【DESCRIPTION】

【Invention Title】

CLEANING JIG OF CAPILLARY FOR WIRE BONDING, CLEANING DEVICE OF CAPILLARY FOR WIRE BONDING, METHOD FOR FABRICATING THEREOF AND METHOD FOR CLEANING USING THE SAME

【Technical Field】

<1> The present invention relates to a cleaning jig of a capillary for wire bonding, a cleaning device of a capillary for wire bonding, a method for fabricating thereof, and a method for cleaning a capillary using the same, which can remove pollutants in the capillary without separating the capillary from a transducer at the time of performing the wire bonding work using the capillary for wire bonding.

【Background Art】

<2> Generally, a wire bonding process among processes for fabricating a semiconductor device means an interconnection between a bond pad of a semiconductor die and an electrically conductive pattern of a substrate by a gold wire, etc. In other words, pads on a semiconductor chip are connected to leads of lead frame by performing the wire bonding process.

<3> The wire bonding is achieved by a wire bonder, wherein the wire bonder includes a discharge tip that forms a ball in a wire, a transducer body that includes an transducer to generate ultrasonic energy, a transducer horn that is coupled to the transducer body to transfer the ultrasonic energy and determines a trace of a wire, and a capillary that is coupled to the transducer horn to perform the wire bonding and a wire cutting. Herein, the discharge tip is coupled to one side of the wire bonder and the transducer body is coupled to a bond head. Further, the transducer body, the transducer horn, and the capillary are defined as a transducer assembly.

<4> In a process for fabricating a semiconductor package, a wire bonding device is used to connect an external connection path of the package such as the lead frame, a ceramic circuit substrate, a printed circuit board, etc. with an input/output pad or a die by using aluminum, gold, copper, etc.

<5> The capillary, which is an essential component of the wire bonding device, is used in the wire bonding process using the wire bonding device.

<6> A configuration of the capillary will be briefly described. The capillary is configured of a cylindrical body whose inside are formed with micro holes.

<7> Herein, the micro hole inside the capillary receives a ball bonding wire having a diameter of 1.0 mil to 1.3 mil (1 mil is 1/1000 inch).

<8> The micro hole is shaped to have a cone form whose caliber becomes smaller toward the tip side and a lower-end tip of the micro hole is called a chamber.

<9> Hereinafter, the transducer assembly according to the related art will be described with reference to the accompanying drawings.

<10> FIG. 1 is a side view for schematically explaining the transducer assembly according to the related art, FIG. 2 is a combined perspective view of a capillary in the transducer assembly according to the related art, and FIG. 3 is a view for explaining a wire ball formation state of the capillary in the transducer assembly according to the related art.

<11> As shown in FIG. 1, the transducer assembly according to the related art is configured to include a transducer 1, a transducer 2, a transducer horn 3, and a capillary 4.

<12> First, the role of the transducer 1 is to generate ultrasonic energy for wire bonding. Of course, the transducer 1 is connected to a high frequency oscillator 5 to generate ultrasonic waves.

<13> The transducer 2 is connected to one side of the transducer 1. Therefore, the ultrasonic waves generated by the transducer 1 are transferred to the transducer horn 3 along the transducer 2.

<14> The transducer horn 3 is connected to the transducer 2 and its diameter becomes small toward its end so that the ultrasonic energy can be concentrated at the end.

<15> The capillary 4 through which a wire 6 penetrates actually performs the wire bonding and is fixed to an end of the transducer horn 3.

<16> In order to perform the wire bonding process, a wire 6 is formed of in a ball (see reference numeral 6a of FIG. 3) form at the end of the wire 6 of the capillary 4 through the high voltage discharge.

<17> The ball contacts and presses a pad of a chip under control of a wire bonding device to transfer the ultrasonic energy to a lower end of the capillary 4. When heat is applied to the pad, the ball is pressed to be primarily bonded to the pad.

<18> The capillary 4 is drawn out from the primary bonding to form a wire loop having a predetermined trace and the wire loop is then connected to a lead of a lead frame by a secondary stitch bond. The above operation is repeated several times to connect the pad of the semiconductor chip to an external connection path of a package.

<19> The tip portion of the capillary 4, in which the ball is formed is contacted/pressed to the lead of the lead frame at the time of performing the primary bonding and the secondary bonding and is in the high voltage discharge state.

<20> As a result, the tip portion of the capillary 4 can be easily polluted by soot during the wire bonding process and a surface of the tip portion contacting the lead frame is attached with plating slimes, such that weldability is degraded at the time of performing the secondary stitch bonding, resulting in rapidly degrading bonding performance and lifespan of the capillary.

<21> Therefore, when the bonding performance and lifespan of the capillary are degraded during the wire bonding process, as shown in FIGS. 2 and 3, the capillary is replaced with a new capillary in the transducer horn 3 and as shown in FIG. 3, the wire 6 is formed in a ball (6a) form at the end of the wire through the high voltage discharge.

<22> At this time, companies using the capillary recycle (clean) the used products to reduce cost and use again. Generally, the recycling (cleaning) capillary is 1/3 the price of a normal product (approximately 1,500 won per a piece).

<23> Although this reduces purchase price, in view of a technical aspect, since the capillary should be replaced according to the same process schedule as a process schedule replacing a new capillary, the capillary is subjected to a parameter tuning by the wire bonding machine, a pull test after bonding a trial product, a ball shear test, etc. If it is determined that the test results are good, mass production can be applied.

<24> However, in the wired bonding according to the related art, there is a problem in that management efficiency at the scene of production is minimal due to the performance of the tests, etc.

<25> In other words, the tests should be performed each time the capillary is replaced. The reason why the tests are needed is that when the capillary is mounted on the transducer, a resistance value up to the tip of the capillary should be measured and an ultrasonic transfer amount should be determined in a control system to observe if a phenomenon is generated by performing the bonding several times at a primary set parameter value and then, if the primary set parameter value needs to be adjusted, perform the bonding at a secondary set parameter value. Therefore, if the capillary is separated from the transducer, since the set parameter values are changed, it is necessary to readjust the parameter values continuously.

<26> Meanwhile, when analyzing in detail the wire bonding technology, the capillary performs a role of primarily welding a gold wire around a chip and leading the gold wire to secondarily weld it to the lead frame and then cutting it. At this time, the weldability of the gold wire is largely affected according to the pollution of the tip portion of the capillary.

<27> Generally, an assembly process of bonding several hundred semiconductor chips is performed while one capillary is used up to its set lifespan. However, among various defects, a welding defect occurs due to the pollution of the tip portion of the capillary in a semiconductor assembly plant. Therefore, the pollution of the tip portion of the capillary in a semiconductor assembly plant causes chronic quality deterioration.

<28> FIG. 4 is a view for explaining a capillary cleaning device according

to the related art.

<29> The capillary cleaning device according to the related art, which uses a device having a vibration effect such as vibration of a power toothbrush, uses a scheme that removes foreign substances of the tip portion of the capillary 4 with a diamond film 7 by mounting the diamond film 7 on a connection member 8, the diamond film 7 being formed by attaching diamond powders having a thickness of 1 ㎛ to 10 ㎛ to a film using an adhesive, and then vibrating a connection member 8 by driving a motor 9. Herein, the diamond film 7 is formed by attaching diamond powder particles having a thickness of 1㎛ to 10㎛ on the film using an adhesive.

<30> However, the problems of the above-mentioned method are as follows: the work should be performed by a high-level expert; the tip surface of the capillary may be worn due to the diamond film during the cleaning process; when the diamond film contacts the tip portion of the capillary, the foreign substances to be removed close a capillary hole into which the wire 6 is inserted; and the foreign substances drop on the chip and a clamp, which cause quality deterioration.

【Disclosure】

【Technical Problem】

<31> Embodiments of the present invention seek to solve one or more of the above problems. Embodiments of the present invention provide a cleaning jig of a capillary for wire bonding, a cleaning device of a capillary for wire bonding, a method for fabricating thereof, and a method for cleaning a capillary using the same, which can remove pollutants in the capillary without separating the capillary from a transducer at the time of performing the wire bonding work using the capillary for wire bonding.

