

CLAIMS:

1. A wire bonding apparatus comprising:
an ultrasonic transducer including a capillary;
5 a flexible connecting frame having a first side to which the ultrasonic transducer is connected;
at least one electrically-driven actuator which is connected to a second side of the flexible connecting frame that is opposite to the first side thereof, the actuator having a longitudinal actuation direction; and
10 an elongated slit located in the flexible connecting frame which extends substantially transversely to the actuation direction of the at least one actuator from a top surface to a bottom surface of the flexible connecting frame and extending along a width of the flexible connecting frame between the first and second sides of the flexible connecting frame, a portion of the flexible connecting
15 frame not including the elongated slit being configured to form at least one pivot point adjacent to an end of the slit about which the flexible connecting frame is rotatable when it is driven by the at least one actuator.
2. The wire bonding apparatus as claimed in claim 1, wherein the ultrasonic
20 transducer is detachably mounted to the first side of the flexible connecting frame via screws that are inserted into the first side of the flexible connecting frame.
3. The wire bonding apparatus as claimed in claim 1 or claim 2, wherein the flexible connecting frame comprises at least two pivot points, each of which is
25 located adjacent to an end of the elongated slit.
4. The wire bonding apparatus as claimed in any one of the preceding claims, wherein a transducer portion of the wire bonding apparatus comprising the ultrasonic transducer and the flexible connecting frame is configured to be
30 detachably mounted to an oscillator portion of the wire bonding apparatus comprising the at least one actuator.

5. The wire bonding apparatus as claimed in claim 4, wherein the transducer portion includes a front base portion having through-holes for receiving the at least one actuator when mounting the oscillator portion to the transducer portion, and the oscillator portion has a rear base portion for attaching it to the front base portion.

6. The wire bonding apparatus as claimed in any one of the preceding claims, further comprising a base portion to which an end of the actuator that is opposite to the end of the actuator connected to the second side of the flexible connecting frame is connected, the base portion having a higher rigidity than the flexible connecting frame such that the flexible connecting frame is rotatable relative to the base portion.

7. The wire bonding apparatus as claimed in claim 6, further comprising at least one preload screw that is inserted into the flexible connecting frame to provide a preload force to the at least one actuator for securely clamping the actuator towards the base portion.

8. The wire bonding apparatus as claimed in claim 6 or claim 7, further comprising a first flexible support connecting the actuator to the flexible connecting frame and a second flexible support connecting the actuator to the base portion, the first and second flexible supports being configured to allow the actuator to be rotatable relative to the base portion.

9. The wire bonding apparatus as claimed in claim 8, further comprising a preload screw that is operative to push the second flexible support towards the actuator to securely clamp the actuator.

10. The wire bonding apparatus as claimed in any one of claims 6 to 9, further comprising a flexible central beam extending parallel to the actuation direction of the at least one actuator, the central beam being configured to connect the flexible connecting frame to the base portion.

11. The wire bonding apparatus as claimed in claim 10, wherein the at least one actuator comprises a first actuator and a second actuator, the first and second actuators being located on opposite sides of the central beam.

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12. The wire bonding apparatus as claimed in claim 10 or claim 11, wherein the central beam further comprises a narrowed portion which is formed by a cut-out made on the central beam at an end of the central beam connected to the flexible connecting frame to form a pivot for oscillating motion of the flexible connecting frame that is transverse to the actuation direction of the actuator.

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13. The wire bonding apparatus as claimed in any one of the preceding claims, further comprising peripheral slits extending from opposite edges of the flexible connecting frame in the direction of the elongated slit so to form pivot points between opposite ends of the elongated slit and corresponding ends of the peripheral slits.

