

[54] FLAKING APPARATUS

[72] Inventors: Daniel E. Wiley, Corpus Christi; Harmon A. McDougal, Beaumont, both of Tex.; Allan L. Turner, Denver, Colo.

[73] Assignee: PPG Industries, Inc., Pittsburgh, Pa.

[22] Filed: July 19, 1971

[21] Appl. No.: 163,900

Related U.S. Application Data

[62] Division of Ser. No. 883,516, Dec. 9, 1969, Pat. No. 3,642,053.

[52] U.S. Cl. 164/276, 164/283

[51] Int. Cl. B22d 11/06

[58] Field of Search 164/87, 276, 283; 165/86, 94

[56] References Cited

UNITED STATES PATENTS

405,914	6/1889	Schultz	164/276
1,291,603	1/1914	Nagy	164/276
2,561,636	7/1951	Pyk	164/87 X

3,197,862 8/1965 Harvey 164/87 X

FOREIGN PATENTS OR APPLICATIONS

72,745 1/1894 Germany 164/276

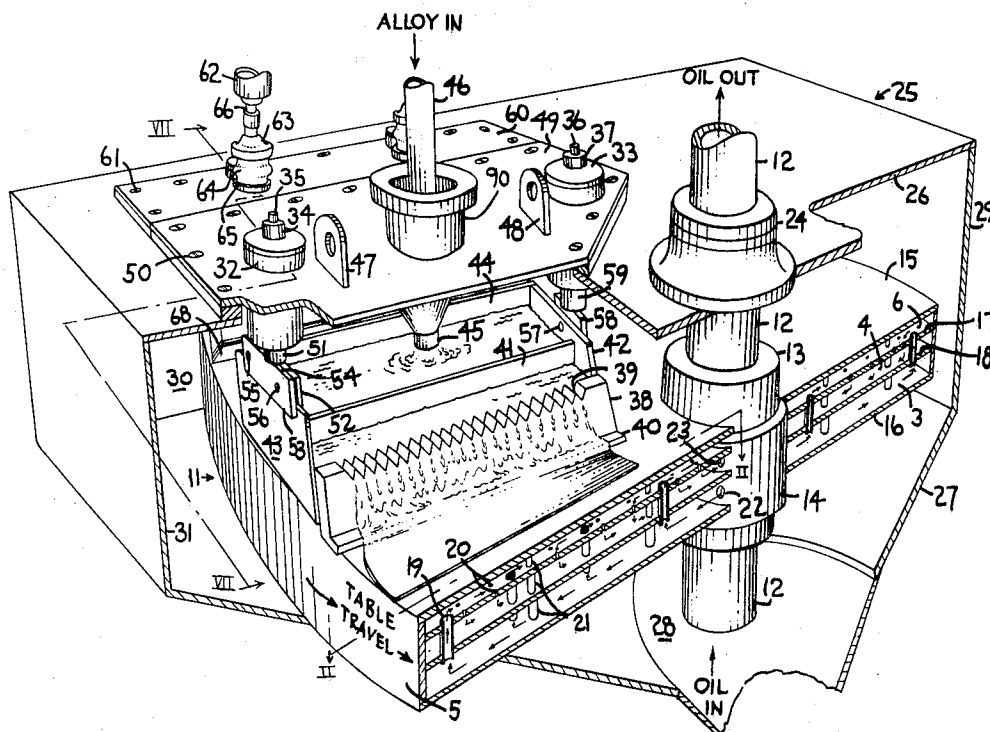
Primary Examiner—R. Spencer Annear

Attorney—Chisholm and Spencer

[57] ABSTRACT

A rotary table is described for use in producing flakes of solid material from solutions or from molten metal baths. In particular the invention is described with reference to the preparation of sodium-lead alloys. In the specific embodiment molten sodium-lead alloy is deposited on the surface of a rotating flat table. Indirect heat exchange is established between the molten metal and a fluid circulating underneath the table surface. Discharge orifices are provided in a chamber below the table surface at a multiplicity of points across its width. Uniform discharge of heat exchange fluid at all points across the undersurface of the table is accomplished by an equal pressure drop being maintained across all of the orifices.

