United States Patent

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[54] **SOLDERING APPARATUS**
5 Claims, 7 Drawing Figs.

[52] **U.S. Cl.** **228/37,** 29/503, 118/429, 134/130, 228/33
[51] **Int. Cl.** **B23k 1/08**
[50] **Field of Search** 228/33, 34, 35, 36, 37; 137/91, 95; 134/104, 130; 118/402, 403, 429; 29/503

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ABSTRACT: Soldering apparatus comprising a sump for receiving molten solder covered with a layer of oil compound. A fountain is disposed centrally in the sump and forms a chamber having an inlet disposed in the molten solder and an upwardly opening outlet disposed centrally in the sump and elevated above the surface of the oil compound. A pump is provided for pulling molten solder in through the inlet and discharging it out the outlet to form a wave over which, for example, printed circuit boards may be passed to solder a plurality of components thereto and form electrical leads between the components. The pump circulates the molten solder through the fountain and out the outlet at a rate sufficient to cause it to spill downwardly around the fountain to pass through the layer of oil compound and carry a sufficient quantity of such oil compound therewith and into the inlet of the fountain to provide a desired ratio of oil compound to solder in the wave.

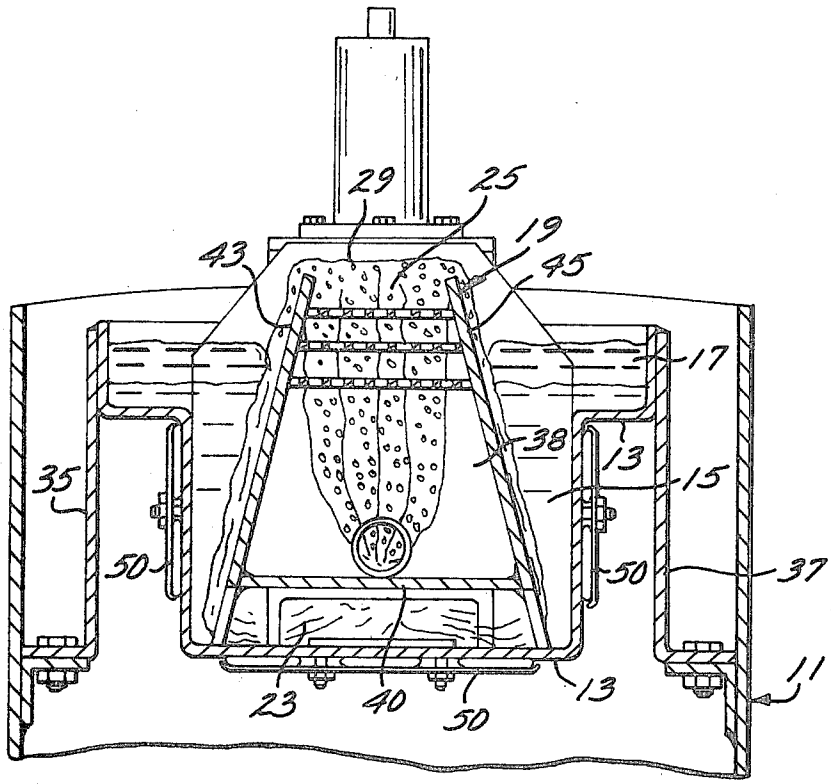


FIG. 1

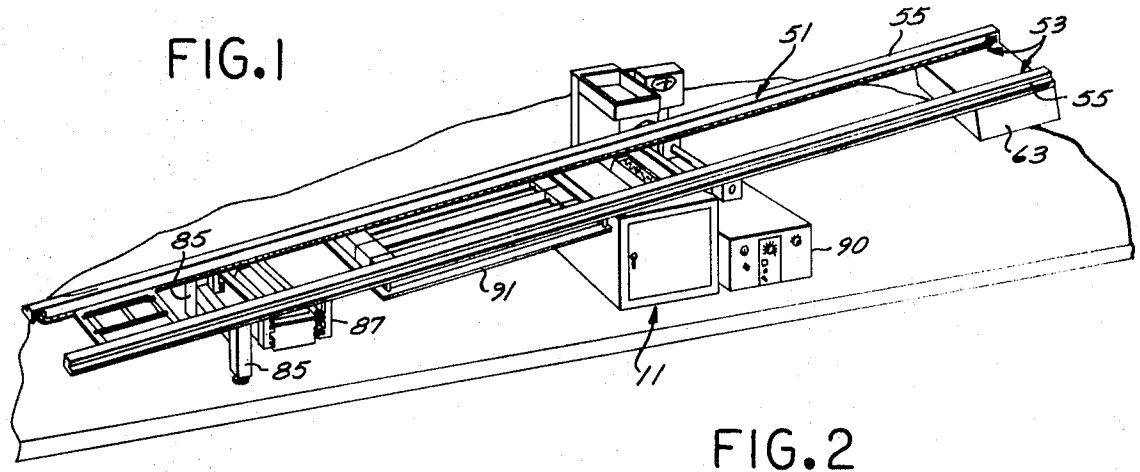


FIG. 2

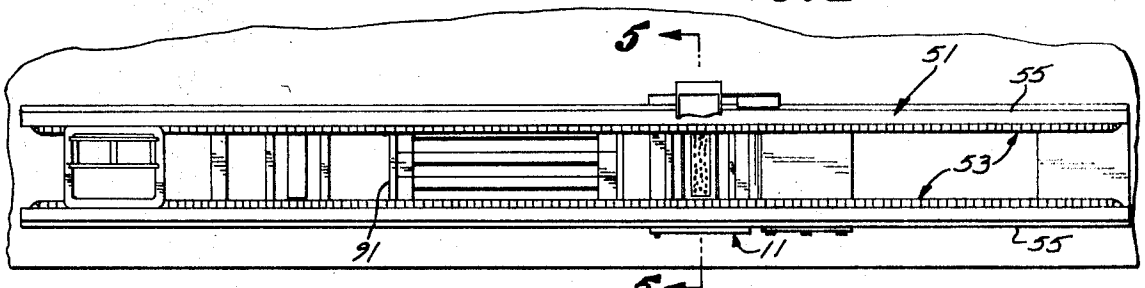


FIG. 3

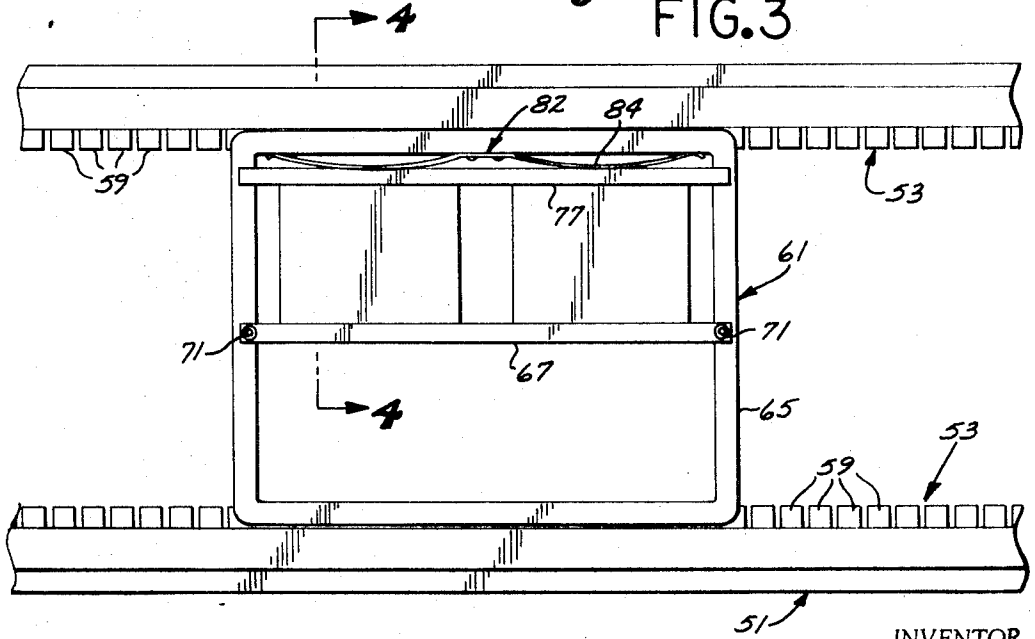
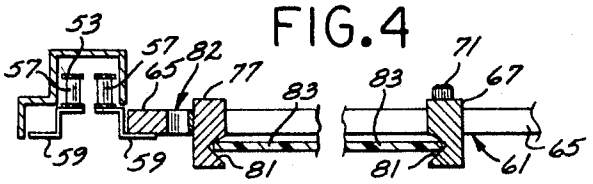


