

DEVICE FOR ARRANGING CONDUCTIVE BALLS

BACKGROUND

5 1. Technical Field

 The present invention relates to an improvement of a device for arranging conductive balls and, more particularly, to an improvement of a device for arranging conductive balls in a predetermined pattern in an apparatus for mounting
10 conductive balls on a substrate.

2. Description of the Related Art

 An apparatus for mounting conductive balls, such as that disclosed in Japanese Patent No. 4487142, was present in the
15 past. This type of apparatus for mounting conductive balls is configured to suck and support conductive balls using a plurality of suction holes formed in a suction head in a predetermined pattern and then mount the conductive balls on a substrate.

20 In this type of apparatus for mounting conductive balls, the suction head moves to a ball feeding part in which a plurality of conductive balls has been accommodated in a random state, and sucks and supports the conductive balls in its suction holes.

25 In such a means for sucking conductive balls, cases may

occur where conductive balls are not supported in some of the suction holes of a suction head. In this state, when the operation of mounting the conductive balls on a substrate is performed, a problem arises in that portions on which
5 conductive balls have not been mounted occur on the substrate, which is a workpiece obtained after the operation of mounting conductive balls.

Therefore, as a means for solving the above problem, there was proposed an apparatus for mounting conductive balls,
10 which is configured to move a ball cup (i.e., a ball feeding head), accommodating a plurality of conductive balls and having an open bottom, along the top surface of an arrangement jig in which support holes for supporting conductive balls have been formed in a predetermined arrangement pattern and
15 then put the conductive balls into the support holes of the arrangement jig in the predetermined arrangement pattern, and which is also configured to support the arranged conductive balls using a suction head and then mount the conductive balls on a substrate.

20 Furthermore, as an improvement to the above apparatus for mounting conductive balls, an apparatus for mounting conductive balls is disclosed in U.S. Patent No. 6,766,938 B2. In this apparatus for mounting conductive balls, an arrangement device configured to arrange conductive balls in a
25 predetermined pattern in such a way as to move a ball sweeper

(i.e., a ball cup) along the top surface of a tilted template (i.e., an arrangement jig) and then put conductive balls into the apertures (support holes) of the template is employed, and the conductive balls arranged by the arrangement device are
5 supported by a pick-up head (i.e., a suction head) and then mounted on a substrate.

SUMMARY

10 In an arrangement device using an arrangement jig, in which support holes for supporting conductive balls have been formed, and a ball cup (the ball sweeper in U.S. Patent No. 6,766,938 B2), it is necessary to change conductive balls accommodated in the ball cup when conductive balls having a
15 diameter different from that of the previously accommodated conductive balls are subsequently handled. In order to change the conductive balls, the previous conductive balls accommodated in the ball cup should be discharged or collected. However, the arrangement device described in U.S.
20 Patent No. 6,766,938 B2 does not disclose a means for discharging or collecting conductive balls.

In general, in this type of arrangement device, the discharge or collection of conductive balls is performed in such a way that an operator personally sucks conductive balls
25 using a suction tool whenever the type of conductive balls is

changed. This work is very inconvenient, and may become a cause of defective mounting because previous and new types of conductive balls having different diameters coexist when there are omissions in the work.

5 An object of the present invention is to ensure the reliable discharge or collection of conductive balls without requiring inconvenient work accompanying the discharge or collection of conductive balls, thereby preventing the defective mounting of conductive balls on a substrate.

10 In order to achieve the above object, a first invention provides a device for arranging conductive balls, including the following features:

First, an arrangement jig configured such that support holes for supporting conductive balls are formed in a predetermined arrangement pattern therein, a ball feeding head configured to feed a group of balls, including a plurality of conductive balls, into the support holes formed in a desired area within the top surface of the arrangement jig, and a transfer means configured to move the ball feeding head
15 relative to the arrangement jig along the top surface of the arrangement jig are included.
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Second, the conductive balls are put into and arranged in the support holes by performing an operation of moving the group of balls along the top surface of the arrangement jig;

25 Third, discharge holes passing through the arrangement

jig are formed at a location outside an area, across which the group of balls passes during the operation of moving the group of balls along the top surface of the arrangement jig, within the top surface of the arrangement jig.

5 Fourth, the group of balls is moved to the location at which the discharge holes have been formed when the group of balls is discharged from the ball feeding head to a location outside the top surface of the arrangement jig.