10 Claims, 7 Drawing Figures



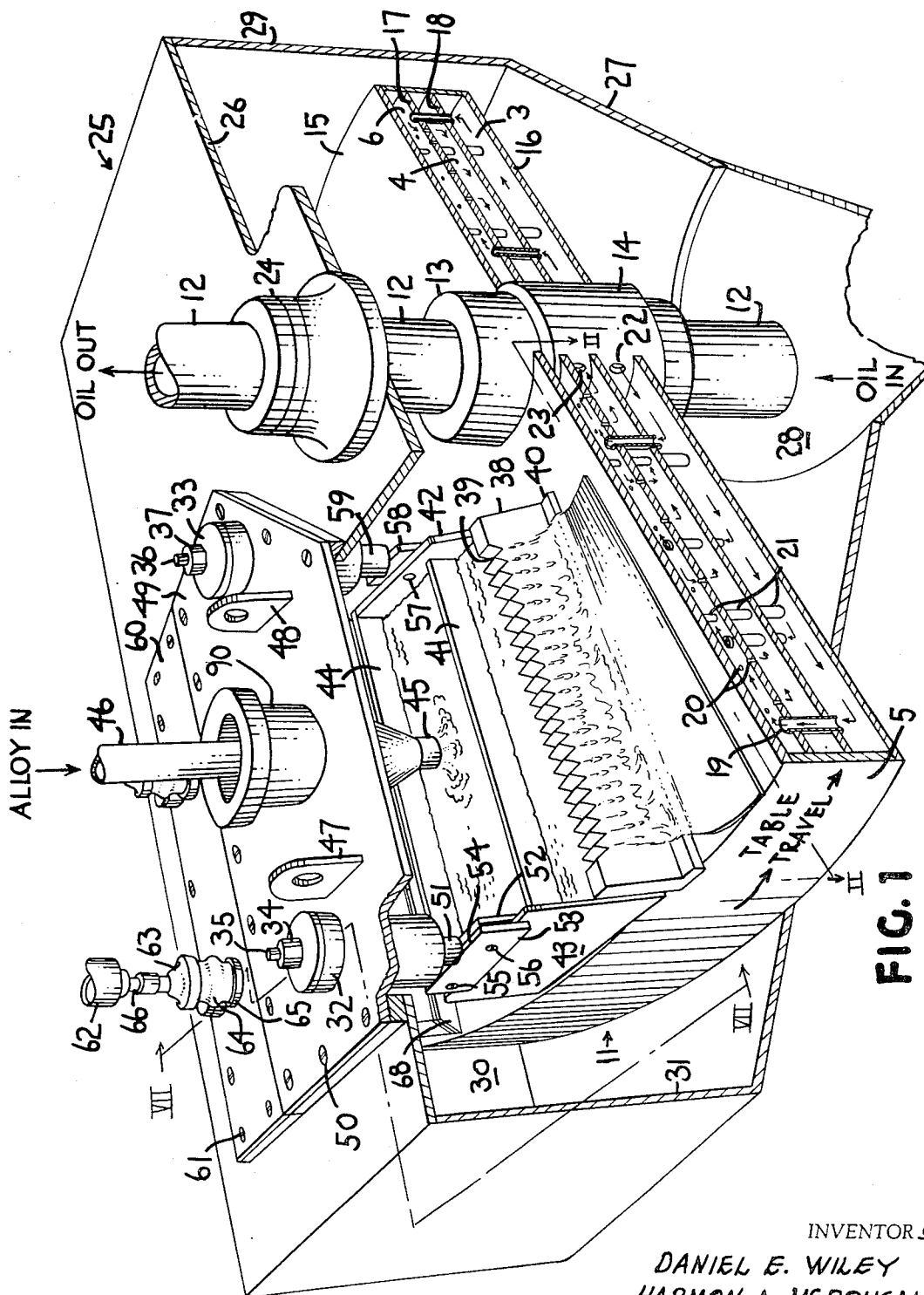


FIG. 1

INVENTORS

DANIEL E. WILEY
HARMON A. McDOUGAL
ALLAN L. TURNER

BY

Chisholm and Spencer
ATTORNEYS

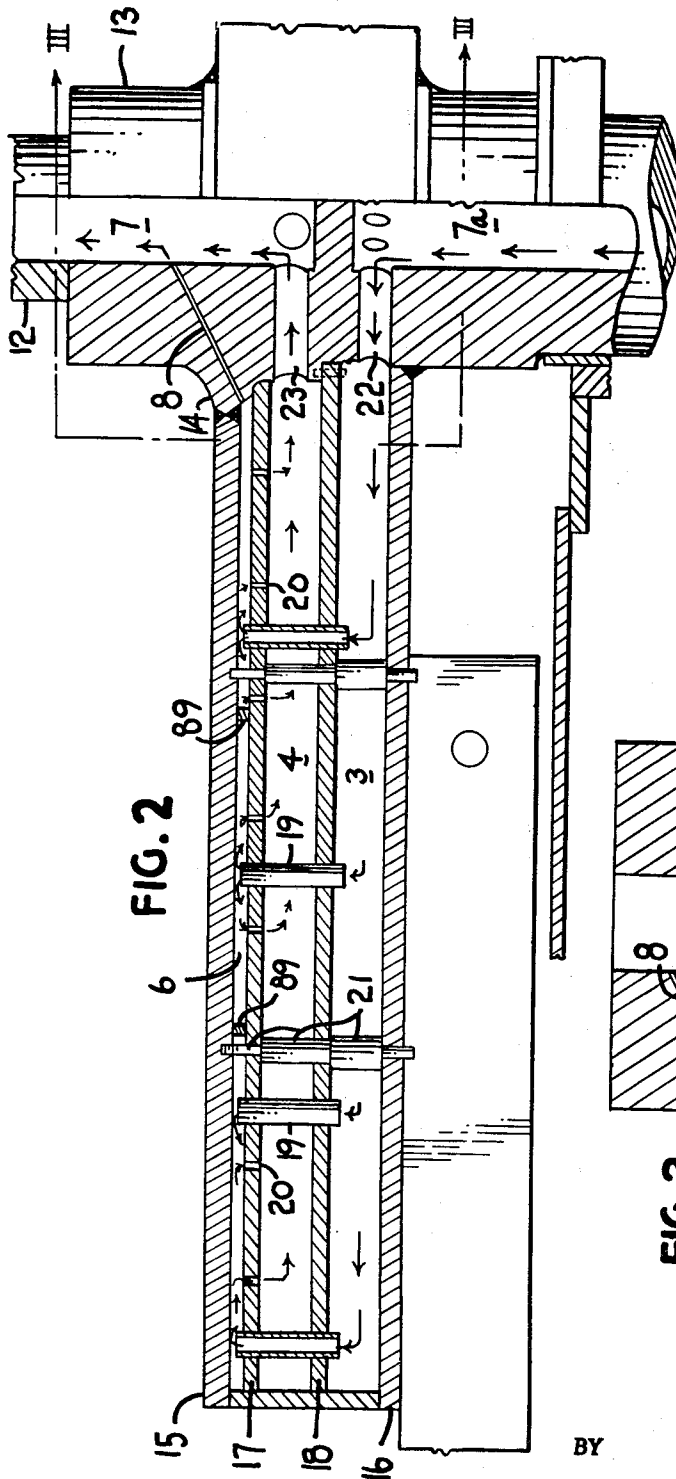


FIG. 2

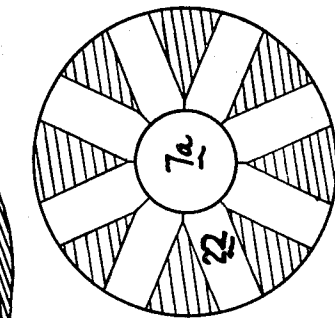


FIG. 4

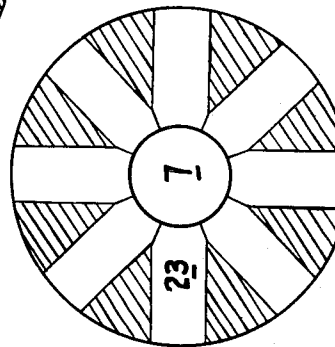


FIG. 5

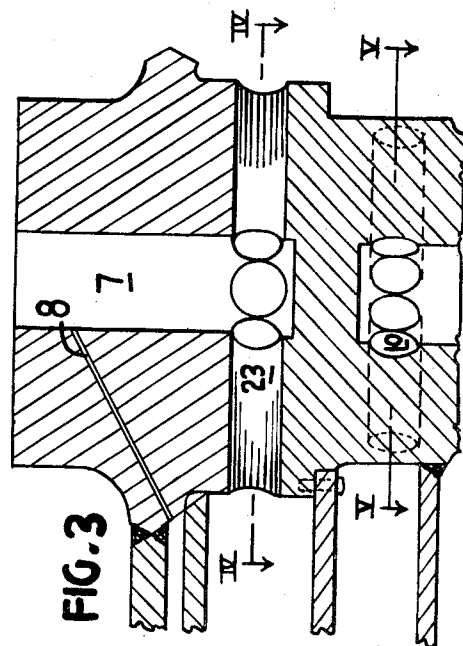


FIG. 3

BY

INVENTORS
 DANIEL E. WILEY
 HARMON A. McDOUGAL
 ALLAN L. TURNER
Charles M. Spencer
 ATTORNEYS

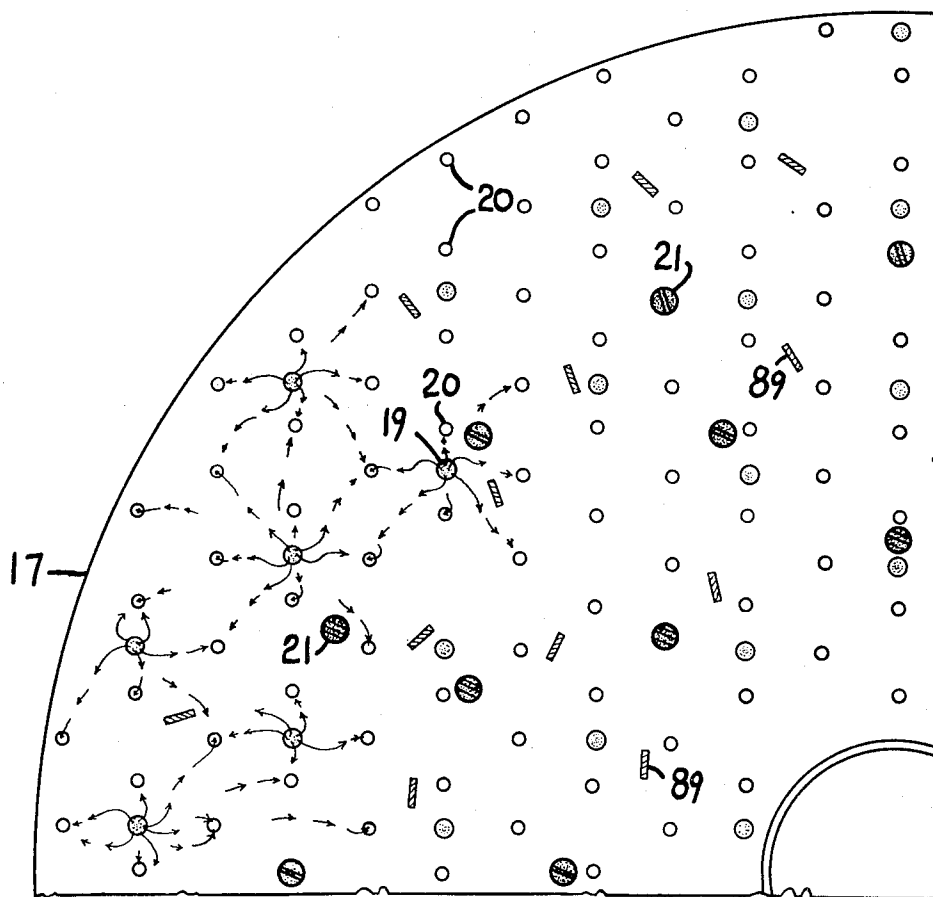


FIG. 6

INVENTORS

DANIEL E. WILBY
HARMON A. McDUGAL
ALLAN L. TURNER

BY

Christensen & Green
ATTORNEYS

FLAKING APPARATUS RELATED APPLICATIONS

This application is a Division of our copending application Ser. No. 883,516, filed Dec. 9, 1969, now U.S. Pat. No. 3,642,053.

BACKGROUND OF THE INVENTION

Many methods have been described in the prior art for the preparation of flakes of material such as sodium-lead alloy, calcium chloride, caustic soda and the like. In instances where flakes of materials such as calcium chloride or caustic soda are produced, typically the operation involves the evaporation of water and the deposition of crystals of the desired salt or material on a moving surface. The solidified salt or hydroxide is subsequently flaked off the moving surface. In the preparation of metal alloys such as sodium-lead alloy this flake preparation is accomplished typically by dipping a flaking wheel into a molten sodium-lead alloy bath. The alloy to be solidified clings to the rotating surface of the wheel which is subjected to cooling. The cooling of the surface of the wheel causes solidification of the alloy on the wheel surface. The wheel is typically scraped during rotation to remove the solid metal from its surface.

