CONSTRUCTION OF SOLDERING TIP 104 108 pdf

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The rear skirt of the tip is slotted into segments the rear edges of which are tapered rearwardly inwardly to be engaged by a forwardly opening conical surface on the front of a metallic sheath covering and supporting the rear portion of the ceramic rod. When the soldering tip is urged rearwardly in its assembly to the remainder of the soldering tool the segmented portions of the skirt are then pressed radially inwardly over the ceramic rod. The slots dividing the skirt into segments extend well forwardly thereof whereby the bending of the segments is forwardly of the tip of the ceramic rod where a thermocouple type temperature sensor may be disposed. Thus the skirt portions make good thermal contact with the rear and central portions of the ceramic rod but not with the temperature sensor front tip portion. This causes some significant isolation of the temperature sensor from the heater driven skirt portions and causes it to be more responsive to the instantaneous temperature of the working portion of the soldering tip. This relationship and configuration provides an improvement in the temperature precision and power regulation of the tip portion of the soldering tool. The term "hand held" is intended herein to include robotic applications and "gas" includes ambient air or inert or relatively inert gases such as carbon dioxide, nitrogen, or the like as when undesired chemical action is to be minimized. In the development of modern, state of the art soldering instruments, many criteria have been exhaustively dealt with including a comfortable and safe handle, ease of operation, low cost to manufacture and maintain, easy parts replacement either for maintenance and repair or for versatility in optimizing its utility for specific, different operations, longevity of the working tip in its severe environment of oxidation and corrosive fumes, and precise temperature control of the working tip with power regulation to maintain a critically important temperature while providing the correct flow of energy to accomplish the soldering or desoldering of costly precision components typical of, for example, modern electronic or computer equipment. It is an object of the present invention to provide a readily removable, replaceable soldering tip which is thermally highly effectively coupled to the heater element and which also promotes a very sensitive temperature control of the working tip relatively independently of the instantaneous temperature of the heater. It is another object to provide such a soldering tip which permits air flow therethrough in the forward direction for hot gas soldering or in the rearward direction for fume removal form the molten solder area. It is another object to provide in combination with such soldering tips a tip removing tool for safely and comfortably removing the tip, even if seized to the heater, while not risking damage to the fragile ceramic heater or sensing element. SUMMARY OF THE INVENTION Briefly, these objects are achieved in a presently preferred example of the invention in which the soldering tip is of the character having a rear, cylindrical skirt portion which fits over the front end of a cylindrical ceramic heater rod having a thermocouple temperature sensor disposed at its forward tip end and a deposited type of heater element disposed rearwardly thereof. Rearwardly of the deposited heater a metallic sheath is disposed snugly over the ceramic rod and is terminated by an outwardly conically tapered forward end. The skirt portion of the soldering tip is axially slotted along essentially its entire length and its rear is terminated by an inwardly conically tapered end such that when the tip is urged rearwardly over the ceramic rod the inwardly tapered skirt end is retained by the outwardly tapered sheath end whereby the slotted skirt is pressed radially inwardly into a tight thermal coupling with the ceramic rod and its heater. When so disposed, the forward end of the skirt portion is positioned contiguously to the forward end of the ceramic rod and its temperature sensor. The inner diameter the skirt portion is slightly larger than the ceramic rod so that a less than maximum thermal coupling exists between them except where the slotted skirt is forced radially inwardly against the rod and so that the tip may be removed and replaced without damaging the rod and its deposited heater. The slots, preferably three angularly equally spaced, extend well forwardly of the front end of the skirt causing for their bending a fulcrum forwardly of the temperature sensor tip of the rod. Accordingly, when the soldering tip is urged rearwardly by an outer retaining sleeve, the slotted skirt portions are held in a tight thermal coupling relation with the deposited heater but not with its temperature sensor

