



**AUTOMATIC DROSS REMOVAL APPARATUS AND  
METHOD**

**Field of the Invention**

The present application relates generally to apparatus and methods for removing  
5 dross from the surface of liquid or molten solder.

**Background of the Invention**

During normal containment of liquid solder in a solder reservoir such as that used  
by a wavesolder device, a metallic oxide forms which is referred to as dross. The dross  
10 floats on the solder surface and must periodically be removed from the solder reservoir to  
prevent contamination of the solder. The manual removal of the dross results in machine  
down time to remove the dross from the solder reservoir. This machine down time can  
result in a high cost of ownership due to frequent maintenance to remove these oxides.

One prior art device is a wavesolder designed so that the dross flows into an area at  
15 one end of the solder pot reservoir such that a machine operator will manually scoop out  
the generated dross into a basket for removal. However, the manual removal of the dross  
can still be time consuming.

Other devices allow the removal of dross from the surface, such as apparatus  
shown in U.S. Patent Nos. 5,087,356 to Webb, 4,509,670 to Cammarata and 3,980,219 to  
20 Schmid. However, these devices do not function optimally because they in part do not  
provide for the reclamation of excess solder from collected dross.

**Summary of the Invention**

An automatic dross removal apparatus, which can be used with a solder wave  
25 apparatus, generally includes a reservoir having a cavity for containing liquid solder, dross  
removal apparatus having a first end extending within the cavity of the reservoir for  
removing dross on the surface of the liquid solder, and a motor engaged with the dross  
removal apparatus. In one embodiment of the invention, the dross is automatically  
removed by a conveyor driven by a motor. In another embodiment of the invention, the  
30 dross is automatically removed by a motor driven receptacle. Means for moving the dross  
from one part of the solder reservoir to another, such as a pump, a nozzle, a sloped surface  
or channel, a paddle or a moving edge, can be included. Preferably, a computer is used to



control the automatic dross removal. The dross can be placed in a dross separation device which can include apparatus for processing the dross to remove any remaining solder.

An advantage of embodiments of the present invention is that a machine having a reservoir of solder, such as a wavesoldering device, does not have to be shut down to  
5 remove dross from the surface of the solder.

Another advantage of embodiments of the present invention is that dross can be removed from a solder reservoir without operator interaction, which creates a more maintenance free machine.

### 10 Brief Description of the Drawings

FIG. 1 is a cross sectional side view of one embodiment of an automatic dross removal apparatus in accordance with the invention.

FIG. 2 is a front isometric view of a dross reclamation device used in conjunction with the automatic dross removal apparatus of FIG. 1.

15 FIG. 3 is a cross sectional side view of another dross reclamation device used in conjunction with the automatic dross removal apparatus of FIG. 1.

FIG. 4 is a front isometric view of another embodiment of an automatic dross removal apparatus in accordance with the invention.

FIG. 5 is a top view of the automatic dross removal apparatus of FIG. 4.

20 FIG. 6 is a cross sectional side view of yet another embodiment of an automatic dross removal apparatus in accordance with the invention.

FIG. 7 is a front isometric view of the conveyor of the automatic dross removal apparatus of FIG. 6.

### 25 Detailed Description of the Invention

FIG. 1 shows an embodiment of the automatic dross removal apparatus 10. The apparatus 10 includes a solder reservoir 12 and a conveyor 14 that is driven by a motor 16. The reservoir 12 contains liquid solder 18 which has dross 20 forming on its top surface. A dross removal mechanism, such as a conveyor 22, has one end protruding into the solder  
30 reservoir 12 to skim the dross 20 from the surface of the solder 18 and carry it on the conveyor. The conveyor 14 is driven by a motor 28 that drives a sprocket 30 that engages and drives the endless belt or chain of the conveyor for removing the dross from the pot. The conveyor can have one or more brackets 15, such as an angle bracket. When power is supplied to the motor, the conveyor draws the angled bracket forward, dragging the dross

on the conveyor and over the edge of the solder reservoir. The conveyor motor is preferably driven by a computer 32 such that the dross removal apparatus 10 can operate automatically with or without operator intervention. Alternatively, the conveyor motor 16 can be controlled by a switch. Preferably, the conveyor motor 16 is computer controlled through timers with overload protection for the device.

The conveyor 22 or other dross removal mechanism removes the dross from the solder reservoir, sends it over chute 17 and deposits it into a container or a dross separation device 34 for further processing. One embodiment of the dross separation device 34, which is shown in FIGS. 1 and 2, includes a first portion 36 and a second portion 38. The first and second portions are movable in relation to one another such that the dross recovered from the solder reservoir 12 can be compressed to remove any usable molten solder. For example, the first portion 36 of device 34 can include a pivot 40 or hinge and be connected to a piston 42 or cylinder that is driven by a motor 43. The second portion 38 can include holes 44 of an appropriate size such that molten solder drops 45 flow through the holes and drops into a receptacle 46.