【Technical Solution】

<32> According to a first aspect of the present invention, there is provided a cleaning jig for cleaning a capillary for wire bonding comprising: a brush mounting part that is formed to mount a wire brush for cleaning the capillary; a suction hole that

is formed at one side of the brush mounting part to suck foreign substances of the capillary; a first joining hole that is formed at one side of the brush mounting part to mount the cleaning jig on a wire bonding device; a second joining hole that is formed at the other side of the brush mounting part to mount the cleaning jig on the wire bonding device; a first through hole that is horizontally formed to the cleaning jig between one side of the suction hole and the joining hole; a first magnet member that is joined to the first joining hole; a second magnet member having a through groove that is joined to the second joining hole but is horizontally formed with respect to the first through hole; and a second through hole that is horizontally formed with respect to the through groove at the other side of the suction hole.

<33> Preferably, the brush mounting part is formed in any one of a rectangular hole, a plurality of circular holes, and a plurality of circular grooves.

<34> Preferably, the cleaning jig of the capillary for wire bonding further comprises a screw hole that fixes the wire brush member mounted on the brush mounting part in a direction intersected with the through hole in the side of the brush mounting part and a screw member that fixes the wire brush member mounted on the brush mounting part through the screw hole.

<35> According to a second aspect of the present invention, there is provided a cleaning jig of a capillary for wire bonding
comprising: a wire brush member that is configured of a plurality of wires for cleaning the capillary for wire bonding; and a wire brush attaching member for fixing the wire brush.

<36> Preferably, the wire brush attaching member is any one of a cleaning jig having a hole or a groove into which the wire brush member is inserted and a cylindrical body into which one end of the wire brush is inserted and from which the other end thereof is exposed.

<37> Preferably, the wire brush member is made from one of metal materials such as tungsten, stainless steel, brass, carbon steel, copper wire, steel

wire (piano wire), molybdenum alloy steel, and high speed steel (high-strength steel) or at least two mixed metal materials of metal materials such as tungsten, stainless steel, brass, carbon steel, copper wire, steel wire (piano wire), molybdenum alloy steel, and high speed steel (high-strength steel) and a cross section diameter of the wire brush member is formed in 0.005 mm to 0.5 mm.

According to a third aspect of the present invention, there is provided a cleaning device of a capillary for wire bonding comprising: a cleaning jig 10 according to the first aspect of the present invention, wherein the brush mounting part that includes brush holes 11 for mounting the wire brush, the brush holes and the suction hole are on a middle portion of the cleaning jig 10, the first joining hole is formed at one side of the middle portion, the second joining hole 14 is formed at the other side of the middle portion, and wherein the cleaning jig further comprises a screw hole 18 formed on a side of the brush hole 11, and a screw member 19 inserted up to the side of the brush hole 11 through the screw hole 18; a brush member 30 that is mounted on the brush hole 11 and fixed by the screw member 19; and a first magnet member 21 that is inserted into the first joining hole 13 to be joined to the cleaning jig 10 and a second magnet member 22 that is inserted into the second joining hole 14 to be joined to the cleaning jig 10 but is formed with a magnet member through groove 23 on the same line as the first and second through holes 15 and 16.

Preferably, the middle portion of the cleaning jig 10 formed with the brush hole 11 and the suction hole 12 is formed to be lower than both sides thereof, having a step, and the portion formed with the brush hole 11 and the suction hole 12 has a concave groove 17 at a bottom surface of the cleaning jig.

Preferably, the brush hole 11 is formed in a rectangular hole, a

plurality of circular holes and the plurality of suction holes 12, which vertically penetrate through the cleaning jig, are formed.

<41> Meanwhile, the first and second magnet members 21 and 22 are made of any one of a samarium-cobalt (SmCo) magnet and an odymium (Nd-Fe-B) magnet that are a rare earth-based magnet or a ferrite-based magnet.

<42> Preferably, the brush member 30 is made from one metal material of tungsten, stainless steel, brass, carbon steel, copper wire, steel wire (piano wire), molybdenum alloy steel, and high speed steel (high-strength steel) or a mixed metal material of more than two metal materials of tungsten, stainless steel, brass, carbon steel, copper wire, steel wire (piano wire), molybdenum alloy steel, and high speed steel (high-strength steel).

<43>

According to a fourth aspect of the present invention, there is provided a method for fabricating a cleaning device of a capillary for wire bonding comprising a cleaning jig that includes a brush hole 11 for mounting a wire brush and a suction hole 12 for sucking foreign substances of the capillary, which are formed at a middle portion of the cleaning jig 10, a first joining hole 13 to be joined to a first magnet member 21, which is formed at one side of the middle portion, a second joining hole 14 to be joined to a second magnet member 22, which is formed at the other side of the middle portion, first through holes extended from the suction hole 12, which are formed at both sides of the second joining hole 15, second through holes 16 formed on the same line as the first through holes 15, a screw hole 18 formed on a side of the brush hole 11, and a screw member 19 inserted up to the side of the brush hole 11 through the screw hole 18, the method comprising: winding a wire used as a brush member raw material 31 so as to be used as the wire brush on first and second rod members 41 and 42 facing each other of a straightening device 40 configured to include a pressurizer lever 43 and a pressing gauge; turning the pressurizer lever 43 to stretch the brush member raw material 31; binding the middle portions of the brush member raw material 31 using a first string member 50; separating

the brush member raw material 31 from the first and second rod members 41 and 42 and binding the brush member raw material 31 with the second string member 51 so as to be able to be used as the brush member; forming each brush member 30 by cutting the brush member raw material 31 by using a cutting member 60 so as to be able to be used as the brush member and removing the first string member 50; putting the brush fixing member 200 on a bending mold member 220 whose upper portion is formed with a concave groove 230 in one direction, and stretching the cut brush member 30 on the brush fixing member 200 and then putting a fixing core member 210 in a direction corresponding to the concave groove 230 at a middle portion of the brush member 30 and in a direction orthogonal to the brush member 30; pushing the fixing core member 210 to the inside of the concave groove 230 by using a bending punch member 240 so that the brush fixing member 200 and the brush member 30 is pushed to the inside of the concave groove 230 of the bending mold member 220 and winding the brush fixing member 200 on the brush member 30; fixing the brush member 30 to the brush fixing member 200 by closely attaching the side of the brush fixing member 200; grinding the brush member 30 to be flat; cutting the brush fixing member 200 at a size to mount on the brush hole 11; and mounting the cut brush fixing member 200 on the brush hole 11 and fixing the brush fixing member 200 to the brush hole 11 by inserting the screw member into the screw hole 18.

<44> Preferably, the grinding the tip of the brush member 30 includes cutting using a Water-Jet device and grinding using a horizontal type grinder on which a diamond wheel is mounted.

<45> Preferably, the method further comprises after the grinding, sequentially cleaning the brush member to which grinding dusts are attached in a vessel in which cleaning agent and ethanol are filled and drying it for 30 minutes to 2 hours in a drier whose internal temperature is 50℃ to 90℃.

<46> Preferably, the method further comprises after drying the brush member 30, joining the first and second magnet members 21 and 22 to each of the first and second joining holes 13 and 14 of the cleaning jig 10.

<47>

According to a fifth aspect of the present invention, there is provided a method for cleaning a capillary using a cleaning device of a capillary for wire bonding comprising: connecting one side of a foreign substances discharging hose member 110 to the second through hole 16; connecting the other side of the foreign substances discharging hose member 110 to a vacuum pump device 120; removing a wire 80 for bonding from a capillary 90 when the capillary 90 is fixed to a transducer horn 70 of a wire bonding device 100 and the wire for bonding penetrates through the capillary 90 to perform a wire bonding work by the number of times set during the wire bonding work in the wire bonding device 100; moving the capillary 90 to the cleaning jig 10 in a state where the capillary 90 is joined to the transducer horn 70; after the capillary 90 is located at the brush member 30, cleaning the foreign substances while moving the tip portion of the capillary 90 up/down and left/right in the brush member 30; moving the tip portion of the capillary 90 to a suction hole 12 of the cleaning jig 10; and discharging the foreign substances of the tip portion of the capillary 90 to the outside through the foreign substances discharging hose member connected to the second through hole 16 of the cleaning jig 10 via a first through hole 15, a second magnet member through groove 23, and a second through hole 16 from the suction hole 2 of the cleaning jig 10 by operating the vacuum pump device 120.