FIG. 4



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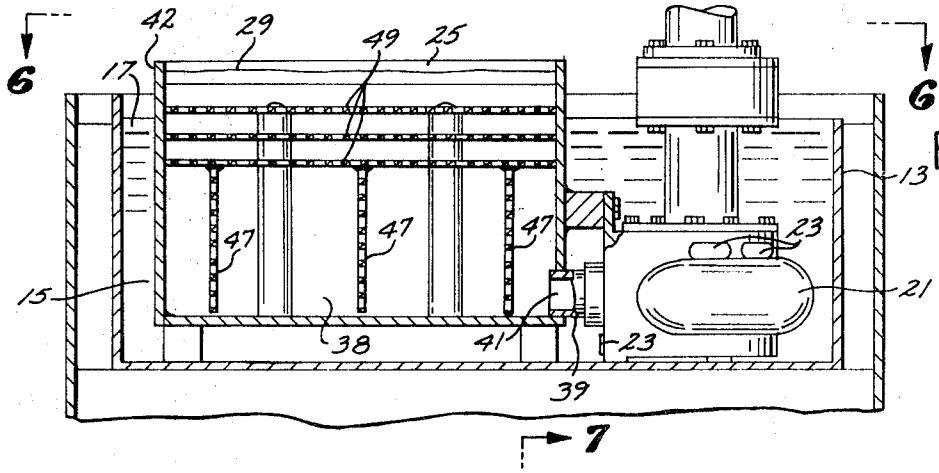