A second invention provides a device for arranging
10 conductive balls, including the following features in the device of the first invention:

First, a tilting means configured to tilt the arrangement jig is mounted on the arrangement jig.

Second, the ball feeding head is formed of a ball cup
15 that has an open bottom and accommodates a plurality of conductive balls along with the arrangement jig.

Third, the operation of moving the group of balls along the top surface of the arrangement jig is performed such that the conductive balls are put into the support holes of the arrangement jig by moving the ball cup, accommodating the
20 plurality of conductive balls, from one end of the top surface of the arrangement jig from the other end thereof in such a way as to tilt the arrangement jig so that one end of the arrangement jig is located at a higher location than the other
25 end thereof using the tilting means configured to tilt the

arrangement jig.

Fourth, the discharge holes are formed at a location outside an area, across which the opening of the ball cup passes during the operation of moving the group of balls along the top surface of the arrangement jig, within the top surface of the arrangement jig.

Fifth, when the plurality of conductive balls accommodated in the ball cup is discharged, the ball cup is moved up to a location, at which the opening of the ball cup communicates with the discharge holes, by tilting the arrangement jig.

A third invention provides a device for arranging conductive balls, including the following features in the device of the first or second invention:

A conductive ball collection means is installed on the arrangement jig, and accommodates the conductive balls discharged through the discharge holes.

The first invention is advantageous in that inconvenient work accompanying the discharge of conductive balls, such as the work in which an operator sucks conductive balls using a suction tool whenever the type of conductive balls is changed, is not required because the discharge holes passing through the arrangement jig are formed at a location outside an area across which a group of balls passes when the operation of putting conductive balls into the support holes is performed

along the top surface of the arrangement jig, so that, when the group of balls is discharged from the ball feeding head to a location outside the top surface of the arrangement jig, the group of balls is moved to the location at which the discharge
5 holes have been formed, and thus are automatically discharged using their own weight. Furthermore, the first invention has the advantage of preventing defective mounting in which erroneous conductive balls are mounted on a substrate because there are no omissions in the discharge of conductive balls
10 and thus there is no situation in which previous and new types of conductive balls having different diameters coexist.

The second invention has advantages identical to those of the first invention, and is also advantageous in that conductive balls can be more reliably and easily discharged
15 because the tilting means configured to tilt the arrangement jig is installed on the arrangement jig, so that, when a plurality of conductive balls accommodated in the ball cup is discharged, the ball cup can be moved to a location at which the opening of the ball cup communicates with the discharge
20 holes by tilting the arrangement jig and then the conductive balls can be discharged.

The third invention is advantageous in that conductive balls can be simply and reliably collected because the conductive ball collection means is installed on the
25 arrangement jig, so that conductive balls discharged through

the discharge holes can be accommodated in the conductive ball collection means.

BRIEF DESCRIPTION OF THE DRAWINGS

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The above and other objects, features and advantages of the present invention will be more clearly understood from the following detailed description taken in conjunction with the accompanying drawings, in which:

10 FIG. 1 is a diagram schematically illustrating an apparatus for mounting solder balls according to a first embodiment;

FIG. 2 is a plan view illustrating an arrangement device in the apparatus for mounting solder balls;

15 FIG. 3 is a diagram illustrating an arrangement state in the arrangement area of the arrangement device;

FIG. 4 is a diagram illustrating the forward operation of the arrangement device in a reciprocating arrangement method, in which FIG. 4(A) illustrates an arrangement operation and
20 FIG. 4(B) illustrates the suction operation of a suction head immediately after the arrangement operation;

FIG. 5 is a diagram illustrating the return operation of the arrangement device in the reciprocating arrangement method, in which FIG. 5(A) illustrates an arrangement
25 operation and FIG. 5(B) illustrates the suction operation of

the suction head immediately after the arrangement operation;

FIG. 6 is a plan view of the arrangement device illustrating the location of a ball cup upon discharge and collection;

5 FIG. 7 is a diagram illustrating a discharge and collection state, in which FIG. 7(A) illustrates the state of being tilted to the left and FIG. 7(B) illustrates the state of being tilted to the right;

FIG. 8 is a diagram illustrating a second embodiment in
10 which an arrangement jig is a mask having no tilting means, in which FIG. 8(A) is a plan view of the second embodiment, FIG. 8(B) is a side view of the second embodiment, and FIG. 8(C) is an enlarged view illustrating a discharge and collection operation; and

15 FIG. 9 is a diagram illustrating a third embodiment in which a ball cup is configured to feed solder balls by selectively sucking and dropping the solder balls using a ball suction part installed inside the ball cup, in which FIG. 9(A) is a plan view of the third embodiment, FIG. 9(B) is a side
20 view of the third embodiment, and FIG. 9(C) is an enlarged view illustrating a discharge and collection operation.