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14. A wire bonding apparatus comprising:

an ultrasonic transducer including a capillary;

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a flexible connecting frame having a first side to which the ultrasonic transducer is connected;

at least one electrically-driven actuator which is connected to a second side of the flexible connecting frame that is opposite to the first side thereof, the actuator having a longitudinal actuation direction;

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an elongated slit located in the flexible connecting frame which extends transversely to the actuation direction of the at least one actuator to form at least one pivot point adjacent to an end of the slit about which the flexible connecting frame is rotatable when it is driven by the at least one actuator;

a base portion to which an end of the actuator that is opposite to the end of the actuator connected to the second side of the flexible connecting frame is connected, the base portion having a higher rigidity than the flexible connecting

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frame such that the flexible connecting frame is rotatable relative to the base portion;

a flexible central beam extending parallel to the actuation direction of the at least one actuator, the central beam being configured to connect the flexible connecting frame to the base portion; and

an additional slit located on the central beam which is connected to a point on the elongated slit, wherein the additional slit is parallel to the actuation direction of the at least one actuator.

15. The wire bonding apparatus as claimed in claim 14, wherein the additional slit separates the central beam into two opposing beams that are further connected to an unseparated flexible beam base on the central beam, such that the flexible beams are operative to rotate when the at least one actuator is driven to oscillate.

16. A wire bonding apparatus comprising;

an ultrasonic transducer including a capillary;

a flexible connecting frame having a first side to which the ultrasonic transducer is connected;

at least one electrically-driven actuator which is connected to a second side of the flexible connecting frame that is opposite to the first side thereof, the actuator having a longitudinal actuation direction;

an elongated slit located in the flexible connecting frame which extends transversely to the actuation direction of the at least one actuator to form at least one pivot point adjacent to an end of the slit about which the flexible connecting frame is rotatable when it is driven by the at least one actuator;

a base portion to which an end of the actuator that is opposite to the end of the actuator connected to the second side of the flexible connecting frame is connected, the base portion having a higher rigidity than the flexible connecting frame such that the flexible connecting frame is rotatable relative to the base portion; and

at least one preload screw that is inserted into the base portion to provide a preload force to the at least one actuator for securely clamping the actuator towards the flexible connecting frame.

- 5 17. The wire bonding apparatus as claimed in claim 16, wherein the preload screw has a non-circular head and is inserted into a blind hole in the base portion, and wherein the blind hole is filled with a filling compound which is hardened to restrict rotation of the head of the preload screw that is embedded in the filling compound.

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18. A wire bonding apparatus comprising:
an ultrasonic transducer including a capillary;
a flexible connecting frame having a first side to which the ultrasonic
15 transducer is connected;

at least one electrically-driven actuator which is connected to a second side of the flexible connecting frame that is opposite to the first side thereof, the actuator having a longitudinal actuation direction;

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an elongated slit located in the flexible connecting frame which extends transversely to the actuation direction of the at least one actuator to form at least one pivot point adjacent to an end of the slit about which the flexible connecting frame is rotatable when it is driven by the at least one actuator;

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a base portion to which an end of the actuator that is opposite to the end of the actuator connected to the second side of the flexible connecting frame is connected, the base portion having a higher rigidity than the flexible connecting frame such that the flexible connecting frame is rotatable relative to the base portion; and

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a first flexible support connecting the actuator to the flexible connecting frame and a second flexible support connecting the actuator to the base portion, the first and second flexible supports being configured to allow the actuator to be rotatable relative to the base portion;

wherein the first flexible support comprises a pivotal axis located on a beam connecting a support base adjacent to the flexible connecting frame and an actuator support adjacent to one end of the actuator.

- 5 19. The wire bonding apparatus as claimed in claim 18, wherein the second flexible support comprises a second pivotal axis located on a second beam connecting a second actuator support adjacent to an end of the actuator that is opposite to the end of the actuator adjacent to the first flexible support, and a second support base adjacent to the base portion.

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20. The wire bonding apparatus as claimed in claim 19, wherein the second support base further comprises a front flexible portion connected to the second beam, a rear flexible portion connected to the base portion, and a slit located between the front and rear flexible portions, the second support base having a
15 contact surface for the application of a preload force to clamp the second flexible support and the actuator.