Various alloys have been prepared in the past using this general type of flaking method. Thus, alloys of sodium-lead, lithium-sodium-lead, lithium-potassium-lead, lead-sodium-magnesium and other similar alloys of metals have been described in the literature. Typical literature describing such alloys and alloy preparation are U.S. Pat. Nos. 1,652,077; 2,061,267; 2,664,605 and 2,635,107.

While flaking methods using a typical prior art flaking wheel have been found to be effective in the preparation of sodium-lead alloys and other similar materials, they do suffer from certain drawbacks. First, the preparation of a metal alloy on a flaking wheel by rotating the wheel through a molten bath requires the maintenance of a substantial body of molten metal. In the case of solutions from which salts are being precipitated on the rotating wheel, the baths or salt solutions through which the wheel rotates are usually agitated to insure uniform distribution of salt throughout the solution. Further, in the preparation of alloys, such as sodium-lead alloy, on a rotating wheel the flaking surfaces are preferably made of an alloy containing appreciable amounts of copper (bronze being typical). These materials are employed to insure that the sodium-lead alloy will stick to the surface of the flaking drum during its rotation out of the molten bath in which its surface rotates. This use of special surfaces is described in U.S. Pat. No. 2,635,107.

It will be readily understood by the skilled artisan that uniformity of deposition is usually a desired object in the preparation of any alloy or flake of material so that particles of uniform thickness may be prepared. This is particularly so in the preparation of sodium-lead alloys which are to be used in the preparation of tetraethyllead or tetramethyllead. Still further, in the prior art considerable difficulty has been encountered even with alloyed surfaces in removing a uniform deposit of sodium-lead alloy from a molten bath using rotary flaking wheels. This difficulty has resulted in the art having recourse to specially prepared surfaces on

rotating wheels. Thus, frequently machined slots and grooves are provided on flaking surfaces to insure sticking of the alloy to the surface as it rotates through the bath. U.S. Pat. No. 2,664,605 describes such a specially prepared surface.

THE PRESENT INVENTION

In accordance with the instant invention a method of preparing flakes and in particular flakes of sodium-lead alloy is provided which makes use of a flat, rotary table on which molten sodium-lead alloy may be deposited in uniform thickness, cooled rapidly and removed from the table in an efficient manner. The method of the instant invention involves introducing a heat exchange medium in contact with the underside of a rotary table and removing the heat exchange fluid from contact with the table underside uniformly across the surface of the table to provide for rapid, efficient and uniform cooling of the material being deposited on the surface of the table. The uniform cooling of the table surface is accomplished by establishing a pressure drop across orifices located in a chamber positioned underneath the table surface. This provides for removing fluid from all portions of the chamber located below the surface at an equal rate. Orifices are positioned across the width and length of the table to provide cooling across most of the table surface at all times. The deposition, in the case of sodium-lead alloy of molten metal on the table surface is conducted in an inert atmosphere preferably a nitrogen atmosphere.

For a more complete understanding of the instant invention, reference is made to the accompanying drawings in which:

FIG. 1 is an isometric view of a flaking assembly in a housing with the housing broken away to show a flaking table, the supply reservoir and associated equipment for the material to be flaked, and showing the flaking table in cross section to expose the internal circulation system used for heat exchange fluid;

FIG. 2 is an enlarged longitudinal section of rotary table 15 of FIG. 1 taken along line II—II;

FIG. 3 is a longitudinal section of FIG. 2 taken along lines III—III;

FIG. 4 is a cross section of FIG. 3 taken along lines IV—IV showing the heat exchange outlets to the interior of rod 12;

FIG. 5 is a cross section of FIG. 3 taken along lines V—V showing the heat exchange inlets communicating with the interior of rod 12;

FIG. 6 is a pie shaped view of the surface of plate 17 of FIG. 1; and

FIG. 7 is a longitudinal section of FIG. 1 taken along lines VII—VII.

Turning to the drawings and with particular reference to FIGS. 1, 2 and 7, there is shown a housing or chamber 25 in which there is positioned the flaking table generally indicated by the numeral 11. Table 11 has a flaking surface or top 15. Below the surface 15 is a chamber 6 formed by a plate member 17 and the side wall 5 of the table 11. A second chamber 4 is formed by plate member 18 and side wall 5 of the table 11 and a third chamber 3 is formed by the bottom plate 16, plate 18 and side wall 5.