<48> Preferably, the foreign substances is filtered by forming a dust collecting filter member 130 between the foreign substances discharging hose member 110 and the vacuum pump device 120.

<49>

According to a sixth aspect of the present invention, there is provided a method for cleaning a capillary using a cleaning device of a capillary for wire bonding comprising: moving a capillary 90 to a cleaning jig 10 in a state where the capillary 90 is joined to a transducer horn 70 when the capillary 90 fixed to the transducer horn 70 of a wire bonding device 100 performs a wire bonding work by the number of times set during the wire bonding work; and after the capillary 90 is located at the

brush member 30, cleaning the foreign substances while moving the tip portion of the capillary 90 up/down and left/right in the brush member 30.

<50> According to a seventh aspect of the present invention, there is provided a cleaning device of a capillary for wire bonding

comprising: a cleaning jig 10 that includes a brush member 30 wherein a plurality of brush holes 11 for mounting a wire brush is formed, both ends of an extra string of a string member 51 penetrate through a lower hole of the brush hole 11 through an upper hole thereof in a state where a middle portion of the cleaning jig 10 is bound by the string member 51, the bound middle portion is located at the lower hole of the brush hole 11, and after both ends of the extra string are fixed not to penetrate through the upper hole through the lower hole of the brush hole 11 in a state where both ends are located at the upper hole of the brush hole 11, both ends are ground; a vibration transferring member 141 that is connected to one end of the cleaning jig 10 to transfer vibration from a motor; and a vibration device 140 that vibrates the brush member 30 of the cleaning jig 10 connected to the vibration transferring member 141.

<51> According to an eighth aspect of the present invention, there is provided a cleaning device of a capillary for wire bonding

comprising: a circular wire brush member 320 formed by inserting a plurality of wires into a cylindrical body 321; a vibration device 310 that is formed at one end of the circular brush member 320 to rotate the circular wire brush member 320; and a power supply device 300 that supplies power to the vibration device 310.

<52> Preferably, the vibration device is configured of a motor or an ultrasonic transducer.

【Advantageous Effects】

<53> According to embodiments of the present invention, the cleaning jig of a capillary for wire bonding, the cleaning device of a capillary for wire bonding, the method for fabricating thereof, and the method for cleaning a capillary using the same has the following effects.

<54> First, the service life of the capillary is generally determined within an error range of data of a quality capability index (CPK), but even though the capillary is cleaned by dividing a predetermined number of times within the service life, the bonding condition is stabilized in an optimal condition at the time of performing the wire bonding work and thus, the bonding yield is improved.

<55> Second, since the capillary is cleaned for every set predetermined number of times, the lifespan of the capillary is extended.

<56> Third, the wire capillary is cleaned, such that productivity is improved as compared to replacing the capillary.

【Description of Drawings】

<57> FIG. 1 is a side view for schematically explaining a transducer assembly according to the related art;

<58> FIG. 2 is a combined perspective view of a capillary in the transducer assembly according to the related art;

<59> FIG. 3 is a view for explaining a wire ball formation state of the capillary in the transducer assembly according to the related art;

<60> FIG. 4 is a view for explaining a cleaning device of a capillary according to the related art;

<61> FIG. 5 is a perspective view for explaining a cleaning device of a capillary for wire bonding according to the present invention;

<62> FIG. 6 is a perspective view for explaining a cleaning jig in the cleaning device of the capillary for wire bonding according to the present invention;

<63> FIG. 7 is a bottom perspective view of the cleaning jig shown in FIG. 6;

<64> FIG. 8 is a plan view of the cleaning jig shown in FIG. 6;

<65> FIG. 9 is a cross-sectional view taken along the line A-A' of the cleaning jig shown in FIG. 8;

<66> FIGS. 10 to 12 are views for explaining a magnet member formed in the cleaning jig according to the present invention;

<67> FIGS. 13 to 21 are views for explaining a method for forming a wire brush in the cleaning jig according to the present invention;

<68> FIG. 22 is a perspective view for explaining a cleaning device of a capillary for wire bonding according to another embodiment of the present invention;

<69> FIG. 23 is a perspective view for explaining a cleaning jig in the cleaning device of the capillary for wire bonding according to another embodiment of the present invention;

<70> FIG. 24 is a bottom perspective view of the cleaning jig shown in FIG. 23;

<71> FIG. 25 is a plan view of the cleaning jig shown in FIG. 23;

<72> FIG. 26 is a cross-sectional view taken along the line B-B' of the cleaning jig shown in FIG. 25;

<73> FIG. 27 is a perspective view for explaining a cleaning device of a capillary for wire bonding according to another embodiment of the present invention;

<74> FIG. 28 is a perspective view for explaining a cleaning jig in the cleaning device of the capillary for wire bonding according to another embodiment of the present invention;

<75> FIG. 29 is a bottom perspective view of the cleaning jig shown in FIG. 28;

<76> FIG. 30 is a plan view of the cleaning jig shown in FIG. 28;

<77> FIG. 31 is a cross-sectional view taken along the line C-C' of the cleaning jig shown in FIG. 30;

<78> FIGS. 32 to 47 are views for explaining a method for forming a wire brush in the cleaning jig according to another embodiment of the present invention;

<79> FIGS. 48 to 61 are views for explaining a method for forming a wire brush according to another embodiment of the present invention;

<80> FIGS. 62 to 65 are views for explaining a method for automatically cleaning a capillary for wire bonding according to the present invention;

<81> FIG. 66 is a flow chart for explaining the method for automatically cleaning the capillary for wire bonding according to the present invention;

<82> FIG. 67 is a view for explaining a cleaning device of a capillary according to another embodiment of the present invention;

<83> FIG. 68 is a cross-sectional view for explaining a cleaning jig according to another embodiment of the present invention;

<84> FIG. 69 is a view for explaining a cleaning device of a capillary according to another embodiment of the present invention;

<85> FIG. 70 is a view showing in detail a brush member shown in FIG. 69;

<86> FIG. 71 is a view for explaining a cleaning device of a capillary according to another embodiment of the present invention;

<87> FIG. 72 is a photograph showing a state before cleaning the capillary according to the related art;

<88> FIG. 73 is a photograph showing a state after cleaning the capillary according to the present invention; and

<89> FIGS. 74 to 83 are photographs for explaining results obtained by performing the wire bonding using the capillary according to the related art and results obtained by performing the wire bonding using the capillary after cleaning the capillary using the cleaning device of the capillary according to the present invention.

<90> <DESCRIPTION FOR KEY ELEMENTS IN THE DRAWINGS>

<91> 10: CLEANING JIG 11: BRUSH HOLE

<92> 11a: BRUSH GROOVE 12: SUCTION HOLE

<93> 13, 14: JOINING HOLE 15, 16, 24: THROUGH HOLE

<94> 17: CONCAVE GROOVE 21, 22: MAGNET MEMBER

<95> 23: THROUGH GROOVE 30: BRUSH MEMBER

<96> 31: BRUSH MEMBER RAW MATERIAL

<97> 40: STRAIGHTENING DEVICE

<98> 41, 42: ROD MEMBER 50, 51: STRING MEMBER

<99> 60: CUTTING MEMBER 70: TRANSDUCER HORN

<100> 80: WIRE FOR BONDING 90: CAPILLARY

<101> 100: WIRE BONDING DEVICE

<102> 110: HOSE MEMBER FOR DISCHARGING FOREIGN SUBSTANCES

<103> 120: VACUUM PUMP DEVICE 130: DUST COLLECTING MEMBER

<104> 140: VIBRATION DEVICE 141: VIBRATION TRANSFERRING MEMBER

<105> 150: RING MEMBER 200: BRUSH FIXING MEMBER

<106> 210: FIXING CORE MEMBER 220: BENDING MOLD MEMBER

<107> 230: CONCAVE GROOVE 240: BENDING PUNCH MEMBER

<108> 300: CHARGER 310: MOTOR

<109> 320: ROTATION BRUSH 400: HANDLE MEMBER

<110> 410: VIBRATION TRANSFERRING MEMBER

<111> 420: WIRE BRUSH MEMBER

【Best Mode】

<112> Hereinafter, exemplary embodiments of the present invention will be described in detail with reference to the accompanying drawings.