As shown in FIG. 2, the dross separation device 34 can include an ejection device 48 that can include, for example, a first portion 50 for ejecting the solder depleted dross, and a piston 51 or cylinder that is driven by a motor 52. The ejection device 48 can eject dross by moving outwardly in the direction of the dross separation device 34 after the first portion 36 is opened such that it is pivoted outwardly from the second portion 38. A conveyor chute 19 for depositing the dross into the dross separation device 34 can also be provided.

FIG. 3 shows an embodiment of the automatic dross removal apparatus 60 that uses a dross separation device 62 which separates the dross into receptacle 64 and reusable solder into receptacle 46. The dross separation device 60 can be a device such as the dross muncher manufactured by the company Solet located in the United Kingdom. Alternatively, dross separation device 60 could be some other manufactured device.

FIGS. 4 and 5 show a second embodiment of the automatic dross removal apparatus 70. The apparatus 70 has a solder reservoir 72 and a dross skimmer 74 having one end 77 protruding into the reservoir 72 for moving or pushing the dross that is directed towards it. The apparatus 70 also has a means for moving the dross within the reservoir towards the skimmer 74 such as one or more pumps 76 and pressure nozzles 78, which use channels to direct the dross to the skimmer 74. The nozzle 78 has a main wave nozzle entrance and exit side weir chambers 80 that are connected internally via tubing allowing

more even flow and to increase the exit side flow to sufficiently flush out the dross 20 from the nozzle. The dross flows out of the nozzles in one direction flushing any dross with it, toward the removal mechanism. A gas inert with solder such as nitrogen can be used to pressurize the nozzle to remove and/or limit oxygen to further reduce dross  
5 formation.

Like the dross removal apparatus 10, the dross removal apparatus 70 can be driven by a motor 32 for automatically moving the skimmer 74 to place the dross in a receptacle 75. The motor 32 is preferably driven by a computer 16 such that the dross removal apparatus 70 can operate automatically with or without operator intervention.  
10 Alternatively, the motor 32 can be controlled by a switch. Preferably, the motor 32 is computer controlled through timers with overload protection for the device.

FIGS. 6 and 7 show a second embodiment of the automatic dross removal apparatus 110. The dross removal apparatus 110 is generally similar to the dross removal apparatus 10 of FIG. 1 with the exception that the conveyor 140 moves in an opposite  
15 direction to the conveyor 14 in a direction shown by arrow 115. As shown in FIG. 6 and best in FIG. 7, the conveyor 140 has two endless chains 134 that support a plurality of L-shaped brackets 131. The brackets 131 preferably have one or more slots 136 to allow liquid solder 118 to pass therethrough.

The dross removal apparatus 110 includes a solder reservoir 112 and a conveyor  
20 114 that is driven by a motor 116. The reservoir 112 contains liquid solder 118 which has dross 120 forming on its top surface. A conveyor 122 has one end protruding into the solder reservoir 112 to skim the dross 120 from the surface of the solder 118, push it up the surface of ramp 119 and dump it into receptacle 175. Alternatively, the dross could be placed in a dross separation device as shown in either FIGS. 2 or 3. The conveyor 114 is  
25 driven by a motor 116 which drives a sprocket 130 that engages and drives the endless belt or chain of the conveyor. The conveyor can have one or more brackets 131, such as an angle bracket. When power is supplied to the motor, the conveyor draws the angled bracket in the direction of arrow 115, and drags the dross on the ramp 119 and over the edge of the solder reservoir. The conveyor motor 116 is preferably driven by a computer  
30 132 such that the dross removal apparatus 110 can operate automatically with or without operator intervention. Alternatively, the conveyor motor 116 can be controlled by a switch. Preferably, the conveyor motor 116 is computer controlled through timers with overload protection for the device.

It should be understood that the foregoing is illustrative and not limiting and that obvious modifications may be made by those skilled in the art without departing from the spirit of the invention. Accordingly, reference should be made primarily to the accompanying claims, rather than the foregoing specification, to determine the scope of the invention.

