CLAIMS

1. A bonding apparatus for flip-chip-bonding bumps ~~(3a)~~ of semiconductor devices ~~(3)~~, which have been adhered on a substrate ~~(1)~~ by a non-conductive adhesive ~~(2)~~, to terminal sections ~~(1a)~~ of the substrate ~~(1)~~ in a state where the semiconductor devices are clamped between an upper die and a lower die, the bonding apparatus comprising:

~~supporting means (4, 15) for supporting the substrate (1), on which the semiconductor devices (3) have been adhered; and~~

~~heating/pressing means (8, 24, 6, 17) for heating and pressing the substrate (1), the heating/pressing means (8, 24, 10, 25) having a built-in heat source (13) and a clamping face (10a, 28b), onto which the substrate (1) supported by the supporting means (4, 15) is pressed,~~

the upper die having a built-in heat source and a clamping face, the upper die being capable of heating and pressing the semiconductor devices onto the clamping face in a state where the substrate is supported by the lower die; and

the lower die having a substrate holding plate and a clamping face, the substrate on which the semiconductor devices have been adhered being mounted on the substrate holding plate, the substrate holding plate being floating-supported, by a plurality of supporting rods, in a state where the substrate holding plate is separated from the clamping face of the lower die so as to increase thermal resistance,

wherein the substrate ~~(1)~~, which is mounted on the substrate holding plate and floating-supported ~~by the supporting means (4, 15)~~, is moved toward the clamping face ~~(10a, 28b)~~ of

the ~~heating/pressing means(8, 24, 6, 17)~~ upper die, by a closing action of the upper die and the lower die, so as to preheat the substrate ~~(1)~~ and the semiconductor devices ~~(3)~~ by radiation heat, ~~and~~

~~the semiconductor devices (3) are pressed onto the clamping face (10a, 28b) of the heating/pressing means (8, 24, 10, 25), in the state where the substrate (1) is supported by the supporting means (4, 15), so as to cure the non-conductive adhesive (2) and bond the bumps (3a) of the semiconductor devices (3) to the terminal sections (1a) of the substrate (1).~~

the semiconductor devices, which are mounted on the substrate held by the substrate holding plate, are pressed onto the clamping face of the upper die by progression of the closing action,

a plurality of the supporting rods are retracted into the lower die and the substrate holding plate is moved until tightly contacting the clamping face of the lower die by completing of the closing action, and

the semiconductor devices, which are mounted on the substrate held by the substrate holding plate and which are clamped between the upper die and the lower die, are heated and pressed so as to cure the non-conductive adhesive and bond the bumps of the semiconductor devices to the terminal sections of the substrate.

~~2. The bonding apparatus according to claim 1,~~

~~further comprising a substrate holding plate (4, 15), the substrate holding plate (4, 15) being supported and separated from the clamping face (6a, 19a).~~

~~3. The bonding apparatus according to claim 2,~~

~~wherein the substrate holding plate (4, 15) has projected supporting sections (4b), whose planar size is smaller than that of the semiconductor devices (3).~~

~~4~~2. The bonding apparatus according to claim 1, wherein the ~~substrate holding plate (4, 15)~~ lower die has a sucking mechanism ~~(16)~~ capable of sucking and holding a surface of the substrate ~~(1), which is an opposite surface of a mounting surface on which the semiconductor devices (3) are mounted~~.

~~5~~3. The bonding apparatus according to ~~any one of claims 1-4~~ claim 1,

wherein ~~the heating/pressing means (8, 24) has a contact face, which contacts the substrate (1), and~~ a release film ~~(14)~~ is sucked and held on the ~~contact face~~ clamping face of the upper die.

~~6~~4. The bonding apparatus according to ~~any one of claims 1-5~~ claim 1,

wherein the substrate supported by the ~~supporting means~~ substrate holding plate is accommodated in a closed space ~~(K)~~, which is formed by ~~the heating/pressing means (8, 24, 6, 17)~~ the closing action, and

the substrate ~~(1)~~ and the semiconductor devices ~~(3)~~ are heated and pressed in a reduced-pressure atmosphere or a pressurized atmosphere produced in the closed space ~~(K)~~.