<113> Meanwhile, terms, which are being widely used, are selected in the specification, however, in a special case, terms may be optionally selected by the present applicant. In this case, the meaning of the corresponding terms will be described in detail in the detailed description of the present invention. We want to be clear that the present invention should be understood through the meaning of the terms, not through a name of the terms.

<114> Also, in describing the embodiments, the description of the technical contents, which are well known to those skilled in the art and not directly related to the present invention, will not be repeated. This is to more clearly transfer the present invention without obscuring the subject of the present invention with unnecessary detail.

<115> FIG. 5 is a perspective view for explaining a cleaning device of a capillary for wire bonding according to one embodiment of the present invention, FIG. 6 is a perspective view for explaining a cleaning jig in the cleaning device of the capillary for wire bonding according to one embodiment of the present invention, FIG. 7 is a bottom perspective view of the cleaning jig shown in FIG. 6, FIG. 8 is a plan view of the cleaning jig shown in FIG.

6, FIG. 9 is a cross-sectional view taken along the line A-A' of the cleaning jig shown in FIG. 8, FIGS. 10 to 12 are views for explaining a magnet member formed in the cleaning jig according to one embodiment of the present invention, and FIGS. 13 to 21 are views for explaining a method for forming a wire brush in the cleaning jig according to one embodiment of the present invention.

<116> Hereinafter, a cleaning jig, a cleaning device, and a cleaning method for cleaning a capillary for wire bonding according to the present invention will be described with reference to various exemplary embodiments.

<117> First, the cleaning jig according to the present invention generally includes a wire brush member configured of a plurality of wires for cleaning the capillary and a cleaning jig for fixing the wire brush member.

<118> Meanwhile, a fixing member for fixing the wire brush member to the cleaning jig of the present invention or various members for removing foreign substances, which are removed by the wire brush, will be described with reference to various embodiments.

<119> Further, various cleaning method using the cleaning device including the cleaning jig according to the present invention will be described.

<120> As shown in FIGS. 5 to 9, the cleaning device for wire bonding according to one embodiment of the present invention is configured to include a cleaning jig 10 that includes a plurality of brush holes 11 for mounting a wire brush and a suction hole 12 for sucking foreign substances of the capillary, which are formed on a middle portion of the cleaning jig 10, a first joining hole 13 to be joined to a first magnet member 21, which is formed at one side of the middle portion, a second joining hole 14 to be joined to a second magnet member 22, which is formed at the other side of the middle portion, first through holes 15 extended from the suction hole 12, which are formed at both sides of the second joining hole 14, and second through holes 16 formed on the same line as the first through hole 15; a brush member 30 that is formed in the plurality of brush holes 11; a first magnet member 21 that is inserted into the first joining hole 13 to be joined

to the cleaning jig 10; and a second magnet member 22 that is inserted into the second joining hole 14 to be joined to the cleaning jig 10 but is formed with a magnet member through groove 23 on the same line as the first and second through holes 15 and 16.

<121> Preferably, the middle portion of the cleaning jig 10 in which the brush hole 11 and the suction hole 12 are formed is formed to be lower than both sides thereof, having a step of 0.2 mm to 0.4 mm.

<122> Preferably, as shown in FIG. 7 that shows a bottom surface of the middle portion of the cleaning jig 10, a portion in which the brush hole 11 and the suction hole 12 are formed has a concave (凹) groove 17 having a depth of 0.2 mm to 0.4 mm.

<123> A plan view and a cross-sectional view of the cleaning jig 10 are the same as those of FIGS. 8 and 9. Herein, an upper diameter of the brush hole 11 and the suction hole 12 may be formed to be 1 mm to 2 mm and a lower diameter of the brush hole 11 may be formed at 70% to 100% as compared to the upper diameter. Further, a depth of the brush hole 11 and the suction hole 12 may be formed to be 10 mm to 14 mm.

<124> Meanwhile, the lower portion of the suction hole 111 is directly connected to the first through hole 15.

<125> And, the first and second joining holes 13 and 14 may be formed to have a diameter of 4 mm to 6 mm.

<126> Thereby, the first and second magnet members 21 and 22 may be formed to have a diameter so that they can be closely joined to the first and second joining holes 13 and 14 and may use one of a rare earth-based magnet and a ferrite-based magnet. At this time, a samarium-cobalt (SmCo) magnet or an odymium (Nd-Fe-B) magnet may be used as the rare earth-based magnet and a strontium magnet or a barium magnet as the ferrite-based magnet may be used but preferably, the samarium-cobalt magnet may be used.

<127> Herein, the first magnet member 21 is formed in a cylindrical form s shown in FIG. 10.

<128> And, the second magnet member 22 has a cylindrical form as shown in

FIG. 11 but is formed to have the through groove 23 in a concave form at a lower portion thereof or as shown in FIG. 12, has a cylindrical form but its lower portion is formed with a through hole 24.

<129> Herein, the reason why the samarium-cobalt (SmCo) magnet, which is the rare earth-based magnet, and the strontium magnet, which is the ferrite-based magnet, are used is that a magnet should maintain magnetic force at high temperature so that the cleaning jig 10 can be attached to an upper portion of the clamp that fixes and presses a lead frame and a temperature of the clamp should be maintained at 150℃ to 250℃ at the time of performing the wire bonding.

<130> Meanwhile, the brush member 30 may be made from one of metal materials such as tungsten, stainless steel, brass, carbon steel, copper wire, steel wire (piano wire), molybdenum alloy steel, and high speed steel (high-strength steel) or at least two mixed metal materials of metal materials such as tungsten, stainless steel, brass, carbon steel, copper wire, steel wire (piano wire), molybdenum alloy steel, and high speed steel (high-strength steel). Preferably, a cross section diameter of the wire brush member is formed of a wire having a fine thread of 0.005 mm to 0.5 mm.

<131> A method of forming the brush member 30 in the cleaning jig 10 will be described with reference to FIGS. 13 to 20.

<132> First, since the wire brush 30 used in the present invention has a thin thickness as described above, it needs to be stretched using a straightening device.

<133> As a result, as shown in FIG. 13, a brush member raw material 31 is wounded on first and second members 41 and 42 facing each other of the straightening device 40 and is stretched by turning a pressurizer lever 43 as shown in FIG. 14. At this time, the brush member raw material 31 is pressed and stretched while viewing a pressing gauge 44 according to a kind of a wire (tungsten, stainless steel, brass, carbon steel, copper wire, steel wire (piano wire), molybdenum alloy steel, and high speed steel (high-strength steel) or a mixed metal material) used as the brush member raw material. For

reference, if tungsten as the raw material of the wire brush member is used, a diameter is 20㎛ and if a tungsten wire having a length of 4000 m is used, tension pressure of 20Kg is applied and maintained for 30 minutes, such that a form of the tungsten wire is maintained in a straight form.

<134> Then, as shown in FIG. 15, the middle portions of the raw material 31 of the brush member are bound by a first string member 50. The reason for binding the raw material of the brush member is to mount the raw material 31 of the brush member on the brush hole 11 of the cleaning jig 10 at a proper length or height and to prevent the brush member raw material 31 in the wire form from mixing or clotting when separating from the first and second rod members 41 and 42.

<135> Thereafter, as shown in FIGS. 16 and 17, the brush member raw material 31 is separated from the first and second rod members 41 and 42, bound by a second string member 51 to be able to be used as the brush member, and cut by a cutting member 60 to be able to be used as the brush member. Next, the first string member 50 is removed. Herein, as the second string member 51, a stainless twisted pair having a thickness of 0.2 mm to 0.3 mm may be used.

