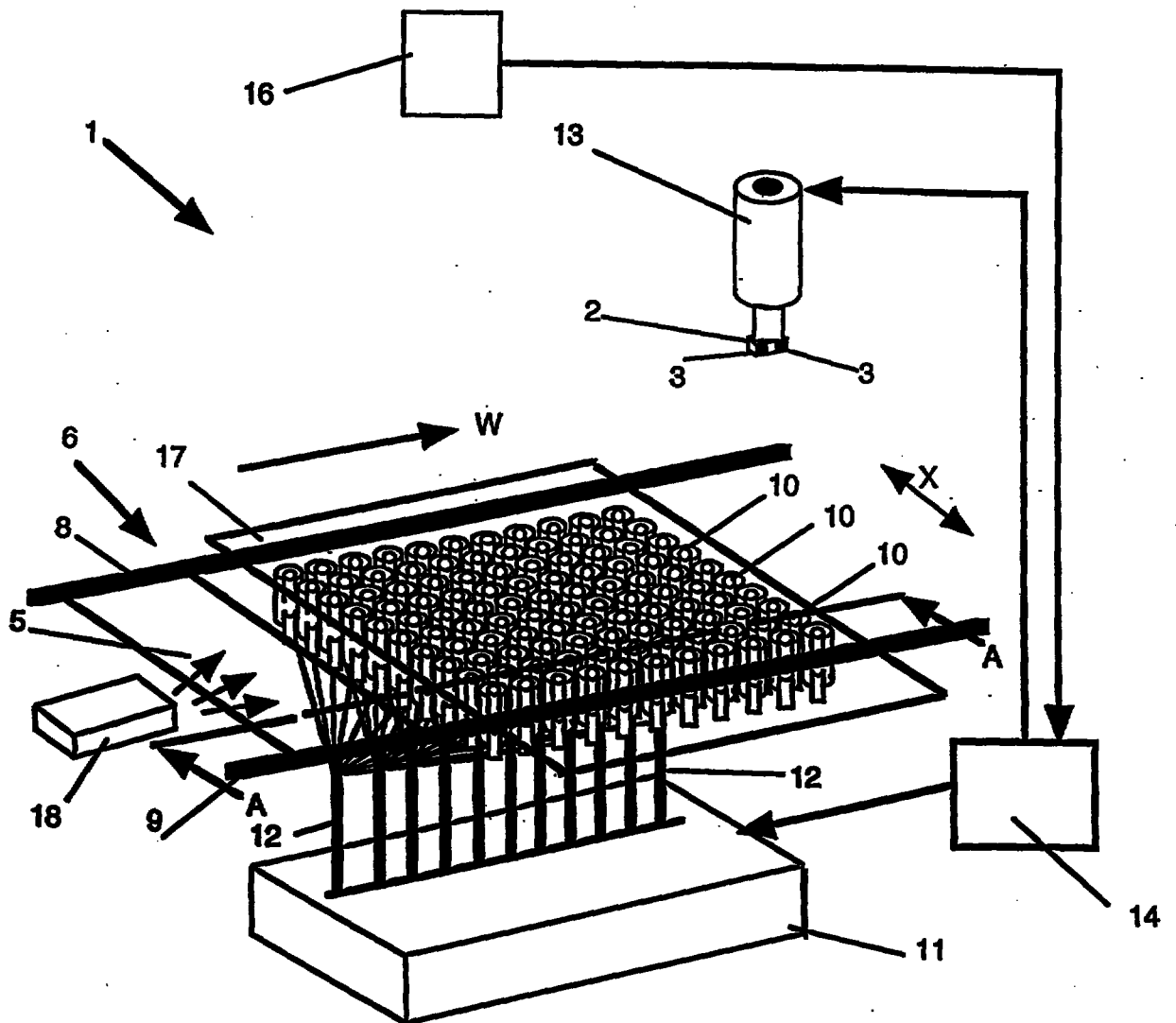


FIG. 1

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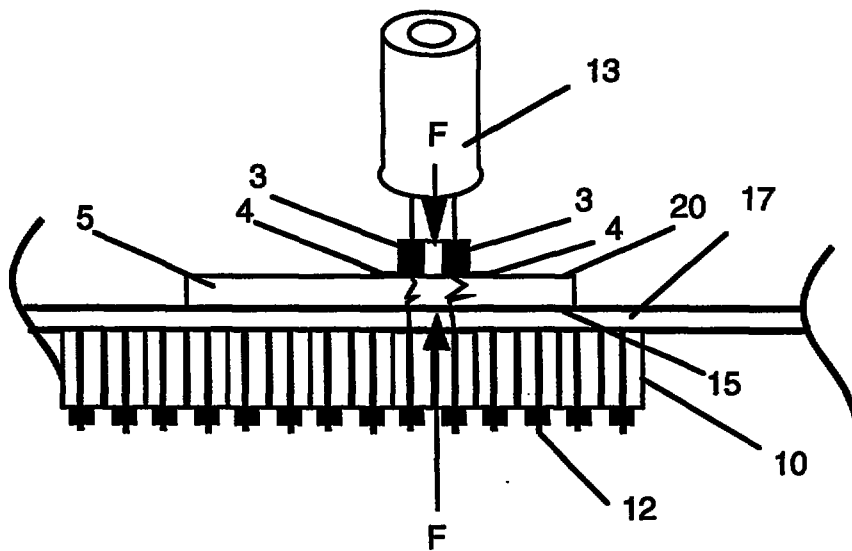


FIG. 2

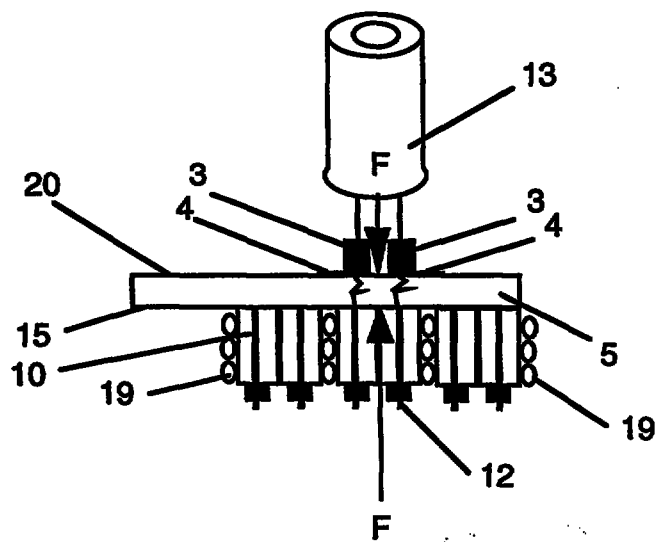


FIG. 3



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10. A method for mounting and bonding components onto contacts of a laser translucent or laser transparent substrate as claimed in claim 9, wherein said step of controlling is further characterised by aligning said contacts to said outlets.

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