As shown in the drawing (FIG. 1), table 11 rotates with the rotation of shaft 12 and the top member 15

3

rides on collar 14 of the bushing 13. On the collar 14 there is shown an inlet 22 and an outlet 23 for the admission of heat exchange fluid and discharge of heat exchange fluid to and from chambers 3 and 4, respectively. Between chambers 3 and 6 fluid communication is established through a plurality of inlets or risers 19. A plurality of orifices 20 are provided in plate 17 and establish fluid communication between chambers 6 and 4.

Positioned above the table surface 15 and rigidly mounted or suspended from the roof 26 of housing 25 is a weir assembly. This assembly is composed of a pair of side walls 42 and 43, a back wall 44 and a front piece or weir 38. The bottom 44a of the weir assembly is shown in FIG. 7. The weir 38 is provided on its upper surface with a series of notches 39 from one side to the other. Interposed between the weir 38 and back wall 44 is a baffle member 41 attached to side walls 42 and 43 and terminating in a vertical direction above the bottom 44a of the assembly (See FIG. 7).

The weir assembly is held in a fixed position above the table surface 15 by plates 53 and 52 which have clamped between them anchor plate 54. Anchor plate 54 is welded to the bottom of the adjustable support bolt 51 which is in threaded engagement with a threaded, recessed socket positioned in support member 32. A similar support member 33 with similar internal threads is provided above wall member 42. An adjustable bolt 59 is in threaded engagement with support member 33 on one end and is welded to a plate 58 on the other extremity. Anchor plate 58 is held in place by a pin 57 mounted in the wall 42. Adjustment of the entire weir assembly up or down with respect to its spacing from the table surface 15 is readily accomplished by movement or rotation of the support members or hangers 32 and 33. Nuts 34 and 37 hold grease fittings 35 and 36 in place on the members 32 and 33, respectively. Grease fittings 35 and 36 are provided to prevent the male threads on bolts 51 and 59 from freezing in the female threads provided in elements 32 and 33 during operation of the flaking table.

The unit is supported on the housing cover 26 by a suitable support plate 49 which is fixedly attached to the cover 26 by a plurality of bolts such as bolt 50. Two lifting lugs 47 and 48 are provided in the plate 49 so that it may be easily lifted from its position on cover 26. An inlet 46 for the introduction of the material to be flaked is provided. In the drawing this is shown as alloy through materials other than alloys are contemplated. A pipe 90 surrounds inlet 46 and houses heating elements (not shown) to maintain the alloy in pipe 46 molten.

Behind plate 49 is a second support plate 60 which is affixed to cover 26 by a plurality of bolts such as bolt 61. This plate 60 supports a blade assembly which contains a blade member 68 shown in FIG. 1 and 7 bolted to a support plate 72 by bolt 73 and rigidly fixed thereto with nut 74. Blade support member 67 is welded to support plate 72. The blade assembly is suspended from cover 26 by the vertical support rods 77 and 77a which are fixedly mounted to units 81 and 80, respectively. The elements 81 and 80 are held in place by pin members 78 and 79, respectively.

Rod 77 is in threaded engagement with socket 82. This socket is sealed with a cap member 84. A nut 76 is

4

fastened to the top of element 82 and holds a grease fitting 75. The grease fitting is set in a recess 88 in a plate 89 which is held in place by screw members 86 and 87.

Rod 77a is provided with a surrounding seal 64 which is mounted to the plate 60 by bolts 69 and 70. The upper end of the rod 77a is threaded and engages threads in cap 63 for firm attachment thereto. A nut 66a is provided which is attached to the upper end of rod 77a and the lower end of a rod 66. Rod 66 is attached to a cylinder 62 which is typically an air cylinder designed to apply constant pressure on rod 66 and consequently the knife assembly.