<136> Subsequently, as shown in FIG. 17, the second string member 51, which binds the brush member 30, is inserted into the brush hole 11 of the cleaning jig 10 and as shown in FIG. 18, the brush member 30 is closely attached to the brush hole 11 by pulling the second string member 51. Then, as shown in FIG. 19, the second string member binds the brush member at the lower portion of the brush hole 11 and both portions of the second string member 51 are stretched to both sides of the brush hole 11 at the lower portion of the cleaning jig 10 to prevent the brush member 30 from easily separating from the brush hole 11. And, as shown in FIG. 20, a tip of the brush member 30 is cut and ground to be flattened by using the cutting member (not shown).

<137> At this time, it is preferable to constantly cut the tip of the brush member 30 exposed to the outside of the upper side of the cleaning jig 10 in the brush member 30 inserted into the cleaning jig 10. At this time, the exposed height of the brush member 30 from the cleaning jig 10 is about 0.5

mm to 1.5 mm. The exposed height is higher by 0.4 mm to 0.6 mm than the top end portion of the cleaning jig 10 so that the tip portion of the capillary does not contact the cleaning jig 10 at the time of cleaning the capillary.

<138> Meanwhile, as a method of cutting the brush member 30, a cutting method, for example, scissors, knife, etc can be used. but more preferably, since the cut tip portion may be pressed or may be not smoothly cut so that there may be remnants at the tip portion thereof, the water-jet cutting and grinding method as the cutting member 60 is used.

<139> When the tungsten wire as the brush member 30 is used, it is cut to maintain a predetermined height by using a hydraulic pressure of 4,000 kg/cm^2 and can be ground to a final height by a horizontal type grinder on which a # 400 diamond wheel is mounted. FIG. 20 shows a form completed by subjecting to the grinding.

<140> At this time, as a processing condition of the horizontal type grinder, a rotational speed of the diamond wheel may be 2,000 rpm, a fixing body of the ground cleaning jig 200 rpm, and a forwarding speed 2 ㎛/sec.

<141> Since grinding dusts are smeared between the tungsten wires while the wire brushes of tungsten manufactured according to the above condition are ground, the tungsten wire brushes are sequentially put in a vessel in which cleaning agent and ethanol are filled and then put in an ultrasonic cleaner to be cleaned for 10 minutes to 50 minutes. Further, it is preferable to completely dry the wire brushes in a drier whose internal temperature is 50 ℃ to 90 ℃ for 30 minutes to 2 hours.

<142> After the brush member 30 is formed in the cleaning jig 10, as shown in FIG. 21, the first and second magnet members 21 and 22 are joined to the first and second joining holes 13 and 14.

<143> When the samarium-cobalt (SmCo) magnet, which is the rare earth-based magnet, and the strontium magnet, which is the ferrite-based magnet, are used as the magnet member, the cleaning jig 10 can be fixed to the upper portion of the clamp.

<144> FIG. 22 is a perspective view for explaining a cleaning device of a

capillary for wire bonding according to another embodiment of the present invention, FIG. 23 is a perspective view for explaining a cleaning jig in the cleaning device of the capillary for wire bonding according to another embodiment of the present invention, FIG. 24 is a bottom perspective view of the cleaning jig shown in FIG. 23, FIG. 25 is a plan view of the cleaning jig shown in FIG. 23, and FIG. 26 is a cross-sectional view taken along the line B-B' of the cleaning jig shown in FIG. 25.

<145> The cleaning device for the capillary for wire bonding according to another embodiment of the present invention is approximately similar to the cleaning device of the capillary for wire bonding and cleaning jig according to one embodiment of the present invention, but the plurality of brush holes 11 for mounting the wire brushes 30 and a plurality of residuals suction holes 12a for sucking residuals of the capillary around the suction hole 12 for sucking foreign substances of the capillary are further formed as shown in FIG. 22. In other words, when the residuals of the capillary drops around the jig during the cleaning of the wire brush 30, the plurality of residual suction holes 12a for sucking the corresponding residuals is further formed. The plurality of residual suction holes 12a for sucking the residuals of the capillary are formed to be penetrated through from the upper portion of the jig 10 to the lower portion thereof as shown in FIGS. 23 and 24, such that the residuals, which are foreign substances of the capillary dropped around the upper portion of the jig, are removed to the outside through the first through hole 15, the second through hole 16, and the through groove 23 via the residuals suction hole 12a from the lower surface of the cleaning jig 10.

<146> If the cleaning jig 10 according to another embodiment of the present invention is shown as a plan view, it is the same as FIG. 25 and a cross-sectional view of the cleaning jig 10 shown in FIG. 25 is the same as FIG. 26.

<147> FIG. 27 is a perspective view for explaining a cleaning device of a capillary for wire bonding according to another embodiment of the present invention, FIG. 28 is a perspective view for explaining a cleaning jig in the

cleaning device of the capillary for wire bonding according to another embodiment of the present invention, FIG. 29 is a bottom perspective view of the cleaning jig shown in FIG. 28, FIG. 30 is a plan view of the cleaning jig shown in FIG. 28, FIG. 31 is a cross-sectional view taken along the line C-C' of the cleaning jig shown in FIG. 25, and FIGS. 32 to 47 are views for explaining a method for forming a wire brush in the cleaning jig according to another embodiment of the present invention.

<148> The cleaning device of the capillary for wire bonding according to another embodiment of the present invention is approximately similar to the cleaning device of the capillary for wire bonding according to one embodiment of the present invention, but the brush hole 11 for mounting the wire brush 30 is formed in a rectangular form and therefore, the wire brush 30 is formed in a form suitable to join to the brush hole 11 in the rectangle.

<149> To this end, the wire brush 30 according to another embodiment of the present invention is fixed by a wire brush fixing member 200 (see FIG. 37), a screw hole 18 for fixing the wire brush fixing member 200 to the brush hole 11 is formed at the side of the cleaning jig 10, and the brush fixing member 200 is fixed to the cleaning jig 10 by screwing a screw member 19. FIG. 37 shows two screw holes 18, but it is apparent to those skilled in the art that a plurality of screw holes can be formed according to a size of the brush hole 11.

<150> In other words, as shown in FIGS. 21 to 31, the cleaning device of the capillary for wire bonding according to another embodiment of the present invention comprises comprising: the cleaning jig 10 that includes the brush holes 11 in a rectangular form for mounting the wire brush and the suction hole 12 for sucking foreign substances of the capillary on a middle portion of the cleaning jig 10, the first joining hole 13 to be joined to the first magnet member 21, which is formed at one side of the middle portion, the second joining hole 14 to be joined to the second magnet member 22, which is formed at the other side of the middle portion, the first through holes 15 extended from the suction hole 12, and formed at both sides of the second

joining hole 14, the second through holes 16 formed on the same line as the first through holes 15, the plurality of screw holes 18 formed to one side of the brush hole 11 through one side of the cleaning jig 10; and the brush member 30 fixed by the brush fixing member to be mounted on the brush hole 11; the screw member 19 inserted through the screw hole 18 to fix the brush fixing member to the brush hole 11; the first magnet member 21 that is inserted into the first joining hole 13 to be joined to the cleaning jig 10; and the second magnet member 22 that is inserted into the second joining hole 14 to be joined to the cleaning jig 10 but is formed with the magnet member through grooves 23 on the same line as the first and second through holes 15 and 16.

<151> Preferably, the middle portion of the cleaning jig 10 in which the brush hole 11 and the suction hole 12 are formed is formed to be lower than both side portions thereof, having a step of 0.2 mm to 0.4 mm.

<152> Further, as shown in FIG. 29 that shows a bottom surface of the middle portion of the cleaning jig 10, a portion in which the brush hole 11, the suction hole 12, and the suction hole 12a for sucking the capillary residuals are formed has a form of a concave (凹) groove having a depth of 17 of 0.2 mm to 0.4 mm.

<153> A plan view of the cleaning jig 10 are the same as that of FIGS. 30 and a cross-sectional view taken along the line C-C' of a plan view shown in FIG. 30 is the same as that of FIG. 31.

