each other by a slit (bottleneck) 43. The slit 43 is located on a side opposite the vertex 421. The horn 16 is formed mirror-symmetrical with respect to a symmetry plane 160 that bisects the first through hole 41 and the second through hole 42. The symmetry plane 160 includes the center of the first through hole 41 and the vertex 421 of the second through hole 42.

[0028] Similarly, the clamper 17 is formed mirror-symmetrical with respect to a symmetry plane 170 of the clamper 17 that is equidistant from each of gripping surfaces of the pair of arms 17L and 17R gripping the wire 2. However, the clamper 17 is not limited to be mirror-symmetrical with respect to the symmetry plane 170, and arrangement of members such as a tightening screw may be different between the pair of arms 17L and 17R.

[0029] Subsequently, an alignment method according to the present invention is described with reference to FIG. 4 to FIG. 6. FIG. 4 is a flowchart showing an example of an alignment method according to the present invention. FIG. 5 is a plan view of the clamper 17 shown in FIG. 2 as viewed from above in the vertical direction. FIG. 6 is a front view of the horn 16 and the clamper 17 shown in FIG. 2 as viewed from a tip side. In an alignment method according to the present invention, first, a mirror surface 200 is disposed to be parallel to the bonding stage 20 (step S1). The mirror surface 200 is not limited to a plane mirror shown in FIG. 6, and may be a plating film processed on the bonding stage 20 or the like. Examples of the mirror surface 200 include those having a function of a mirror surface.

[0030] Subsequently, as shown in FIG. 5, when the mirror surface 200 is viewed through the second through hole 42, a mirror image 420 of the second through hole 42 reflected on the mirror surface 200 is aligned with the center of the second through hole 42 (step S2). To align the mirror image 420, for example, a viewpoint 400 (shown in FIG. 6) may be moved to a position where the mirror image 420 is seen in the center of the second through hole 42. The terms “view” and “see” are not limited to visual observation and include capturing an object within an imaging range of a camera.

[0031] As shown in FIG. 6, in the alignment method according to the present invention, the

clamper 17 is aligned based on positions of the mirror image 420 and the horn 16 (step S3). To align the clamper 17, for example, the clamper 17 may be moved so that the symmetry plane 170 of the clamper 17 overlaps the symmetry plane 160 of the horn 16 when viewed from the viewpoint 400.

[0032] The procedure of the alignment method described so far may be automatically performed by the control part 10 or may be manually performed by an operator. In the case where the control part 10 performs the aforesaid procedure, the bonding apparatus 1 may further include an actuator that moves the clamper 17.

[0033] According to the alignment method of each embodiment of the present invention, as shown in FIG. 6, in a direction perpendicular to the bonding stage 20, the mirror image 420 of the second through hole 42 reflected on the mirror surface 200, the second through hole 42, and the viewpoint 400 viewing the foregoing are arranged in a row. Since the symmetry plane 170 of the clamper 17 is moved so as to overlap the symmetry plane 160 of the horn 16 while maintaining this positional relationship, the horn 16 and the clamper 17 can be accurately aligned with each other. Since the second through hole 42 has a teardrop shape, the horn 16 and the clamper 17 can be relatively accurately aligned with each other with the vertex 421 as a mark.

[0034] The embodiments described above are for facilitating the understanding of the present invention rather than for limiting the interpretation of the present invention. Each element included in the embodiments and its arrangement, material, condition, shape, size, and the like are not limited to those illustrated and can be appropriately changed. It is possible to partially replace or combine the configurations shown in different embodiments.

Description of Reference Numerals

[0035] 1: bonding apparatus; 2: wire; 10: control part; 11: base; 12: XY table; 13: bonding head; 14: torch electrode; 15: capillary (an example of bonding tool); 16: horn; 17: clamper; 17L, 17R: arm; 18: wire tensioner; 19: rotary spool; 20: bonding stage; 21: heater; 22: ultrasonic