DETAILED DESCRIPTION

25 The first and other embodiments of the present invention

will be described below with reference to the accompanying drawings. FIG. 1 is a diagram schematically illustrating an apparatus for mounting solder balls. The apparatus for mounting solder balls includes a suction head 1 configured to
5 suck and support solder balls B, i.e., conductive balls, and then mount the solder balls B on a substrate A, an arrangement device 2 configured to arrange the solder balls B at a location corresponding to the suction holes of the suction head 1, a substrate stage 3 configured to allow the suction
10 head 1 to mount the solder balls B on the substrate A placed thereon, and a ball feeding device 4 configured to feed the solder balls B into the ball cup 7 of the arrangement device 2.

The suction head 1 can be moved by a transfer device (not
15 illustrated) among the standby location of the suction head 1 indicated by dotted lines above the arrangement device 2 in FIG. 1, the unloading location of the suction head 1 indicated by solid lines above the arrangement device 2 in the same drawing, and the mounting location of the suction head 1
20 indicated by dotted lines above the substrate stage 3 in the same diagram.

FIG. 2 is a plan view illustrating the arrangement device 2 in the apparatus for mounting solder balls. As illustrated in FIG. 2 as well as FIG. 1, the arrangement device 2 includes
25 an arrangement jig 5 configured such that support holes for

supporting the conductive balls B are formed in a predetermined arrangement pattern therein, a tilting means 6 configured to tilt the arrangement jig 5, a ball cup 7 configured to have an open bottom and accommodate a plurality of solder balls B along with the arrangement jig 5, a transfer device 8 configured to move the ball cup 7 along the top surface of the arrangement jig 5, and ball collection boxes 9. Meanwhile, in the present invention, although it is desirable to move the ball cup 7 and the arrangement jig 5 relative to each other, only the ball cup 7 is moved along the top surface of the arrangement jig 5 in the first embodiment.

The arrangement jig 5 includes an arrangement plate 51 and a seesaw stage 52. Although the arrangement jig 5 may basically include only the arrangement plate 51, the seesaw stage 52 constitutes part of the arrangement jig 5 in the first embodiment because discharge holes 53 are configured to pass through the seesaw stage 52, as illustrated in FIG. 1.

The arrangement plate 51 is a rigid plate having a specific thickness. An arrangement area 55 is formed in the center part of the arrangement plate 51, and discharge portions each including a plurality of discharge holes 53 is formed in columns along both side ends of the arrangement plate 51 that are located outside the arrangement area 55.

In FIG. 2, a rectangular portion surrounded by dotted lines indicated in the center part of arrangement plate 51

forms the arrangement area 55. In the arrangement area 55, support holes 54 for supporting the solder balls B are formed in a predetermined arrangement pattern. The arrangement pattern of the arrangement area 55 is the same as that of the suction holes (not illustrated) of the suction head 1.

As illustrated in FIG. 3, the support holes 54 are holes each have a size that allows each of the solder balls B to be accommodated in each of the support holes 54, and are formed in accordance with the size of the solder balls B and the arrangement of the suction holes of the suction head 1.

The arrangement area 55 is an area where the solder balls B are arranged in a predetermined arrangement pattern. The support holes 54 in the arrangement area 55 are downwardly sucked by a vacuum source, as indicated by the arrows in FIG. 3. Accordingly, the solder balls B can be easily put into and securely supported in the support holes 54.