<154> Hereinafter, a method of forming the brush member 30 in the cleaning jig 10 according to another embodiment of the present invention will be described with reference to FIGS. 32 to 47.

<155> First, as in another embodiment of the present invention, tungsten to be used as the brush member using the device and method as shown in FIGS. 13 to 15 is stretched and as shown in FIG. 32, the middle portions of the brush member raw material 31 is bound by the first string member 50 and are then cut by the cutting member 60 to be used as the brush member.

<156> Then, as shown in FIGS. 33 and 34, the brush fixing member 200 is put

on a bending mold member 220 whose upper portion is formed with a concave groove 230 and the cut brush member 30 is stretched on the brush fixing member 200 and fixing core members 210 are put to be orthogonal to each other at the middle portion of the brush member 30.

<157> Thereafter, as shown in FIG. 35, the fixing core member 210 is pushed into the inside of the concave 230 by a bending punch member 240, such that the brush fixing member 200 is also pushed into the inside of the concave groove 230, thereby allowing the brush fixing member 200 to wind the brush member 30.

<158> Subsequently, as shown in FIG. 36, when the brush fixing member 200 is separated from the bending mold member 220 and tightened by extrusion rollers 250 and 260 at both sides of the brush fixing member 200, as shown in FIG. 37, the brush fixing member 200 completely fixes the brush member 30.

<159> Herein, a size or a depth of the concave groove 230 and a thickness of the brush fixing member 200 and a thickness of the fixing core member 210 can be properly controlled according to a formed thickness of the brush member 3, a experience on the spot a, or an experiment.

<160> Next, as shown in FIG. 38, the tip of the brush member 30 is cut and ground to be flatted by the cutting member.

<161> At this time, as a method of cutting the brush member 30, a cutting method, for example, scissors, knife, etc. can be used, but since the cut tip portion may be pressed or may be not smoothly cut, which may cause remnants at the tip portion thereof, more preferably, the water-jet cutting and grinding method as the cutting member 60 is used.

<162> As shown in FIGS. 39 to 41, the brush fixing member 200 is cut at a size suitable to be mounted on the brush hole 11 by the cutting member 60 and as shown in FIGS. 42 and 43, the brush member 30 is inserted into the brush hole 11 of the cleaning jig 10. FIG. 44 shows a cross-sectional view taken along the line D-D' of FIG. 43.

<163> The method of forming the brush member in the cleaning jig inserts the brush member 30 into the brush hole 11 as shown in FIG. 45 and then inserts

the screw member 19 into the screw hole 18 as shown in FIG. 46 to tighten the side of the brush fixing member 200, such that the cleaning device of the capillary for wire bonding is completed by preventing the brush fixing member 200 from separating from the brush hole 11 as shown in FIG. 47.

<164> FIGS. 48 to 61 are views for explaining a method of forming the wire brush according to another embodiment of the present invention.

<165> The method of forming the wire brush according to another embodiment of the present invention has the same process of maintaining a form of the wire in a straight form by using the straightening device 40, the first and second rod members 41 and 42, and the pressurizer lever 43 and then binding the middle portions of the brush member raw material 31 using the first string member 50, as in FIGS. 13 to 15.

<166> Then, as shown in FIG. 48, the brush member raw material 31 is bound by second string member 51 to be able to be used as the brush member and is cut by the cutting member 60 to be able to be used as the brush member 30. Thereafter, the first string member 50 is removed. Herein, as the second string member 51, a stainless twisted pair having a cross section diameter of 0.2 mm to 0.3 mm may be used.

<167> Subsequently, as shown in FIGS. 49 to 51, both tips of the wire member 30 are curved at the center of the wire member 30 and the curved middle portion is then wound by the second string member 51.

<168> And, as shown in FIG. 52, the brush member 30 bound by the second string member 51 is inserted into the brush groove 11 of the cleaning jig 10. At this time, the brush member 30 is closely inserted into the brush groove 11 by the second string member 51.

<169> Thereafter, as shown in FIG. 53, the tip of the brush member 30 is cut and ground to be flattened by the cutting member 60.

<170> At this time, the height of the tip of the brush member 30 inserted into the brush groove 11a of the cleaning jig 10 is cut and ground in the range where the tip portion of the capillary does not contact the cleaning jig 10.

<171> Meanwhile, as the method of cutting the brush member 30, a cutting method, for example, scissors, knife, etc. can be used, but more preferably, since the cut tip portion may be pressed or may not be smoothly cut, causing remnants at the tip portion thereof, the water-jet cutting and grinding method as the cutting member 60 is used.

<172> When the tungsten wire as the brush member 30 is used, it is cut to maintain a predetermined height by a hydraulic pressure of 4,000 kg/cm^2 and can be ground to a final height by a horizontal type grinder on which a # 400 diamond wheel is mounted. FIG. 54 shows a form completed by subjecting to the grinding.

<173> At this time, as a processing condition of the horizontal type grinder, a rotational speed of the diamond wheel may be 2,000 rpm, a fixing body of the ground cleaning jig 200 rpm, and a forwarding speed 2 ㎛/sec.

<174> Since grinding dusts are smeared between the tungsten wires while the wire brushes of tungsten manufactured according to the above condition are ground, the tungsten wire brushes are sequentially put in a vessel in which cleaning agent and ethanol are filled and then put in an ultrasonic cleaner to be cleaned for 10 minutes to 50 minutes. Further, it is preferable to completely dry the wire brushes in a drier whose internal temperature is 50 ℃ to 90 ℃ for 30 minutes to 2 hours.

<175> Then, as shown in FIG. 55, E-rings 150 having a larger diameter than the brush groove 11a and elasticity are prepared and as shown in FIG. 56, the E-rings 150 are inserted into the brush groove 11a in which the brush members 30 are formed, thereby preventing the brush member 30 from separating from the brush groove 11a. At this time, it is preferable to use a diameter of the E-ring 150 by 3% to 20% than a diameter of the brush groove 11a.

<176> At this time, the cleaning jig 10 according to another embodiment of the present invention is shown in FIG. 57.

<177> As such, the cleaning jig according to another embodiment of the present invention is similar to the cleaning jig shown in FIG. 23 but has a difference in that the wire brush 30 is formed in the brush groove 11a, not

the brush hole 11.

<178> In other words, as shown in FIG. 58, a portion of forming the brush groove 11a in the bottom surface of the cleaning jig 10 is closed.

<179> This can be more clearly appreciated through FIG. 60 showing a cross-sectional view taken along the line E-E' of a plan view of the cleaning jig shown in FIG. 59.

<180> When a portion in which the brush member 30 according to another embodiment of the present invention is mounted is formed of the brush groove 11a, there is an effect of preventing one end of the E-ring 150 from protruding to the lower portion. Of course, although not shown in the drawings, it is apparent to those skilled in the art that it can be configured in the form of the brush hole 11, instead of the brush groove 11a.

<181> FIG. 61, which is a cross-sectional view taken along the line F-F' of a plan view of the cleaning jig shown in FIG. 59, shows that the plurality of suction holes 12a for sucking remnants is formed to be penetrated from the upper portion of the cleaning jig to the lower portion thereof.

<182> FIGS. 62 to 65 are views for explaining a method for automatically cleaning a capillary for wire bonding according to the present invention and FIG. 66 is a flow chart for explaining the method for automatically cleaning the capillary for wire bonding according to the present invention.

<183> The automatic cleaning method of the capillary for wire bonding according to the present invention has a characteristic of cleaning the capillary in a state where the capillary is separated from the wire bonding device (transducer horn).

<184> As shown in FIGS. 62 and 63, when a capillary 90 is fixed to the transducer horn 70 and the wire 80 for bonding penetrates through the capillary 90 to perform (S20) the wire bonding work by the set number of times while the wire bonding work (S10) is performed in a wire bonding device 100, the tip portion of the capillary is polluted by soot or is attached with plating slimes. As a result, the automatic cleaning method of the capillary for wire bonding according to the present invention removes (S30) the wire

for bonding from the capillary 90 after the wire bonding process is performed by a predetermined number of times and moves (S40) the capillary 90 to the cleaning jig 10 attached to the wire bonding device 100 by a program of a bonder facility in a state where the capillary 90 is joined to the transducer horn 70.