~~7~~5. The bonding apparatus according to ~~any one of claims 1-6~~ claim 1,

wherein ~~the heating/pressing means is a first die (8) having the built-in heat source (13),~~

~~the supporting means is a second die (6), which floating-supports the substrate holding plate (4), and~~

the semiconductor devices ~~(3)~~, which are mounted on the substrate ~~(1)~~ held by the substrate holding plate ~~(4)~~, are heated and pressed, in a state where the semiconductor devices ~~(3)~~ are pressed onto ~~a clamping face (10a) of the first die (8) and the substrate holding plate (4) is clamped by the clamping face (6a) of the second die (6), by closing the first and second dies (6, 8) until stopper blocks (30, 31) contact each other~~ the clamping face of the upper die and the substrate holding plate is clamped by the clamping face of the lower die, by performing the closing action until stopper blocks, which are respectively formed in facing surfaces of the upper die and the lower die, contact each other.

~~8. A bonding method for flip-chip-bonding semiconductor devices (3), which have been adhered to terminal sections (1a) of a substrate (1) by a non-conductive adhesive (2), to the substrate (1), the bonding method comprising:~~

~~a supporting step, in which the substrate (1), on which the semiconductor devices (3) have been adhered, is supported, at a position separated from a clamping face (6a, 19a), by supporting means (4, 15);~~

~~a preheating step, in which the substrate (1), which has been supported by the supporting means (4, 15), is moved toward~~

the clamping face (10a, 28b) of the heating/pressing means (8, 24), which has a built-in heat source (13), so as to preheat the substrate (1) and the semiconductor devices (3), until reaching a prescribed temperature, by radiation heat; and

a bonding step, in which bumps (3a) of the semiconductor devices (3) are heated until reaching a melting point, in a state where the semiconductor devices (3) are pressed on the clamping face (10a, 28b) of the heating/pressing means (8, 24), so as to cure the non-conductive adhesive (2) and bond the bumps (3a) to the terminal sections (1a) of the substrate (1).

9. The method according to claim 8,

further comprising:

a step of accommodating the substrate (1), which is supported by the supporting means (4, 15), in a closed space (K), which is formed by the heating/pressing means (8, 24, 6, 17); and

a step of producing a reduced-pressure atmosphere in the closed space (K) by discharging air from the closed space (K), or producing a pressurized atmosphere in the closed space (K) by introducing compressed air into the closed space (K),

wherein the accommodating step and the producing step are performed before the preheating step.

10. A bonding apparatus for bonding laminated members of a work (W), which are laminated with an adhesive layer (104), the bonding apparatus comprising:

an upper die (111); and

a lower die (112) for clamping the work (W) with the upper die (111),

~~wherein the upper die (111) includes a first heating/pressing section (116) for heating and pressing the work (W), and~~

~~wherein the lower die (112) includes: a second heating/pressing section (117) for heating and pressing the work (W), the second heating/pressing section (117) being moved upward and downward; and a supporting section (124,141) being relatively retracted into a clamping face (117a) of the second heating/pressing section (117) by relatively moving the second heating/pressing section (117) upward, the supporting section (124,141) being relatively projected from the clamping face (17a) of the second heating/pressing section (117) by relatively moving the second heating/pressing section (117) downward.~~

~~11. The bonding apparatus according to claim 10,~~

~~wherein the supporting section (141) can be moved upward and downward, and~~

~~a movable range of the supporting section (141) is smaller than that of the second heating/pressing section (117).~~

~~12. The bonding apparatus according to claim 10 or 11,~~

~~wherein the upper die (111) includes a movable spacer section (144), which is provided under the first heating/pressing section (116) and which can be moved upward and downward, and~~

~~the movable spacer section (144) has a cooling function, the cooling function is suspended in a state where the movable spacer section (144) contacts the first heating/pressing section (116), the work (W) supported by the supporting section (141) is~~

~~cooled in a state where the movable spacer section (144) is separated from the first heating/pressing section (116).~~