portion forwardly thereof. This relation provides an effective degree of isolation between the temperature sensor and the heated portions of the skirt while coupling it closer with the forward working portion of the tip. Forward of the finger guard rim 28 a second set of threads 30 is formed for holding and operating other elements of the tool combination as described infra. Also formed at the forward end of the collar 26 is a reduced diameter retaining shoulder Along the body of the finger grip collar 26 a tubular layer 34 of soft foam is provided for a cushioned grip for the operator while adding additional thermal insulation from the warm body The collar 26 and the body 20 are preferably molded of a relatively high density plastic. A heater assembly 36 is "plugged into" the forward end of the body 20 and retained by interlocking keys 38 and a combination dimple-detent The heater assembly includes a base 42 which is supported by its keyed connected to the tool body 20 and by its fit within the inner cylindrical wall 44 of the collar A silicone rubber o-ring 46 provides a snug, removable connection therebetween. A heater column 48 is cantilevered centrally axially forwardly from the heater assembly base 42 and includes a metallic sheath 50 extending forwardly to a point just rearwardly of a deposited type heater element 52 disposed on the forward central portion of a hollow ceramic heater rod The forward end of the sheath 50 is terminated in an outwardly flared or tapered conical retainer In this example, a thermocouple type of temperature sensor 58 is formed at the forward tip end 60 of the ceramic rod Accordingly, in this example, a pair of electrical signal leads 62 are provided along the length of the ceramic rod 54, through the base 42 and its electrical plug-in with the tool body 20, and thence through the tool and to a control station, not shown, by means of a four-conductor-plus ground cable also not shown. In like manner, a pair of power electrical leads 64 are provided from the heater element 52, through the heater base and the tool body and to the control station through the four conductor cable. In like manner, a positive ground connection 66 to the sheath 50 is carried through the tool by a lead 68 to the external cable. To summarily complete the description of FIG. Thusly, as will be described in more detail below, when the tip 74, the outer retaining sleeve 70, and the heater assembly 36 are placed together as shown and the finger grip collar 26 is threaded onto the body 22, the soldering tool 20 is securely, but removably, assembled for immediate utilization. With particular reference to FIGS. It is noted that the structure of these figures may be considered to be identical to that of FIG. The tip 74 includes a soldering point 78 followed by a heater rod encompassing skirt portion The rear of the skirt portion is terminated by an inwardly-rearwardly tapered conical surface 82 adapted to engage the inner conical surface of the retainer The conical surface 82 is preferably knurled with sharp ridges 84 to assure a good grounding connection therebetween and, when the tip is rotated with respect to the retainer 56 while in contact therewith, a cleaning scouring action is achieved further to assure a positive, zero resistance connection. In the mid portion of the tip 74 an enlarged diameter portion creates two annular retaining shoulders: The tip 74 is slotted through the wall of the skirt portion preferably into three angularly equal segments 89 to maximize their strength and thermal capacity. The slots extend well forwardly of the forward end of the skirt portion so that the effective fulcrum for radially bending the skirt segments inwardly is at the forward end of the skirt portion. The inner diameter of the skin portion is larger than the ceramic heater rod whereby good thermal conductivity therebetween is achieved by radially compressing the skirt segments into contact with the rod; and this is accomplished by urging the tip rearwardly so that its rear tapered surface 82 is thrust inwardly as its rearward displacement is resolved radially inwardly by its engagement with the inner conical surface of the retainer Hence, the heater element 52 is placed in tight thermal connection with the tip while the temperature sensor 58 is not and, accordingly, is significantly more responsive to the soldering point temperature than to that of the heater driven skirt segments. From thence the gas is forced over the skirt segments 89 and through the slots therebetween and finally forwardly and outwardly over the soldering point 78 where, depending upon parameter values determined by the operator, the gas may be used to provide an inert atmosphere for the soldering operation, it may be used for pre-heating the workpiece, it may be used directly for hot-gas soldering, it may be used to divert noxious fumes away or toward a collector fan, or any combination or sequence of such operations. The structure of the handle, body, and heating assembly as well as the duct 90 and the outer retaining sleeve 70 may be identical to that of the example of FIG. The tip 94, however, may be formed separately from its heat collecting skirt portion The latter may be a simple cylindrical cup thrice slotted for its full length and having a central bore through its