What is claimed is:

1. An automatic dross removal apparatus for a reservoir having a cavity for containing liquid solder, the apparatus comprising:
  - a conveyor having a first end extending within the cavity of the reservoir for removing dross on the surface of the liquid solder; and
  - a motor adapted to drive the conveyor for removing the dross from the reservoir.
2. The automatic dross removal apparatus of claim 1, wherein the conveyor is an endless belt.
3. The automatic dross removal apparatus of claim 2, wherein the conveyor has a plurality of angle brackets being attached to a surface of the endless belt for engaging the dross.
4. The automatic dross removal apparatus of claim 1, in combination with a dross separation device being adjacent a second end of the conveyor for separating solder from the dross collected from the automatic dross removal apparatus.
5. The automatic dross removal apparatus and dross separation device of claim 4, wherein the dross separation device comprises:
  - a first portion;
  - a second portion being in a movable relation to the first portion, one of the first and second portions having a perforated section for allowing the liquid solder to pass therethrough; and
  - means for moving the first portion in relation to the second portion.
6. The automatic dross removal apparatus of claim 5, wherein the means for moving the first portion in relation to the second portion comprises a piston operatively connected to a second motor.
7. The automatic dross removal apparatus of claim 1, further comprising a computer connected to the motor for controlling the conveyor.
8. An automatic dross removal apparatus for a reservoir having a cavity for containing liquid solder, the apparatus comprising:

a conveyor having an endless belt and a first end extending within the cavity of the reservoir for removing dross on the surface of the liquid solder;

a motor adapted to drive the conveyor for removing the dross from the reservoir;

a computer electrically connected to the motor for controlling the motor; and

5 a dross separation device.

9. The automatic dross removal apparatus and dross separation device of claim 8, wherein the dross separation device comprises:

a first portion;

10 a second portion being in a movable relation to the first portion, one of the first and second portions having a perforated section for allowing the liquid solder to pass therethrough; and

means for moving the first portion in relation to the second portion.

15 10. An automatic dross removal apparatus for a reservoir having a cavity for containing liquid solder, the apparatus comprising:

a skimmer having a first end extending within the cavity of the reservoir and being movable within the reservoir for moving dross on the surface of the liquid solder out of the reservoir;

20 a motor adapted to move the skimmer for removing the dross from the reservoir; and

means for moving the dross within the reservoir towards the skimmer.

11. The automatic dross removal apparatus of claim 10, wherein the means for moving  
25 the dross is one or more pumps.

12. The automatic dross removal apparatus of claim 10, wherein the means for moving the dross is one or more sloped channels.

30 13. The automatic dross removal apparatus of claim 10, in combination with a dross separation device being adjacent a second end of the conveyor for separating solder from the dross collected from the automatic dross removal apparatus.

14. The automatic dross removal apparatus and dross separation device of claim 10, wherein the dross separation device comprises:

a first portion;

5 a second portion being in a movable relation to the first portion, one of the first and second portions having a perforated section for allowing the liquid solder to pass therethrough; and

means for moving the first portion in relation to the second portion.

15. An automatic dross removal apparatus for a reservoir having a cavity for containing liquid solder, the apparatus comprising:

a skimmer having a first end extending within the cavity of the reservoir and being movable within the reservoir for moving dross on the surface of the liquid solder and out of the reservoir;

a motor adapted to move the skimmer for removing the dross from the reservoir;

15 at least one channel for moving the dross within the reservoir towards the skimmer;

a computer electrically connected to the motor for controlling the motor; and

a dross separation device for separating solder from the dross collected from the automatic dross removal apparatus.

20 16. The automatic dross removal apparatus and dross separation device of claim 15, wherein the dross separation device comprises:

a first portion;

25 a second portion being in a movable relation to the first portion, one of the first and second portions having a perforated section for allowing the liquid solder to pass therethrough; and

means for moving the first portion in relation to the second portion.

17. The automatic dross removal apparatus of claim 16, wherein the means for moving the first portion in relation to the second portion comprises a piston operatively connected to a second motor.

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18. A method for automatically removing dross from a solder reservoir having a cavity for containing liquid solder, the method comprising:

providing a conveyor having a first end extending within the cavity of the reservoir;

providing a motor adapted to drive the conveyor;  
removing dross on the surface of the liquid solder by controlling the motor to drive the conveyor and collect the dross.

5 19. The method of claim 18, further comprising:

providing a dross separation device being adjacent a second end of the conveyor;  
and

separating excess solder from the removed dross by placing the dross collected from the automatic dross removal apparatus into the dross separation device.

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20. The method of claim 18, further comprising:

providing a computer electrically connected to the motor; and  
controlling the motor using the computer.

15 21. A method for automatically removing dross from a solder reservoir having a cavity for containing liquid solder, the method comprising:

providing a skimmer having a first end extending within the cavity of the reservoir and being movable within the reservoir;

providing a motor adapted to move the skimmer;

20 moving the dross within the reservoir towards the skimmer; and

moving dross on the surface of the liquid solder out of the reservoir by driving the motor to move the skimmer and remove the dross from the reservoir.

22. The method of claim 21, further comprising:

25 providing a dross separation device being adjacent a second end of the skimmer;  
and

separating excess solder from the removed dross by placing the dross collected from the automatic dross removal apparatus into the dross separation device.

30 23. The method of claim 21, further comprising:

providing a computer electrically connected to the motor; and  
controlling the motor using the computer.