The discharge holes 53 are through holes that pass through the arrangement plate 51, more precisely through holes that pass through the arrangement plate 51 and the seesaw stage 52. In the first embodiment, the discharge holes 53 are formed in columns in each of which a plurality of small holes through which the solder balls B can pass is arranged at intervals, and form the discharge portions that discharge the solder balls B. Since the discharge holes 53 are small holes, they can be formed at a lower cost than longitudinal holes

even when the arrangement plate 51 and the seesaw stage 52 are rigid plates. Furthermore, since the discharge holes 53 are formed in columns in each of which a plurality of small holes is arranged at intervals, they can ensure higher rigidity than
5 continuous slits. The locations at which the discharge holes 53 are formed are locations outside the arrangement area 55, more precisely locations outside an area across which the opening of the bottom of the ball cup 7 passes in order to perform the operation of putting solder balls into the support
10 holes 54 of the arrangement area 55, that is to say locations outside an area across which a group of balls passes during the operation of putting balls into the support holes 54.

Although the columns of the discharge holes 53 are formed along both side ends of the arrangement plate 51 in the first
15 embodiment, the columns of the discharge holes 53 should not necessarily be formed along both side ends of the arrangement plate 51, but the column of the discharge holes 53 may be formed along a single side end of the arrangement plate 51. Furthermore, although the columns of the discharge hole 53
20 formed in the arrangement plate 51 are illustrated as being formed along the both sides ends, respectively, in the diagrams of the first embodiment, two or more columns may be formed in each of the both side ends. Furthermore, although the columns of the discharge hole 53 are illustrated as being
25 formed to have a length corresponding to the overall length of

the opening of the ball cup 7, the columns are not necessarily formed to have the length corresponding to the overall length of the opening.

The arrangement plate 51 needs to be changed in response
5 to a change in the size of the solder balls B being used, a change in the arrangement of the suction holes of the suction head 1, or the like. Accordingly, the arrangement plate 51 is mounted on the seesaw stage 52 so that the arrangement plate 51 can be selectively mounted and dismounted by an arrangement
10 plate fastener 50. Meanwhile, in the first embodiment, the arrangement plate 51 and the seesaw stage 52 constitute the arrangement jig of the present invention. The arrangement plate 51 and the seesaw plate 52 perform seesaw movement in an integrated manner.

15 The seesaw stage 52 is formed of a rigid plate in order to seesaw the arrangement plate 51. Through holes that constitute part of the discharge holes 53 are formed in the seesaw stage 52 at locations corresponding to those of the arrangement plate 51. The ball collection boxes 9, i.e.,
20 means for collecting the solder balls B, are disposed under the seesaw stage 52 at locations corresponding to the discharge holes 53. The ball collection boxes 9 are detachably mounted directly on the seesaw stage 52. When the size of the seesaw stage 52 is smaller than that of the seesaw
25 stage 52 of the first embodiment and the columns of the

discharge holes 53 are formed only through the arrangement plate 51, the ball collection boxes 9 are detachably mounted under the arrangement plate 51 at locations corresponding to those of the columns of the discharge holes 53.

5 Although the ball collection boxes 9 are mounted directly on the arrangement jig 5 in the first embodiment, one or more ball collection boxes 9 cannot be directly attached when an arrangement jig 5 is thin like an arrangement mask 56 illustrated in FIG. 8 or 9, in which case the one or more ball
10 collection boxes 9 need to be spaced apart from the arrangement jig 5 and then supported. In such a case, when continuous cutaway portions and longitudinal slits are used as the discharge portions, a problem arises in that the ball collection boxes 9 should be designed to have an excessively
15 deep depth in order to prevent balls from jumping to the outside due to bounces of the balls, thus resulting in an increase in the size of the apparatus. In contrast, according to the embodiments, the discharge holes 53 constituting the discharge portions present above the ball collection boxes 9
20 are small holes, and thus even the ball collection boxes 9 having a shallow depth are sufficient to collect balls.

A tilting means 6 for tilting the arrangement plate 51 and the seesaw stage 52 includes a seesaw base 62 configured to perform seesaw movement using the rotation shaft 63 of a
25 stationary base 60 as a pivot, and a seesaw movement motor 61

configured to seesaw the seesaw base 62.