otherwise closed front end. The tip 94 proper includes a soldering point 98 followed by an outwardly tapered, conical surface which is engaged by the retaining shoulder 76 of the outer retaining sleeve The soldering tip 94 is formed with a rearwardly extending tubular portion having a length essentially coextensive with the heater element deposited on the ceramic rod The entire tip 94 is centrally bored to form a hot gas nozzle for directing the soldering gas onto the workpiece. In operation, pressurized gas is urged through the duct 90, through the annular space between the sheath 50 and the outer retaining sleeve 70, through the slots in the skirt portion 96, inwardly over the front end of the hollow ceramic heating rod, rearwardly along the annular space between the ceramic rod and the tubular portion of the tip 94, and then forwardly out through the central bore nozzle The tip includes a forward soldering point and a slotted rear body portion with a rear, enlarged diameter portion forming a retaining shoulder to be engaged by the retaining tip of the screw-on collar A hot air heater pipe extends the length of the heater portion of the hollow ceramic rod 54 and is smaller in diameter than the inner diameter thereof. The forward end of the pipe is formed with a flange which extends radially outwardly to the collar The front end of the accumulator skirt portion is centrally bored for the pipe and is otherwise closed. In operation, gas is fed forwardly into the annular space between the sheath 50 and the outer sleeve 70, through the slots between the skirt segments, forwardly between the front portion of the accumulator and the ceramic rod, over its end 60, rearwardly between the ceramic rod and the pipe , and thence forwardly therethrough to the slotted rear body portion of the soldering tip After passing through this tortuous heat collecting path, the gas is directed over the soldering point and forwardly onto the workpiece. Forwardly of the threads ", the inner diameter of the threaded tip is reduced to form a retaining shoulder for engaging and retaining the flange of the pipe The front portion of the tip is bored to form a nozzle within which is disposed a flatted needle past which the heated gas may flow in laminar fashion toward the workpiece. In the example of FIG. The tip in this example has the form of a square or rectangular cup which fits over the SMD and engages its terminals along the periphery of the cup. The cup is formed with a reduced diameter end from which extends rearwardly an internally threaded portion for engaging the threads of the accumulator slotted skirt portion Thusly, when the tip is threaded onto the threads , the pipe is secured to the assembly and a gas flow passage is created from the SMD to the rear of the heater column In this example, however, the gas flow is vacuum drawn whereby the soldering tip cup functions as a "suction cup" to draw the SMD off its circuit board as soon as its terminals are desoldered; or, alternatively, the cup may be used to hold and place an SMD for an installation soldering operation until the operator stops the suction and releases the SMD to its desired position on the board. A finger operated slide or rotary collar valve is provided so that, when desired, the operator may permit an adjusted mix of ambient cool air into the duet As in the example of FIG. As will be described in more detail below, the removal tool is a unitary body machined from aluminum, or the like, or molded of a high density plastic. The large diameter, rear end of the tool may be knurled externally for finger gripping for torque as its internal threads are turned onto its mating threads As the tool is thusly threaded rearwardly over the threads 30 the slotted forward tip end is spread over the retaining shoulder 86 until it snaps radially inwardly over the shoulder The tool may then be unthreaded forwardly to push the tip out of engagement with the retainer 56 and free of its seized contact with the ceramic heater rod. The forwardly inwardly conically tapered portion has an axial length such that the tool extends from the front of the finger guard rim 28 to just rearwardly of the retaining shoulder 88 when the tip 74 is installed