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## (54) AN IMPROVED MICRO-SOLDERING TOOL


(71) We, COMPAGNIE INTERNATIONALE POUR L'INFORMATIQUE CII-HONEYWELL BULL of 94 Gambetta, 75020 Paris France, a French Body Corporate, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—


The present invention relates to a soldering tool which is particularly suitable for effectively soldering, in a single swift operation, the connecting tags of an integrated circuit microwafer, i.e. a "chip", to the corresponding ends, or terminals, of conductors carried by a substrate such as a printed circuit board. The connecting tags have already been soldered by a similar technique to the contacts of the microwafer and, often have had their ends coated with a suitable soldering or brazing material. At least the terminals of the conductors on the substrate have in turn been coated with this material, if not the whole of the conductors on the surface of the substrate. Also, the geometrical positions of the terminals correspond to the geometrical positions of the connecting tags on the microwafer.

The soldering process is thus as follows: once the chip is positioned above the substrate, either in contact with it or at a very short distance from it and with the ends of the connecting tags situated above the terminals of the conductors; the soldering tool is lowered, then heated by Joule effect, and its "bit" presses the ends of the connecting tags against the terminals, the soldering material on the tags melts and hence soldering takes place. The tool is then raised again. This process is of course automated by means outside the scope of the present invention.

For the method to be effective, the soldering tool needs to have, in addition to satisfactory mechanical rigidity as far as its soldering "bit" is concerned, the lowest possible thermal inertia and complete uniformity of heating of the surface by which the said "bit" bears against the connecting tags and terminals. The reason for this is to ensure that the localised melting of the soldering or brazing material is effective and sufficiently fast for there to be no danger of re-melting the previously soldered region attaching the other ends of the connecting tags to the terminals on the chip (even if the melting point of the first material is higher than that of the second material).

The object of the invention is to provide a micro-soldering tool which satisfies the above requirements.

In general terms, a micro-soldering tool which operates by Joule effect often comprises a pair of uprights made of a conductive metal or alloy which sandwich an insulating strip between them. These uprights are respectively connected to the poles of a current generator. The sandwich in fact forms the shank of a tool with which is associated, by a suitable mechanical and electrical connection, a soldering bit which is generally rectangular and made of a material selected from the group formed by tantalum, titanium, molybdenum and tungsten or their alloys. In one embodiment, which was described in a French patent Specification No. 2 306 041, the rectangular bit consists of a small plate having a roughened surface which is connected to the two uprights of the current supply sandwich by lateral flanges which are machined, together with the bit, from a sheet of a material selected from the above mentioned group, which is cut and then folded so that the flanges which are attached to the outer faces of the uprights support the said soldering bit at a suitable distance from the lower face of the sandwich. Advantageously, the bit is then machined to define the surface which is applied to the chip and this machining assists uniformity of heating by creating around the bit a "border" of higher electrical resistance which thus heats up more rapidly. To increase the speed of heating and likewise of cooling (when the current is switched off) the flanges may be cut in the shape of trapezia whose minor base boarders on the bit.

A soldering tool according to the present invention also has a heating bit but is intended to solder connecting tags to terminals which

are "peripheral" with respect to a chip so that the centre of the bit is cut-away to accommodate the chip and to apply pressure only to the ends of the connecting tags.

Accordingly the present invention consists in a tool for microsoldering using the Joule effect, comprising a heating bit connected by two electrically conductive side pieces to two sides of a tool shank which in operation supplies electrical current to a conductive circuit formed by the bit and the side pieces, said side pieces being formed integrally with the bit, and the bit having a central aperture so as to be in the form of a closed loop having two opposite sides which are directly connected to the side pieces, each side piece having its cross-section reduced symmetrically at its intersection with the side of the loop connected thereto.

In order that the invention may be more clearly understood reference will now be made to the accompanying drawings which show an embodiment of the invention, and in which:

Fig. 1 is a perspective view of a soldering tool in accordance with the invention,

Fig. 2 is a partial developed plan view of the heating part of the tool, and

Figs. 3 and 4 are enlarged views, partly in section, of the lateral faces of the bit after the side portions of the heating section have been folded.

Thus, broadly speaking, the micro-welding tool shown in Fig. 1 comprises a shank which is formed by a pair of relatively heavy conductive uprights 1 and 2 which sandwich a strip 3 of electrically insulating material between them. Alternatively, the assembly could be achieved by means of a plastics bonding agent impregnated into the material of the strip, by polymerising the bonding agent. To this tool shank are connected by means of screws, such as 5, the side pieces 7 and 8 of the heating portion of the tool, which is thus detachable. This portion, which is allotted the general reference numeral 6, also has a bit 9 which connects together the lower ends of the two side pieces. This bit 9 is cut-away at the centre at 10 and, as can also be seen in Fig. 2, the combination of the side pieces and the bit is cut from a metal strip made of a metal such as tantalum, which is then shaped by folding and, if necessary, by stamping to the final configuration shown in Fig. 1. In the embodiment shown, the end pieces are vertical and flat and broadly rectangular in shape. If necessary, they could be inclined (if the side of the bit parallel to the thickness of the sandwich of the shank were narrower than this thickness) and their sides could be cut away to cause their surface to become trapezoidal (if the corresponding side of the bit were narrower than the said sandwich).