In FIGS. 2 and 3 there is shown a vertical section of the inner portion of the table surface 15 and the internals below it as well as the internals of shaft member 12. As can be seen there are three chambers located below the table surface 15. The heat exchange chamber 6 formed by surface 15, plate 17 and table side wall 5 is shown spaced from the table surface 15 by stiffener members 89 and stiffener supports 21 which are also employed to support plates 17 and 18. In chamber 6 a conduit or weephole 8 is provided at the upper edge of the end of the chamber nearest the shaft 12. This path or weephole 8 is important since it provided a means for evacuating air completely from chamber 6 so that the heat exchange fluid can effectively be used in that chamber. The travel path of heat exchange fluid is shown in FIG. 2 clearly and as can be seen the fluid enters chamber 3 through opening 22. The chamber 3 is maintained filled with fluid which rises into chamber 6 through the inlet members 19. The heat exchange fluid is discharged from chamber 6 via orifices 20 into the chamber 4. A constant pressure drop across each of these orifices 20 is established and the discharged fluid enters chamber 4 from which it is removed via channels 23 to the central chamber 7 of shaft 12. The fluid is subsequently cooled and returned to the table through the central chamber 7a in the lower end of shaft 12 for recirculation via conduits 22 to the table.

FIG. 4 shows the positioning of the plurality of pathways or conduits 23 used to remove heat exchange fluid from chamber 4 and pass it to chamber 7.

FIG. 5 shows similarly the positioning of the plurality of paths 22 which take fluid from chamber 7a and feed it to the chamber 3.

In FIG. 6 the surface of the plate 17 is shown as a pie section top view of plate 17 looking down on plate 17 from above. The placement of the spacers 89 which are utilized to hold plate 17 and plate 15 apart the desired distance is depicted. Also shown is the placement of the support members 21. The probable flow pattern of the heat exchange fluid is shown by the arrows leaving the risers 19 and entering the orifices 20.

In the overall operation of the device and taking as exemplary its use in the preparation of sodium-lead alloy the flaking table and associated apparatus is operated in the following manner.

Heat exchange fluid used in this instance was Mobil-Therm oil, a light motor oil stable at temperatures up to 500° F. It was pumped via chamber 7a in shaft 12 through openings 22 into the chamber 3. The table is rotated in the direction shown in FIG. 1. The fluid is pumped through chamber 3 and up through the risers

19 until chamber 6 is filled with the liquid. The fluid entering chamber 6 fills that chamber and emerges through orifices 20 as well as through the weephole 8 of FIG. 2. The discharged fluid from the weephole 8 enters chamber 7 of shaft 12 while the fluid passing across orifices 20 fills chamber 4 and exits into chamber 7 of shaft 12 via paths 23. The pressure drop across the chamber 6 and 3 at the orifices 20 is 5 psig.

When circulation of heat exchange fluid has been established in the table the molten alloy is introduced via tube 46 and spout 45 to the interior of the vessel 38. Baffle member 41 spaced from the bottom 44a of the vessel 38 smooths out the tendency of the molten alloy to ripple or form waves at the surface so that a smooth surface of molten alloy is presented to the toothed openings or notches 39 cut in the top of the weir plate 38. The faces of the notches 39 cut in the top of weir plate 38 form a 90° angle with respect to each other. The slope of face plate 38 is at an angle of about 15° from a vertical line drawn from the jointure of plate 38 and spreader 40. Molten alloy in the weir assembly passes through the notches 39 and flows by gravity down the face plate 38 and across the spreader 40 where it contacts the table top 15 passing underneath it in a counterclockwise path. The sodium-lead alloy is cooled by the fluid in chamber 6 and which is in contact with the table surface as it rotates in the housing 25. An inert nitrogen atmosphere is maintained in the housing 25 during the flaking operation by maintaining a nitrogen pad on the system. The table is rotated at a rate of 10 revolutions per minute. As the table rotates, the alloy on the surface 15 solidifies into a uniform sheet of solid alloy which ultimately in its rotation comes in contact with blade 68 of the blade assembly. This blade 68 is at an approximate 15° angle to the table surface and is firmly held in this relationship by the supports 77 and 77a. As the solid alloy passes in contact with the blade, it is broken off as shown in FIG. 7. The blade is angled in the manner of a snow plow towards the outer edge of the table so that alloy as it is broken off by the blade is pushed off the outer edge of the table and falls into chute 28 seen in FIG. 1 to storage. Operating in this manner with a table 100 inches in diameter a product of solid sodium-lead alloy flakes is produced readily at levels on the order of 250 pounds per hour. The major pressure drop across the heat exchange system is the 5 psig across the orifices 20, the pressure drop across the remainder of the system being negligible.