The seesaw stage 52 is fastened to the seesaw base 62, and the arrangement plate 51 is fastened to the seesaw stage 52 by the arrangement plate fastener 50, although the
5 arrangement plate 51 may be detached from the seesaw stage 52 when necessary. Accordingly, the seesaw stage 52 and the arrangement plate 51 fastened onto the top surface of the seesaw base 62 are tilted selectively to the left and to the right by rotating the seesaw base 62 rotatably mounted on the
10 rotation shaft 63 of the stationary base 60 through the operation of the seesaw movement motor 61, thereby tilting the seesaw base 62 selectively to the left and to the right. A tilted angle, i.e., a seesaw angle, is a total of 60°, i.e., the sum of 30° above a reference horizontal state and 30° below
15 from the reference horizontal state in the first embodiment.

The ball cup 7 having an open top and bottom is disposed in the arrangement device 2. The ball cup 7 that constitutes a ball feeding head in the present invention accommodates the plurality of solder balls B along with the arrangement plate
20 51. The ball cup 7 is moved along the top surface of the arrangement plate 51 constituting the upper part of the arrangement jig 5 by means of the transfer device 8. Accordingly, the solder balls B accommodated in the ball cup 7 are moved along the arrangement plate 51 as a group of balls.
25 Meanwhile, although it is preferred that the ball cup 7 and

the arrangement jig 5 perform relative movement in the present invention, only the ball cup 7 moves in the first embodiment.

The transfer device 8 includes a cup transfer motor 80, a driving pulley 81, a driven pulley 82, a timing belt 83, and a slider 84. That is, the ball cup 7 can be moved in the lateral direction of FIG. 2 via the slider 84, attached to the timing belt 83 wound around the driving pulley 81 and the driven pulley 82, by the operation of the cup transfer motor 80.

10 Meanwhile, the ball cup 7 is monitored by a residual quantity sensor (not illustrated). Accordingly, when the residual quantity of the solder balls B reaches a predetermined value, solder balls B are additionally fed into the ball cup 7 by the ball feeding device 4.

15 The operation of the arrangement device 2 according to the first embodiment is described below. First, an arrangement operation is described. The arrangement device 2 employs a reciprocating arrangement method. FIG. 4 is a diagram illustrating a forward operation, in which FIG. 4(A) illustrates an arrangement operation, and FIG. 4(B) illustrates a suction operation that is performed by the suction head immediately after the arrangement operation.

25 The initial state of the arrangement device 2 is a horizontal state as illustrated in FIG. 1, and the ball cup 7 is placed at a location indicated by solid lines on the left

side of FIG. 1. From this state, the seesaw base 62 is tilted to the right by seesawing (i.e., rotating) the seesaw base 62 attached to the stationary base 60 via the shaft through the operation of the seesaw movement motor 61. Accordingly, the
5 seesaw stage 52 mounted on the seesaw base 62 and the arrangement plate 51 mounted on the seesaw stage 52 enter the state of being tilted to the right, as illustrated in FIG. 4 (A).

In this state, the arrangement device 2 is in the state
10 in which one end thereof (the left end thereof in FIG. 4(A)) is placed at a higher location than the other end thereof (the right side thereof in the same diagram). In this state, the ball cup 7 is moved from the left location of the ball cup 7 indicated by dotted lines in FIG. 4(A) to the right location
15 of the ball cup 7 indicated by solid lines in the same diagram by operating the cup transfer motor 80. During the above movement, suction is applied to all the support holes 54 of the arrangement plate 51 by connecting the support holes 54 to the vacuum source.

20 The ball cup 7 in which the solder balls B have been accommodated is moved along the top surface of the arrangement plate 51, and performs the operation of putting the solder balls B into the support holes 54 of the arrangement plate 51, so that the solder balls B are put into the support holes 54,
25 with the result that the solder balls B are disposed in a

predetermined arrangement.

Thereafter, the arrangement device 2 is returned to the horizontal state, as illustrated in FIG. 4(B), the support of the solder balls B is inspected by an inspection camera (not illustrated), the suction head 1 is moved above an unloading location, the connection between the support holes 54 and the vacuum source is released, and then the suction head 1 is allowed to suck and support the solder balls B and then pull the solder balls B from the respective support holes 54 of the arrangement plate 51 by making the suction head 1 enter a suction state. Thereafter, the suction head 1 is moved above the substrate stage 3 as indicated on the right side of FIG. 1, and is then lowered and mounts the solder balls B on the substrate A.