~~13. The bonding apparatus according to any one of claims 10-12,~~

~~wherein the lower die (112) includes a plate (129) for supporting the work (W), the plate (129) being provided above the supporting section (124,141).~~

~~14. The bonding apparatus according to any one of claims 10-13,~~

~~wherein the lower die (112) includes: an inner wall face (133a) being formed along an outer face of the second heating/pressing section (117); and~~

~~a heating section (138) for heating the inner wall face (133a).~~

~~15. The bonding apparatus according to any one of claims 10-14,~~

~~wherein the upper die (111) includes a first box section (136), whose lower die side is opened,~~

~~the lower die (112) includes a second box section (137), whose upper die side is opened,~~

~~the first heating/pressing section (116) is accommodated in the first box section (136),~~

~~the second heating/pressing section (117) and the supporting section (124) are accommodated in the second box section (137), and~~

~~edges of the first box section (136) contact edges of the~~

second box section (137) so as to form a closed space (131), and at least one of a compressor (141) and a decompressor is connected to the closed space (131).

16. A bonding method for bonding laminated members of a work (W), which are laminated with an adhesive layer (104), by clamping the work (W) between an upper die (111), which includes a first heating/pressing section (116), and a lower die (112), which includes a second heating/pressing section (117) being moved upward and downward and a supporting section (124,141) being extended upward and downward, the bonding method comprising the steps of:

(a) supporting the work (W) by the supporting section (124,141), which is projected from a clamping face of the second heating/pressing section (117);

(b) transferring the work (W) from the supporting section (124,141) to the clamping face (117a) of the second heating/pressing section (117) by moving the second heating/pressing section (117) upward and/or moving the supporting section (124,141) downward to relatively retract the projected supporting section (124,141) into the clamping face (117a) of the second heating/pressing section (117);

(c) pressing the work (W) onto a clamping face of the first heating/pressing section (116) by further moving the second heating/pressing section (117) upward; and

(d) heating and pressing the clamped work (W) by the first heating/pressing section (116) and the heating/pressing section (117).

~~17. The method according to claim 16,~~

~~wherein the supporting section (124,141) is upwardly moved, together with the second heating/pressing section (117), until immediately before the work (W) contacts the first heating/pressing section (116), in the step (b).~~

~~18. The method according to claim 16 or 17,~~

~~wherein the upper die (111) further includes a movable spacer section (144), which is provided under the first heating/pressing section (116) and moved upward and downward and which has a function of cooling the work (W), and~~

~~further comprising the steps of:~~

~~(e) transferring the work (W) from the second heating/pressing section (117) to the supporting section (141) by moving the second heating/pressing section (117) downward and projecting the evacuated supporting section (141) and separating the work (W) from the first heating/pressing section (116) by moving the movable spacer section (144), which contacts the work (W), downward, after performing the step (d); and~~

~~(f) cooling the work (W), which contacts the movable spacer section (144) and is supported by the supporting section (141), by the cooling function of the movable spacer section (144), after performing the step (e).~~

~~19. The method according to claim 18,~~

~~further comprising the step of:~~

~~(g) separating the movable spacer section (144) from the cooled work (W) by moving the movable spacer section (144) upward, suspending the cooling function of the movable spacer~~

~~section (144), and then pressing the movable spacer section (144) onto the first heating/pressing section (116) with heating the movable spacer section (144) by a heating function of the movable spacer section (144), after performing the step (f).~~

6. The bonding apparatus according to claim 1, wherein a cooler is provided to at least one of a part of the upper die, which corresponds to the semiconductor devices, and a part of the lower die, which corresponds to the terminal sections of the substrate.

7. The bonding apparatus according to claim 1, wherein the plurality of the supporting rods are provided to the lower die and located at positions which do not correspond to the positions immediately under the semiconductor devices.

8. The bonding apparatus according to claim 1, wherein the substrate holding plate is floating-supported by the supporting rods, which are biased by a coil spring provided in the lower die, in a state where upper ends of the supporting rods are projected and separated from the clamping face of the lower die.