FIG. 5

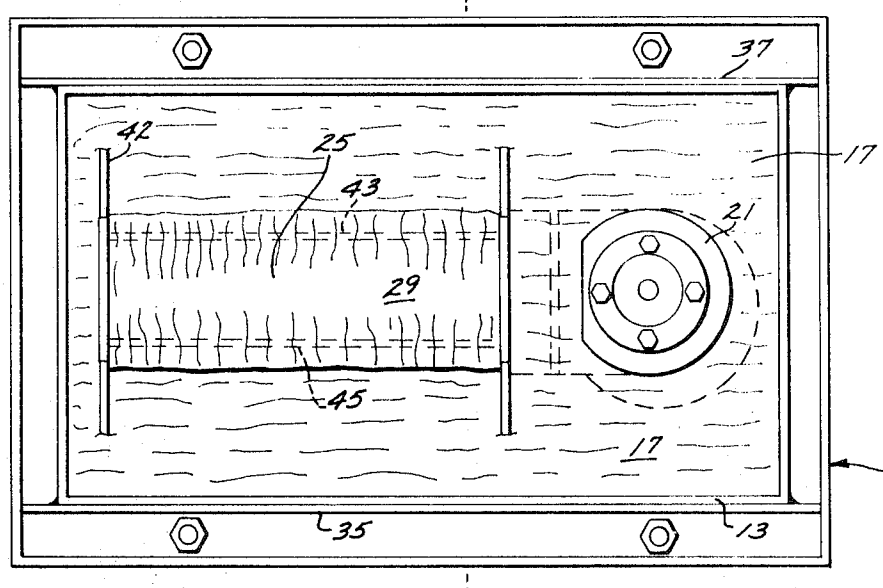


FIG. 6

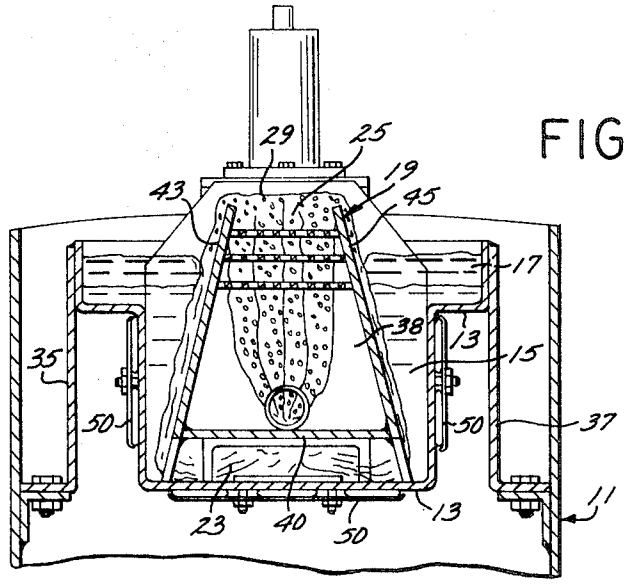


FIG. 7

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SOLDERING APPARATUS

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention relates generally to devices for soldering components together.

2. Description of Prior Art

Prior art soldering devices have been proposed for intermixing an oil compound and molten solder to reduce dripping from the soldered component during solidification and consequent icicling and bridging, and also reducing oxidization and consequent formation of a film, or dross, on the surface of the solder. These devices generally include a sump having molten solder therein and covered with a layer of oil compound. A fountain is provided which includes a first inlet disposed in the solder and a second inlet disposed in the oil compound and the ratio of the resultant solder-oil compound mix is controlled by valve means. A device of this type is shown in U.S. Pat. No. 3,058,441. Such devices suffer the shortcoming of including a pair of inlets for the fountain and valve means must be provided for controlling the ratio of oil compound to solder. Valves located in the oil compound conduits frequently have oil baked on the seats thereof during operation of the devices thereby changing the oil flow rate and altering the ratio of oil to colder thus resulting in improper soldering of components passed through the wave. Further, the depth and vertical location of the layer of oil compound floating on the solder must be maintained rather accurately to avoid introducing either air or solder into the oil compound inlet.

SUMMARY OF THE INVENTION

The present invention is characterized by a sump containing molten solder covered by a layer of oil compound. A fountain is disposed in the sump and includes an inlet disposed in the solder, and an upwardly facing outlet disposed above the oil compound. A pump draws solder in said inlet and discharges it out said outlet at a rate which causes the expelled solder to flow downwardly through the oil compound in the sump at a rate sufficient to pull sufficient oil compound therewith, and into the inlet, to form the desired oil-compound-to-solder ratio in the resultant soldering wave formed above the outlet.

An object of the present invention is to provide soldering apparatus which will thoroughly intermix solder and oil to prevent icicling and provide for well-defined electrical leads on printed circuit boards.

A further object of the present invention is to provide a soldering apparatus of the type described which does not require a valve for controlling the oil-to-solder ratio.

Another object of the present invention is to provide soldering apparatus of the type described which includes a pump for circulating the solder through the oil compound at a rate which will create a mixture containing the desired ratio of oil compound to solder.

The objects and advantages of the present invention will become apparent from consideration of the following description when taken in conjunction with the accompanying drawings.