15 In a subsequent mounting operation, since the ball cup 7 is placed at the location of the ball cup 7 indicated by solid lines on the right side of FIG. 4(B), the ball cup 7 is moved from the location of the ball cup 7 indicated by dotted lines above the right side of FIG. 5(A) to the location of the ball cup 7 solid lines below the left side of FIG. 5(A) by tilting the arrangement device 2 to the left, thereby allowing the solder balls B to be accommodated in the respective support holes 54 of the arrangement plate 51. Thereafter, the solder balls B are mounted on the substrate A in a sequence identical to that of the initial mounting operation.

When a second type of solder balls B having a different diameter need to be mounted after a first type of solder balls B have been mounted, the solder balls B are discharged from the ball cup 7 through the following discharge operation.

5 First, when the location of the ball cup 7 at the time when the previous mounting operation has been terminated is the location of the ball cup 7 indicated by solid lines in FIG. 4(B), the ball cup 7 is moved to a location, at which the opening of the ball cup 7 communicates with the discharge
10 holes 53 below the opening of the moved ball cup 7, as illustrated in FIG. 7(B), by tilting the arrangement plate 51 to the right, as illustrated in the same diagram.

Meanwhile, when the columns of the discharge holes 53 are formed on both side ends of the arrangement plate 51, as in
15 the first embodiment, the arrangement plate 51 may be tilted to the right, or the arrangement plate 51 may be tilted to the left, as illustrated in FIG. 7(A). In this case, the ball cup 7 is moved to a location at which the opening of the ball cup 7 communicates with the discharge holes 53 below the opening
20 of the moved ball cup 7 in the same manner.

As a result of the opening of the ball cup 7 communicating with the discharge holes 53, the solder balls B are discharged from the discharge holes 53 due to their own weight, and the discharged solder balls B are accommodated in
25 the ball collection box 9. This ball collection box 9 may be

separated and processed.

Although an example in which the solder balls B are discharged through the discharge holes 53 located on the lower side of the tilted arrangement device 2, as illustrated in FIGS. 7(A) and 7(B), is described in the first embodiment, the solder balls B may be discharged through the discharge holes 53 located on the higher side of the tilted arrangement device 2.

Furthermore, although the rigid arrangement plate 51 having a specific thickness is used in the first embodiment, an arrangement mask 56 having a thickness corresponding to the diameter of solder balls B being used is used in the arrangement jig 5 of a second embodiment illustrated in FIG. 8 and in the arrangement jig 5 of a third embodiment illustrated in FIG. 9. In order to use the thin arrangement mask 56 as the arrangement jig 5, the thin arrangement mask 56 should be attached to a frame (not illustrated) by applying tension. In this situation, it is difficult to form longitudinal holes or continuous slits in the arrangement mask 56 in terms of rigidity. However, when the discharge holes 53 are small holes and are formed in columns in each of which the small discharge holes 53 are arranged at intervals, they can ensure higher rigidity than the longitudinal holes or the continuous slits.

Meanwhile, although the ball cup 7 is used as the ball

feeding head of the present invention in the embodiments illustrated in the diagram, the ball feeding head is not limited to the ball cup 7, but may be any type of component as long as the component accommodates or supports a group of balls including a plurality of solder balls B and moves the group of balls along the top surface of the arrangement jig 5.

Furthermore, although the ball cup 7 of the first or second embodiment is a longitudinal box-shaped component that has an open top and bottom and a length covering the arrangement area 55 and that functions to accommodate the plurality of solder balls B along with the arrangement plate 51, the ball cup 7 may be a box-shaped object that has a closed top and the area of an open bottom smaller than that of an arrangement area 55 and that functions to suck and move solder balls B using an internal suction plate 70 and release suction once or a plurality of times above an arrangement area 55 or above a discharge portion in which discharge holes 53 have been formed, thereby putting the solder balls B into the arrangement area 55 or the discharge holes 53 or discharging the solder balls B, as in the third embodiment illustrated in FIG. 9.

Meanwhile, when the bottom of the ball cup 7 is open and the area of the ball cup 7 is smaller than that of the arrangement area 55, as in the third embodiment, it is preferred that discharge holes 53 are not formed in

longitudinal columns but are formed to have a shape identical to that of the bottom opening of the ball cup 7 and to be parallel, as illustrated in FIG. 9.