The cross-section of each of the side pieces 7 and 8 is reduced by cut-outs, such as 11, on either side of its vertical axis of symmetry in the region at which it is connected to the bit. The lower edges of these cut-outs also define the upper edges of the bit 9. In addition, an intermediate cut-out 12, which is shown as circular for convenience (and particularly because this shape causes less reduction in mechanical strength) is formed in this narrower portion of the side pieces so as to form therein two paths 13 and 14 for current which are symmetrical about the vertical axis of the side pieces. The cut-out 12 encroaches into the wall of the bit. The result of these cut-outs is to create vour preferential heating points where the current enters and leaves the bit since the resistance of the circuit rises abruptly at these points. The bit is thus virtually divided into the half-loops 16 and 17, shown in Fig. 2, in which the heat distribution is balanced, and is so balanced virtually instantaneously as soon as current is applied.

In Fig. 2 a broken line 15 indicates fold lines on the initial blank for producing the heating element. Figs. 3 and 4 are side views half in cross-section showing the configuration of the bit after folding and stamping of the blank shown in Fig. 2.

In these Figures it can be seen that the face of the bit which is intended to be applied to the ends of the connecting tags on the chip for the soldering operation has been further machined to improve the match between its surface and that formed by the envelope of these connecting tag ends in the plane into which they are brought by the pressure from the tool. The terminal face 18 produced by this machining will then be ground as required to ensure that the points where the sides of the loop join are of reduced cross-section with respect to the remainder of the loop. What should be stressed is that, as can be seen in Figs. 3 and 4, the current paths in the lateral arms of the bit 9 are than constricted in the parts which are hatched in these Figures, thus creating preferred heating points formed by the half-loops 16 and 17 adding to the effect achieved by those, (13 and 14) obtained by means of the cut-out 12. It is quite clear that these preferred heating paths will be similarly balanced and, if the connecting tags are presented only under arms 16 and 17, thus being present on the chip only along two of its opposite sides, the formation of such paths of reduced cross-section may be assisted by the requisite degree of machining of this nature solely in these two arms.

It is obvious that the heating of the tool will be a function of the electrical power which is applied during a given period, which may possibly be monitored by some suitable means (an infra-red thermal couple etc).

WHAT WE CLAIM IS:—

1. A tool for microsoldering using the Joule effect comprising a heating bit connected by two electrically conductive side pieces to two sides of a tool shank which in operation supplies electrical current to a conductive circuit formed by the bit and the side pieces, said side pieces being formed integrally with the bit, and the bit having a central aperture so as to be in the form of a closed loop having two opposite sides which are directly connected to the side pieces, each side piece having its cross-section reduced symmetrically at its intersection with the side of the loop connected thereto.

2. A tool according to claim 1, wherein the reduction in cross-section of each side piece is caused by a pair of symmetrical cut-outs in the edges of the side piece, each side piece also including a central cut-out which also reduces the cross-sectional area through which electrical current flows in use to the the side of the bit which is attached to the side piece.

3. A microsoldering tool as claimed in claim 1 or 2, wherein the loop has at least two other sides which are of reduced thickness in the region where they join the first mentioned two opposite sides.

4. A method of producing a microsoldering tool according to any one of the preceding claims, comprising the stages of cutting away a metal strip to define the central portion of the loop of the bit and the symmetrical reduction in cross-section of the side pieces, folding the side-pieces to raise them with respect to said bit, and stamping the bit to define lateral edges rising from a plane portion.

5. A soldering tool substantially as hereinbefore described with reference to the accompanying drawings.

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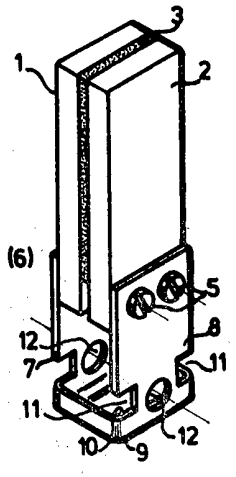
2 SHEETS *This drawing is a reproduction of the Original on a reduced scale*
Sheet 1

**FIG: 1**



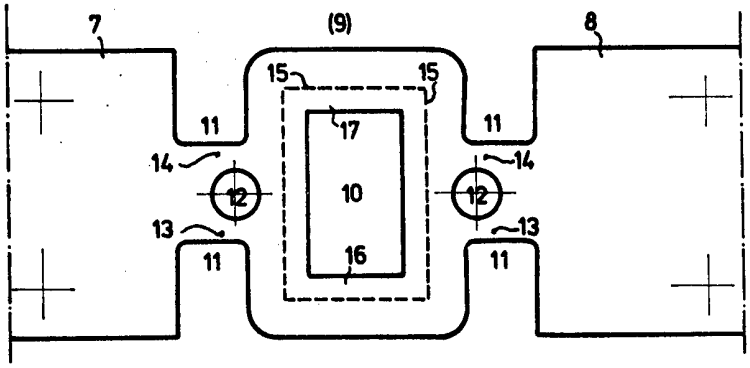




**FIG: 2**

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2 SHEETS *This drawing is a reproduction of the Original on a reduced scale*
Sheet 2

**FIG: 3**

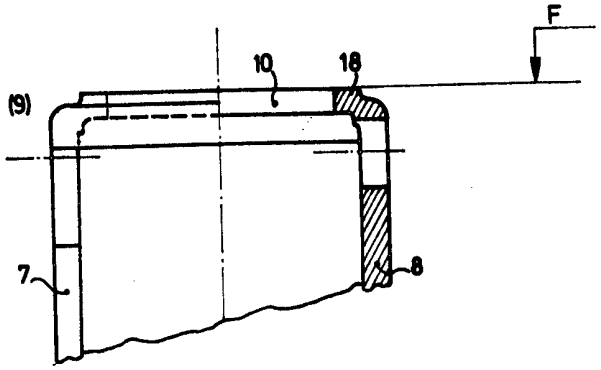


**FIG: 4**