DESCRIPTION OF THE DRAWINGS

FIG. 1 is a perspective view of a soldering apparatus embodying the present invention;

FIG. 2 is top view of the soldering apparatus shown in FIG. 1;

FIG. 3 is a partial top view, in enlarged scale, of the soldering apparatus shown in FIG. 1;

FIG. 4 is a broken vertical sectional view, in enlarged scale, taken along the line 4–4 of FIG. 3;

FIG 5 is a vertical sectional view in enlarged scale, taken along the line 5–5 of FIG. 2;

FIG. 6 is a plan view taken along the line 6–6 of FIG. 5; and

FIG. 7 is a vertical sectional view taken along the line 7–7 of FIG. 6.

DESCRIPTION OF THE PREFERRED EMBODIMENT

The soldering apparatus of present invention includes a cabinet, generally designated 11, which supports a sump 13 (FIG. 5) containing molten solder 15 covered by a layer of oil compound or wetting agent 17. Disposed centrally in the sump 13 is a fountain, generally designated 19, which receives solder 15 and oil compound 17 from a pump 21 having inlets 23 which are disposed within the solder 15. The fountain 19 is formed with an upwardly facing opening 25 over which is formed a molten solder wave 29. Thus, the pump 21 may be operated to pull solder 15 in through the inlets 23 to force such solder into the fountain 19 and upwardly out the opening 25 to form the wave 29. The solder 15 will be pumped at a sufficient rate to cause the solder spilling downwardly about the outer periphery of the fountain 19 to pull a selected amount of oil compound 17 therewith and into the inlets 23 to form a mixture having the desired ratio of oil compound 17 to solder 15 for forming the wave 29.

Referring to FIG. 7, the sump 13 is supported from the cabinet 11 by means of mounting brackets 35 and 37. Referring to FIG. 5, the pump 21 is in communication with the right-hand end of the fountain 19 by means of a pipe 29 which forms a discharge port 41 within a plenum chamber 38 formed by such fountain 19. The fountain 19 includes a pair of upright end walls 42 and 44, and a pair of sidewalls 43 and 45 (FIG. 7) which slope upwardly and inwardly to form the outlet 25 between their upper edges.

A plurality of vertical and horizontal walls from vertical and horizontal baffles 47 and 49, respectively, for interrupting smooth laminar flow of the molten solder and oil compound 17 to form a wave of uniform height above the top baffle 49. As best seen in FIG. 7, electric heaters 50 are secured to the bottom wall and sidewalls of the sump 13 for maintaining the solder 15 heated to the desired temperature.

An inclined conveyor, generally designated 51, is supported across the top of the fountain 19 and includes a pair of opposed conveyor chains, generally designated 53, carried in respective longitudinal tracks 55. Referring to FIG. 4, the conveyor chains 53 include chain links 57 which mount opposed holding fingers 59 for receiving carrier trays, generally designated 61. The chains 53 thread over sprockets (not shown) disposed at opposite ends of the tracks 55 and the sprockets at the upper end of the conveyor 51 are driven by a motor housed within a housing 63.

The carrier 61 includes a rectangular frame 65 which has a longitudinal backing bar 67 mounted thereon. The backing bar 67 is formed on its opposite ends with outwardly facing notches which receive the frame 65 and have setscrews 71 for being tightened against the frame 65 to hold such backing bar 67 in position on the frame. A holding bar 77 is arranged coextensive with the backing bar 67 and is formed on its opposite extremities with outwardly facing notches which loosely fit the frame 65. Referring to FIG. 4, both the bar 67 and 77)FIG. 4) are formed with confronting, longitudinal grooves 81 which receive the opposite edges of printed circuit boards 83.

Still referring to FIG. 3, a formed leaf springs, generally designated 82, is mounted on the frame 65 behind the holding bar 77 and includes a pair of arcuate portions 84 which press thereagainst.