over the heater column 48 and within the retainer The inner diameter of the forward tip end of the removal tool is less than the outer diameter of the shoulder However, because the forward conical portion of the tool is slotted into a plurality, preferably three, of segments , the tip end effectively spreads radially outwardly by being pulled over the shoulder 86 when the tool is turned onto the threads When by this action the tip end snaps over the shoulder 88, the segments return to their quiescent diameter and firmly grasp the body of the soldering tip When the step illustrated in FIG. The tip ejector apparatus ejects the tip 74 from the removal tool and retains it safely within a bin The ejector includes the open-at-the-top retainer bin and an ejector vane mounted upwardly from the base of the bin. The vane fits within the slot separating a pair of the segments and engages the rear of the retained soldering tip The removal tool may then be pulled rearwardly as indicated by the motion arrow with a force appropriate to spread the segments and release the tip 74 into the safe confines

of the bin To facilitate these steps the rearward side of the bin may be notched by a half port the sill of which provides a stabilizing shelf for the tool while it is being drawn rearwardly to eject the soldering tip There have thus been disclosed and described a number of examples of the invention which provide the advantages and achieve the objects set forth herein above. Claims 4 I claim: A soldering tip for a hand held electric soldering iron of the character including a cylindrical heater rod with a predetermined outer diameter and having a forward end and a heating element disposed thereon, the soldering tip being of the character to fit removably over the forward end of the heater rod and its heating element and comprising: The invention as set forth in claim 1 in which the number of said segments is three. The invention claimed is an electric soldering iron tool having a soldering tip and tip removal apparatus comprising: The invention as set forth in claim 3 in which the number of said segments of said soldering tip body is three.

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This invention has as an object. This invention has as another object the provision of an ultrasonic soldering iron in which over-heating of the transducer elements is avoided. A still further object of the present invention is the provision of an ultrasonicsoldering unit of compact and efiicient design. Other objects will appear hereinafter. For the purpose of illustrating the invention there is shown in the drawings forms which are presently preferred; it being understood, however, that this invention is not limited to the precise arrangements and instrumentalities shown. Figure 1 is a perspective view of an ultrasonic soldering unit, including the ultrasonic soldering iron of the present invention. Generator 16 is connected by line 18to a gas-pressure or air-pressure control box Sheath 40 extends through a pipe cross Conduit 44 through which air passes between air-pressure regulator 26 and air-pressure gauge 28, extends into and out of pipe cross 42, but is perforated within pipe cross 42 permitting the escape of air therewithin. Conduit 44 is air-tightly secured in respect to pipe cross 42 at both its entrance and its exit. The soldering iron 12 is provided with a terminal fitting 54 over which conduit 50 is slipped. Fitting 54 is provided with a beaded terminal edge 56 which aids in the retention of conduit 50 thereon. In addition, a tightly Wound plastic tape, or like holding means 58, and wire loops 60 serve to retain conduit 50 operatively positioned over fitting 54 notwithstanding the movement of soldering iron 12 during operative manipulation thereof. Thus, thetinner diameterof fitting 54 is somewhat larger than the outerdiameter of sheath 40, so that a clearance constituting the channel 62 is provided between the outer surface of sheath 40 and the inner wall of fitting I Fitting 54 may be retained in operative position in respect to soldering iron 12 by threaded screws 55 and Thus, screw 55 is inserted inwardly through outer flat retention plate 59 and inner tubular housing 61 into fitting Posts 66 and 68 are. Soldering tip 76 is joined to coupling bar 84 by threaded bolt 89, which is received in rriatingly threaded female openings in coupling bar 84 and in soldering tip A tubular extension 90 is telescopically received within tubular housing 61 and is retained in fixedly secured relation thereto by means of threaded screws 92, and by screw 93 which joins plate 59, housing 61 and extension 90 together. A mating pair of telescopic retention bushings 94 and 95 are retained in position against the inner face of housing by threaded screws Bushings 9,4 and 