While in the above description of the equipment certain dimensions, pressures and speeds have been enumerated, it will be obvious that considerable variation in these matters can be tolerated. Thus, table speed can be greater or less than enumerated above. Should it be increased, an increase in heat exchange fluid flow can be readily provided by adjustment of the flow in nozzle members 20 and inlets 19. The pressure drop across nozzles 20 can be varied by varying the size of the orifice. This can be readily accomplished by providing replaceable nozzles in plate 17 or by replacement of plate 17 with another plate having different orifice sizes. In the above example a blade angle of 15° to the horizontal was employed, but is not critical to the invention since other angles can be used effectively. In a similar way the angle of the weir plate 38 with respect to the vertical may be changed.

In discussing the invention with respect to the preparation of sodium-lead alloy a lubricating motor oil having some acidity and being stable at the temperatures encountered in this system (200° to above 400° F.) is described as the heat exchange media. Obviously where other materials are being flaked a different coolant or heat exchange material will be employed. Thus, for a caustic soda flaking operation a chilled brine might be employed. The alloy is cooled during operation of the cooling system herein described from the molten temperatures to its solidification temperature typically 700° F. During its travel around the table, the alloy is cooled typically to 300° F. or lower before it is scraped by the knife.

The pattern shown for the orifices 20 and risers 19 in FIG. 6 forms the preferred embodiment of the instant invention as regards fluid distribution. Thus, it will be seen that where feasible each riser is surrounded by a diamond formed of four orifices. The pattern was interrupted at the edge of the table and in those instances where a stiffener or support interfered but otherwise was followed around the entire table surface.

While the invention therefore has been described with reference to certain specific embodiments, it is not intended to be so limited except insofar as appears in the following claims.

We claim:

1. Apparatus for preparing a solid flake of a material comprising a rotatable table having the underside of its surface in contact with a first chamber, a second chamber positioned below said first chamber and in communication therewith through a plurality of orifices of uniform dimension, a third chamber positioned below said second chamber and in communication with said first chamber through a plurality of conduits means to maintain all of said chambers filled with heat exchange fluid, means to maintain a uniform pressure drop across said orifices, means to deposit material to be flaked on said table, and means to remove said material as it solidifies on said table.

2. Flaking apparatus comprising a substantially flat flaking table mounted on a shaft and adapted to be rotated in a horizontal plane, a chamber positioned below the underside surface of said table and in indirect heat exchange contact therewith, a plurality of first conduit means in the floor of said chamber for introducing fluid into said chamber, a plurality of orifice means adjacent said first conduit means for removing fluid from said chamber, further conduit means communicating with said chamber for removing air from said chamber, means for introducing fluid into said first conduit means, means for spreading a liquid film of material to be flaked on the surface of said table and means to remove solidified material from the table surface.

3. The flaking apparatus of claim 2 wherein a second chamber is positioned beneath the chamber positioned below the underside surface of said flaking table and wherein fluid communication between said chambers is provided by said plurality of orifice means.

4. The flaking apparatus of claim 3 wherein a third chamber is positioned beneath said second chamber and wherein fluid communication between said third chamber and the chamber positioned below the underside surface of said table is provided by said plurality of first conduit means.

7

8

5. The flaking apparatus of claim 3 comprising conduit means for removing fluid from said second chamber into a chamber in said shaft, said further conduit means being in fluid communication with said shaft chamber.

6. A sodium-lead alloy flaking apparatus comprising a substantially flat flaking table rotatable in a horizontal plane and mounted on a shaft, a first chamber beneath and in indirect heat exchange contact with the underside of said table, said first chamber having a plurality of orifice means in the floor thereof, a second chamber beneath said first chamber and in fluid communication therewith through said plurality of orifice means, a third chamber beneath said second chamber, a plurality of first fluid conduit means connecting said first and said third chambers, further fluid conduit means for removing air from said first chamber, means for introducing fluid into said third chamber, means for removing fluid from said second chamber, alloy

depositing means above said table for depositing a layer of molten alloy on said table as said table is rotated and means to remove said alloy from the table surface after it solidifies thereon.

7. The apparatus of claim 6 wherein there is provided means for adjusting the vertical height of the alloy depositing means with respect to the table surface.

8. The apparatus of claim 6 wherein said shaft has an internal chamber which is in fluid communication with said means for introducing fluid into said third chamber and with said means for removing fluid from said second chamber.

9. The apparatus of claim 8 wherein said further conduit means is in fluid communication with the chamber within said shaft.

10. The apparatus of claim 6 wherein said orifice means are adjacent to and surround said first conduit means.

* * * * *

20

25

30

35

40

45

50

55

60

65