The lower end of the conveyor 51 is supported on a pair of legs 85 and has a fluxer 87 disposed thereunder. The fluxer 87 is of conventional construction and may include brushes for applying flux to the circuit boards 83 as they are moved up the conveyor 51. Disposed intermediate the fluxer 87 and the cabinet 11 is a preheater 91 which preheats the printed circuit boards 83 prior to application of the solder wave 29. The controls for the solder pump 21, conveyor speed and preheater 87 are all contained in a compact control console 90 which may be conveniently and rapidly replaced in case of failure.

In operation, the sump 13 is filled to the desired level with molten solder 15 and such solder is covered with a layer of oil compound 17. The fluxer 87, preheater 91 and pump 21 are

started and the conveyor **51** actuated. The pump **21** pulls molten solder through the inlets **23** and passes it out the discharge port **41** into the fountain **19** where it is forced through the vertical baffles **47** and upwardly through the horizontal baffles **49**. The upwardly expelled solder and oil compound mixture forms the wave **29** and then spills downwardly along the outer periphery of the sidewalls **43** and **45** to pass through the layer of oil compound **17** and back through the molten solder **15**. The mixture passing down through the oil compound **17** pulls a portion thereof downwardly and introduces it into the pump inlet **23** for passage through the impeller of the pump **21** for thorough mixing and subsequent discharge back into the fountain **19**. The pump **21** is operated at a speed which will circulate the solder **15** at a rate which will effect the desired ratio of oil compound **17** to solder **15**.

The components (not shown) have been previously mounted on the boards **83** and such boards etched to define the circuitry. The backing bar **67** on the carrier **61** has also been adjusted for the width of the circuit boards **83** to be printed and such boards are placed in the carrier by inserting one edge thereof in the groove **81** formed by the biased holding bar **77** and pressing that member against the bias of the spring **82** to enable the opposite edge thereof to be received within the groove **81** of the holding bar **67**. The carrier **61** is then placed on the lower end of the conveyor **51** and will be passed over the fluxer **87** and preheater **91**. The boards **83** are then passed over the wave **29** formed by the combination oil compound **17** and solder **15** to apply the desired solder.

From the foregoing description, it will be apparent that the soldering apparatus of present invention provides an economical and convenient means for soldering of electrical components. The ratio of solder to oil compound is controlled by pump rate and there is no requirement for maintaining the layer of soldering agent at any one particular level. Further, a carrier is provided for convenient receipt of a circuit board and rapid release thereof.

Various modifications and changes may be made with regard to the foregoing detailed description without departing from the spirit of the invention.

I claim:

1. Soldering apparatus for producing a standing wave formed by a mixture of a selected ratio of oil compound and molten solder, said apparatus comprising:

a sump;

molten solder in said sump;

a layer of oil compound floating on said solder;

fountain means in said sump including a passage having an inlet disposed in said molten solder and an upwardly opening outlet disposed above the surface of said oil compound, said inlet being disposed a sufficient distance below the surface of said oil compound such that pumping of said molten solder and oil compound out said outlet at a predetermined rate will cause the stream of molten solder pouring downwardly from said outlet to agitate said oil compound and intermix therewith sufficiently to produce a mixture of said selected ratio at said inlet; and

a pump for pumping said mixture through said passage at said predetermined rate.

2. Soldering apparatus as set forth in claim **1** that includes:

baffles arranged in said outlet to interrupt flow of said mixture and provide a uniform wave above said outlet.

3. Soldering apparatus as set forth in claim **1**, that includes:

a heater disposed in heat exchange relationship with said sump for heating said molten solder.

4. Soldering apparatus as set forth in claim **1** that includes:

a plurality of vertically spaced horizontal walls, said walls including perforations for passage of said solder-and-oil compound to interrupt flow thereof and provide a uniform wave above said outlet.

5. Soldering apparatus as set forth in claim **1** wherein:

said pump includes a variable-speed drive means for varying the flow rate of said pump to adjust the ratio of solder to oil compound.