95 serve the dual purpose of providing an air-tight seal between the innermost end of extension 90 and the terminal portion of tubular housing Extension 90 is provided with discharge outlets 98 comprising perforations in its wall proximate the innermost end of tip heater A flange head and an annular flange are provided at the terminal portion of soldering iron 12 and serve to retain tip heater 74 in position. If desired, shims and may be removed, permitting the discharge of air from passageway 88, not only through discharge outlets 98 but also through discharge outlets which are provided in flange head The operation of the soldering iron 12 of the present invention is as follows: Control of operation of soldering iron 12 is efiected through foot switch 10, the depression of foot switch 10 causing energizing current to be passed through generator 16 and into soldering iron Air is continuously transferred through conduit 22, air pressure regulator 26 and conduit 50 through channel 62 and channel This stream of air prevents the stack 78 and coupling bar 84 from becoming overheated, such air stream acting as a heat-exchange medium, withdrawing heat from stack 78 and coupling bar 84, during its passage through the aforesaid channel The air is discharged from soldering iron 12 to the atmosphere through discharge outlets In this manner, the soldering iron 12 may be used for extended periods of time without overheating stack 78, notwithstanding the simultaneous use of tip heater Moreover, the soldering iron 12 may be freely manlpulated, being unencumbered by a plurality oflines passing thereto. In the embodiment of the ultrasonic soldering iron designated shown in Figure 3 the conduit 50a containing a wire-encompassing sheath a is slip-fitted over the beaded terminal edge 56a of terminal fitting 54a. A passageway designated 52a is provided between the inner Wall surface of conduit a and sheath 40a. Conduit 50a may be secured to a pipe cross within an air-pressure control box similar to that shown in Figure 1. Moreover, the wires within sheath 40a may be in electrical contact with a suitable generator generally similar to that shown in Figure 1. Wires 36a and 38g extend through channels and , respectively, in terminal fitting

54a. Terminal fitting 54a is also provided with channels 62a for permitting the passage. The outer shell of ultrasonic soldering iron a includes a tubular housing 6 1a which is air-tightly fitted over the forwardmost end of terminal fitting 54a, and secured thereto by screws 57a. The forwardmost end of the shell of ultrasonic soldering iron comprises nose element , which is threada bly secured to the forwardmost portion of housing 61a. The magnetostrictive transducer 78a and coupling bar 84a are wedged within the interior 88a of ultrasonic soldering iron by a pillow block which is carried within terminal fitting 54a and a mating wedge which is engaged with magnetostrictive transducer 78a. Air discharge openings When ultrasonic soldering iron v is in use, air is flowed through passageway 52a, channels 62a, interior 88a and discharge openings The flowing air serves as a heat-exchange medium and serves to withdraw heat from stack The present invention may be embodied in other specific forms without departing from the spirit or essential attributes thereof, and accordingly, reference should be made to the appended claims, rather than to the foregoing specification as indicating the scope of the invention. Ultrasonic soldering apparatus including a soldering iron comprising a longitudinal and generally imperforate housing, a magnetostrictive transducer within said houslng, a soldering tip coupled to said magnetostrictive transducer, said magnetostrictive transducer being spaced from the inner wall surface of said housing, a discharge orifice in the wall of said housing intermediate the ends of said housing, an inlet to said housing spaced from the end of said magnetostrictive transducer remote from said soldering tip, a flexible tubular conduit joined to said inlet, sheathed electrical conductors extending through said conduit and inlet into said housing to said magnetostrictive transducer, said flexible conduit having an internal crosssection sufficiently greater than the cross-section of said sheathed electrical conductors to permit the passage of gas therethrough, and a passageway extending from said inlet to said discharge orifice in the wall of said housing, 3. Ultrasonic soldering apparatus including a soldering iron comprising a longitudinal and generally imperforate housing, means for generating vibratory energy within said housing, a soldering tip coupled to one end of said means for generating vibratory energy by a coupling bar, support means spaced from and adjacent.

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