<185> Then, as shown in FIG. 64, the cleaning is performed after the capillary 90 is located at the brush member 30. The cleaning work is performed (S50) for 3 seconds to 20 seconds while the capillary 90 mounted on the transducer horn 70 moves from the brush member 30 up/down and left/right.

<186> And, as shown in FIG. 65, the tip of the capillary moves to the suction hole 12 of the cleaning jig 10 to remove foreign substances generated from the brush member 30 while performing the cleaning work (S60). At this time, the sucked foreign substances are discharged to the outside through the foreign substances discharging hose member 100 connected to the second through hole 15 of the cleaning jig via the first through hole 15, the second magnet member through hole 23, and the second through hole 16 of the cleaning jig 10 from the suction hole 12 of the cleaning jig 10. At this time, a stronger cleaning can be performed when a vacuum pump device 120 is used and the foreign substances can be filtered in the dust collecting filter 130 when the dust collecting filter 120 for filtering the foreign substances is configured in the middle of the foreign substances discharging hose member 110.

<187> Then, the wire 80 for bonding is back inserted into the capillary hole to start the wire bonding (S70).

<188> As such, as shown in FIGS. 62 to 66, the automatic cleaning method of the capillary for wire bonding according to the present invention is only one embodiment and can be variously changed by those skilled in the art.

<189> FIG. 67 is a view for explaining a cleaning device of a capillary according to another embodiment of the present invention and FIG. 68 is a cross-sectional view for explaining a cleaning jig according to another embodiment of the present invention.

<190> The cleaning device according to another embodiment of the present invention uses a device generating the vibration effect similar to vibration of a power toothbrush or ultrasonic vibration. The cleaning device of the capillary according to another embodiment of the present invention comprises the cleaning jig 10 that includes the brush member 30 wherein the plurality of brush holes 11 for mounting the wire brush is formed, both ends of an extra string of the string member 51 penetrate through the lower hole of the brush hole 11 through an upper hole thereof in a state where the middle portion of the cleaning jig 10 is bound by the string member 51, the bound middle portion is located at the lower hole of the brush hole 11, and after both ends are fixed in a state where both ends are located at the upper hole of the brush hole 11, both ends are ground; a vibration transferring member 141 that is connected to one end of the cleaning jig 10 to transfer vibration from a motor; and a vibration device 140 that vibrates the brush member 30 of the cleaning jig 10 connected to the vibration transferring member 141.

<191> The cleaning device of the capillary according to another embodiment of the present invention transfers the vibration effect vibration effect such as the vibration of the power toothbrush or the ultrasonic vibration to the vibration transferring member 141 through the vibration device 140 and the vibration transferring member 141 transfers the corresponding vibration to the cleaning jig 10, making it possible to remove the foreign substances of the tip portion of the capillary 90.

<192> Therefore, the cleaning jig 10 according to another embodiment of the present invention is connected to the vibration transferring member 141 to use the cleaning due to the vibration, such that it is preferable to have a form where the brush member 30 is formed at the front surface of the cleaning jig 10 as shown in FIG. 67. Since this method uses the brush, there is an advantage in that a low-level expert can easily remove the foreign material of the capillary as compared to the case of using the diamond film as in the related art.

<193> Herein, as the vibration device 140, the motor or the ultrasonic transducer can be used.

<194> FIG. 69 is a view for explaining a cleaning device of a capillary according to another embodiment of the present invention and FIG. 70 is a view showing in detail a brush member 320 shown in FIG. 69.

<195> The cleaning device according to another embodiment of the present invention comprises a circular wire brush member 320; a vibration device 310 that is formed at one end of the circular brush member 320 to rotate the circular wire brush member 320; and a power supply device 300 that supplies power to the vibration device 310. Herein, as the vibration device 140, the motor or the ultrasonic transducer can be used and as the power supplying device 300, a charger or a battery can be used. At this time, as the circular wire brush member 320, a form such as the circular brush wherein one end of the plurality of wires is inserted into a cylindrical body 321 and the other end thereof is exposed can be used.

<196> The cleaning device of the capillary according to another embodiment of the present invention transfers the vibration effect such as the vibration of the power toothbrush or the ultrasonic vibration to the circular wire brush member 320 through the vibration device 310, such that the cylindrical wire brush member 320 is rotated by 360° , making it possible to remove the foreign substances of the tip portion of the capillary.

<197> FIG. 71 is a view for explaining a cleaning device of a capillary according to another embodiment of the present invention.

<198> The cleaning device of the capillary according to another embodiment of the present invention includes a brush member 421 in a form of the power toothbrush; a rotation member 421 that fixes and rotates the wire brush member 420; a vibration transferring member 410 that transfers vibration to the rotation member 421; and a handle member 400 that transfers the vibration to rotate the rotation member 421 through the vibration transferring member 410 and perform a role of the handle. Herein, the inside of the handle member 400 is provided with the charger or the battery, similarly to the

power toothbrush and transfers the vibration through the vibration transferring member 410. At this time, the wire brush member 420 rotates 45 ° left and right, making it possible to remove the foreign substances of the tip portion of the capillary.

<199> FIG. 72 is a photograph showing a state before cleaning the capillary according to the related art and FIG. 73 is a photograph showing a state after cleaning the capillary according to the present invention.

<200> The state before the cleaning of the capillary according to the related art shows a photograph after performing the wire bonding 200,000 times. It can be appreciated that the surface of the capillary is significantly rough due to the foreign substances after performing the wire bonding 200,000 times and the capillary hole is significantly closed.

<201> To the contrary, it can be appreciated that the state after the cleaning of the capillary according to the present invention has minimal foreign substances on the surface of the capillary and the capillary hole is also not closed.

<202> At this time, FIGS. 72 and 73 are photographs magnified up to about 500 to 600 times by an electron microscope.

<203> FIGS. 74 to 83 are photographs for explaining results obtained by performing the wire bonding using the capillary according to the related art and results obtained by performing the wire bonding using the capillary after cleaning the capillary using the cleaning device of the capillary according to the present invention.

<204> At this time, FIG. 24 is a photograph after performing the wire bonding 200,000 times, FIG. 75 is a photograph after performing the wire bonding 400,000 times, FIG. 76 is a photograph after performing the wire bonding 600,000 times, FIG. 77 is a photograph after performing the wire bonding 800,000 times, FIG. 78 is a photograph after performing the wire bonding 1,000,000 times, FIG. 79 is a photograph after performing the wire bonding 1,200,000 times, FIG. 80 is a photograph after performing the wire bonding 1,400,000 times, FIG. 81 is a photograph after performing the wire bonding

1,600,000 times, FIG. 82 is a photograph after performing the wire bonding 1,800,000 times, and FIG. 83 is a photograph after performing the wire bonding 2,000,000 times.

<205> At this time, each photograph is a photograph magnified up to about 500 to 600 times by an electron microscope. Herein, two sheets of photographs of the column are photographs showing the results of the wire bonding before cleaning the capillary and two sheets of photographs of the right column are photographs showing the results of the wire bonding after cleaning the capillary.

<206> As shown in FIGS. 74 to 83, it can be appreciated that the wire bonding surface is rough at the time of performing the wire bonding before cleaning the capillary. However, it can be appreciated that the wire bonding surface is clear at the time of performing the wire bonding after cleaning the capillary.

<207> As described above, the present invention describes various embodiments of the cleaning jig for cleaning the capillary for wire bonding and various embodiments of the cleaning device, and the cleaning method, but it is apparent to those skilled in the art that the cleaning jig of the present invention basically includes the wire brush member 30 configured of the plurality of wires for cleaning the capillary, the attaching member (for example, the cleaning jig 10 or the cylindrical body 321, etc.) to which the wire brush for fixing the wire brush is attached.

<208> In other words, it is apparent to those skilled in the art that the string member 50 or the ring member 150 for fixing the wire brush member 30 is one of various embodiments and can be variously changed. The circular or rectangular brush hole 11 or the brush groove 11a for mounting the wire brush member 30 can be variously changed. Further, it can be appreciated to those skilled in the art that the suction hole 12 or the plurality of suction holes 12a for sucking the foreign substances removed at the time of cleaning the capillary can be also varied.