Although the arrangement jig 5 of the first embodiment includes the tilting means 6, it may be possible to move the ball cup 7 to the location of the discharge holes 53 without using the tilting means 6 while maintaining the arrangement jig 5 in a horizontal state and then discharge solder balls B, as in the second and third embodiments of FIGS. 8 and 9.

10 In the case of the arrangement jig 5 of the second embodiment illustrated in FIG. 8, the operation of putting solder balls B into an arrangement area 55 and the operation of discharging solder balls B through discharge holes 53 are performed in a horizontal state. In the operation of putting
15 the solder balls B into the arrangement area 55, the operation of moving the ball cup 7 from the right side of FIG. 8 to the left side of the same diagram while maintaining the arrangement jig 5 in a horizontal state and then putting the solder balls B into support holes (not illustrated in FIG. 8)
20 in the arrangement area 55 is performed in a reciprocating manner. Meanwhile, in the operation of discharging the solder balls B through the discharge holes 53, the operation of moving the ball cup 7, stopped in front of the discharge holes 53, to a location above discharge holes 53 while maintaining
25 the arrangement jig 5 in a horizontal state and then

discharging the solder balls B from the ball cup 7 through the discharge holes 53 using their own weight is performed, as illustrated in FIG. 8(C).

Meanwhile, in the case of the arrangement jig 5 of the third embodiment illustrated in FIG. 9, the operation of putting solder balls into the support holes (not illustrated in FIG. 9) of an arrangement area 55 is performed by reciprocating the ball cup 7 while maintaining the arrangement jig 5 in a horizontal state so that the ball cup 7 moves throughout the arrangement area 55 in a zigzag manner, and the operation of discharging solder balls B through discharge holes 53 is performed by moving the ball cup 7 above the discharge holes 53 while maintaining the arrangement jig 5 in a horizontal state and then releasing the suction of a suction plate 70 once or a plurality of times, as illustrated in FIG. 9(C).

Although the specific embodiments of the present invention have been disclosed for illustrative purposes, those skilled in the art will appreciate that various modifications, additions and substitutions are possible without departing from the scope and spirit of the invention as disclosed in the accompanying claims.

WHAT IS CLAIMED IS:

1. A device for arranging conductive balls, comprising:
 - an arrangement jig configured such that support holes for
 - 5 supporting conductive balls are formed in a predetermined arrangement pattern therein;
 - a ball feeding head configured to feed a group of balls, including a plurality of conductive balls, into the support holes formed in a desired area within a top surface of the
 - 10 arrangement jig; and
 - transfer means configured to move the ball feeding head relative to the arrangement jig along the top surface of the arrangement jig;
 - wherein the conductive balls are put into and arranged in
 - 15 the support holes by performing an operation of moving the group of balls along the top surface of the arrangement jig;
 - wherein discharge holes passing through the arrangement jig are formed at a location outside an area, across which the group of balls passes during the operation of moving the group
 - 20 of balls along the top surface of the arrangement jig, within the top surface of the arrangement jig; and
 - wherein the group of balls is moved to the location at which the discharge holes have been formed when the group of balls is discharged from the ball feeding head to a location
 - 25 outside the top surface of the arrangement jig.

2. The device of claim 1, wherein:

tilting means configured to tilt the arrangement jig is mounted on the arrangement jig;

5 the ball feeding head is formed of a ball cup that has an open bottom and accommodates a plurality of conductive balls along with the arrangement jig;

the operation of moving the group of balls along the top surface of the arrangement jig is performed such that the
10 conductive balls are put into the support holes of the arrangement jig by moving the ball cup, accommodating the plurality of conductive balls, from one end of the top surface of the arrangement jig from a remaining end thereof in such a way as to tilt the arrangement jig so that one end of the
15 arrangement jig is located at a higher location than a remaining end thereof using the tilting means configured to tilt the arrangement jig;

the discharge holes are formed at a location outside an area, across which the opening of the ball cup passes during
20 the operation of moving the group of balls along the top surface of the arrangement jig, within the top surface of the arrangement jig; and

when the plurality of conductive balls accommodated in the ball cup is discharged, the ball cup is moved up to a
25 location, at which the opening of the ball cup communicates

with the discharge holes, by tilting the arrangement jig.

3. The device of claim 1 or 2, further comprising
conductive ball collection means installed on the arrangement
5 jig, the conductive ball collection means being configured to
accommodate the conductive balls discharged through the
discharge holes.