<209> While certain embodiments have been described above, it will be

understood that the embodiments described are by way of example only. Accordingly, the device and method described herein should not be limited based on the described embodiments. Rather, the devices and methods described herein should only be limited in light of the claims that follow when taken in conjunction with the above description and accompanying drawings.

[CLAIMS]

1. A cleaning jig for cleaning a capillary for wire bonding comprising:

a brush mounting part that is formed to mount a wire brush for cleaning the capillary;

a suction hole that is formed at one side of the brush mounting part to suck foreign substances of the capillary;

a first joining hole that is formed at one side of the brush mounting part to mount the cleaning jig on a wire bonding device;

a second joining hole that is formed at the other side of the brush mounting part to mount the cleaning jig on the wire bonding device;

a first through hole that is horizontally formed to the cleaning jig between one side of the suction hole and the joining hole;

a first magnet member that is joined to the first joining hole;

a second magnet member having a through groove that is joined to the second joining hole but is horizontally formed with respect to the first through hole; and

a second through hole that is horizontally formed with respect to the through groove at the other side of the suction hole.

2. The cleaning jig for cleaning a capillary for wire bonding according to claim 1, wherein the brush mounting part is formed in any one of a rectangular hole, a plurality of circular holes, and a plurality of circular grooves.

3. The cleaning jig for cleaning a capillary for wire bonding according to claim 1, further comprising a screw hole that fixes the wire brush member mounted on the brush mounting part in a direction intersected with the through hole in the side of the brush mounting part and a screw member that fixes the wire brush member mounted on the brush mounting part through the screw hole.

4. A cleaning device of a capillary for wire bonding comprising:

a cleaning jig according to claim 1, wherein the brush mounting part includes brush holes for mounting the wire brush, the brush holes and the suction hole are on a middle portion of the cleaning jig, the first joining hole is formed at one side of the middle portion, the second joining hole is formed at the other side of the middle portion,

and wherein the cleaning jig further comprises a screw hole formed on a side of the brush hole, and a screw member inserted up to the side of the brush hole through the screw hole;

a brush member that is mounted on the brush hole and fixed by the screw member; and

a first magnet member that is inserted into the first joining hole to be joined to the cleaning jig and a second magnet member that is inserted into the second joining hole to be joined to the cleaning jig but is formed with a magnet member through groove on the same line as the first and second through holes.

5. The cleaning device of a capillary for wire bonding according to claim 4, wherein the middle portion of the cleaning jig formed with the brush hole and the suction hole is formed to be lower than both sides thereof, having a step, and the portion formed with the brush hole and the suction hole has a concave groove at a bottom surface of the cleaning jig.

6. The cleaning device of a capillary for wire bonding according to claim 4, wherein the brush hole is formed in a rectangular hole, a plurality of circular holes and the plurality of suction holes, which vertically penetrate through the cleaning jig, are formed.

7. The cleaning device of a capillary for wire bonding according to claim 4, wherein the first and second magnet members are made of any one of a samarium-cobalt (SmCo) magnet and an odymium (Nd-Fe-B) magnet that are a rare earth-based magnet or a ferrite-based magnet.

8. The cleaning device of a capillary for wire bonding according to claim 4, wherein the brush member is made from one metal material of tungsten, stainless steel, brass, carbon steel, copper wire, steel wire (piano wire),

molybdenum alloy steel, and high speed steel (high-strength steel) or a mixed metal material of more than two metal materials of tungsten, stainless steel, brass, carbon steel, copper wire, steel wire (piano wire), molybdenum alloy steel, and high speed steel (high-strength steel) and a cross section diameter of the wire brush member is formed in 0.005 mm to 0.5 mm.

9. A method for fabricating a cleaning device of a capillary for wire bonding comprising a cleaning jig that includes a brush hole for mounting a wire brush and a suction hole for sucking foreign substances of the capillary, which are formed at a middle portion of the cleaning jig, a first joining hole to be joined to a first magnet member, which is formed at one side of the middle portion, a second joining hole to be joined to a second magnet member, which is formed at the other side of the middle portion, first through holes extended from the suction hole, which are formed at both sides of the second joining hole, second through holes formed on the same line as the first through holes, a screw hole formed on a side of the brush hole, and a screw member inserted up to the side of the brush hole through the screw hole, the method comprising:

winding a wire used as a brush member raw material so as to be used as the wire brush on first and second rod members facing each other of a straightening device configured to include a pressurizer lever and a pressing gauge;

turning the pressurizer lever to stretch the brush member raw material;

binding the middle portions of the brush member raw material using a first string member;

separating the brush member raw material from the first and second rod members and binding the brush member raw material with the second string member so as to be able to be used as the brush member;

forming each brush member by cutting the brush member raw material

by using a cutting member so as to be able to be used as the brush member and removing the first string member;

putting the brush fixing member on a bending mold member whose upper portion is formed with a concave groove in one direction, and stretching the cut brush member on the brush fixing member and then putting a fixing core member in a direction corresponding to the concave groove at a middle portion of the brush member and in a direction orthogonal to the brush member;

pushing the fixing core member to the inside of the concave groove by using a bending punch member so that the brush fixing member and the brush member is pushed to the inside of the concave groove of the bending mold member and winding the brush fixing member on the brush member;

fixing the brush member to the brush fixing member by closely attaching the side of the brush fixing member;

grinding the brush member to be flat;

cutting the brush fixing member at a size to mount on the brush hole; and

mounting the cut brush fixing member on the brush hole and fixing the brush fixing member to the brush hole by inserting the screw member into the screw hole.

10. The method according to claim 9, wherein the grinding the tip of the brush member includes cutting using a Water-Jet device and grinding using a horizontal type grinder on which a diamond wheel is mounted.

11. The method according to claim 9, further comprising after the grinding, sequentially cleaning the brush member to which grinding dusts are attached in a vessel in which cleaning agent and ethanol are filled and drying it for 30 minutes to 2 hours in a drier whose internal temperature is 50°C to 90°C.

12. The method according to claim 9, further comprising after drying the brush member, joining the first and second magnet members to each of the first and second joining holes of the cleaning jig.

13. A method for cleaning a capillary using the cleaning device of a capillary for wire bonding according to claim 4 comprising:

connecting one side of a foreign substances discharging hose member to the second through hole;

connecting the other side of the foreign substances discharging hose member to a vacuum pump device;

removing a wire for bonding from a capillary when the capillary is fixed to a transducer horn of a wire bonding device and the wire for bonding penetrates through the capillary to perform a wire bonding work by the number of times set during the wire bonding work in the wire bonding device;

moving the capillary to the cleaning jig in a state where the capillary is joined to the transducer horn;

after the capillary is located at the brush member, cleaning the foreign substances while moving the tip portion of the capillary up/down and left/right in the brush member;

moving the tip portion of the capillary to a suction hole of the cleaning jig; and

discharging the foreign substances of the tip portion of the capillary to the outside through the foreign substances discharging hose member connected to the second through hole of the cleaning jig via a first through hole, a second magnet member through groove, and a second through hole from the suction hole of the cleaning jig by operating the vacuum pump device.

14. The method according to claim 13, wherein the foreign substances is

filtered by forming a dust collecting filter member between the foreign substances discharging hose member and the vacuum pump device.

15. A cleaning device of a capillary for wire bonding comprising:

a cleaning jig that includes a brush member wherein a plurality of brush holes for mounting a wire brush is formed, both ends of an extra string of a string member penetrate through a lower hole of the brush hole through an upper hole thereof in a state where a middle portion of the cleaning jig is bound by the string member, the bound middle portion is located at the lower hole of the brush hole, and after both ends of the extra string are fixed not to penetrate through the upper hole through the lower hole of the brush hole in a state where both ends are located at the upper hole of the brush hole, both ends are ground;

a vibration transferring member that is connected to one end of the cleaning jig to transfer vibration from a motor; and

a vibration device that vibrates the brush member of the cleaning jig connected to the vibration transferring member.