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ABSTRACT

"REMOVABLE SPOUT FOR A HOPPER"

A spout (10) is removably mounted to a hopper (1) of an electrolytic cell by a coupling (28) allowing the spout (10) to rock relative to the spout when jarred. A handler (40) is provided for the mounting of the spout (10) onto the hopper (1) without an operator entering into the electrolytic cell.

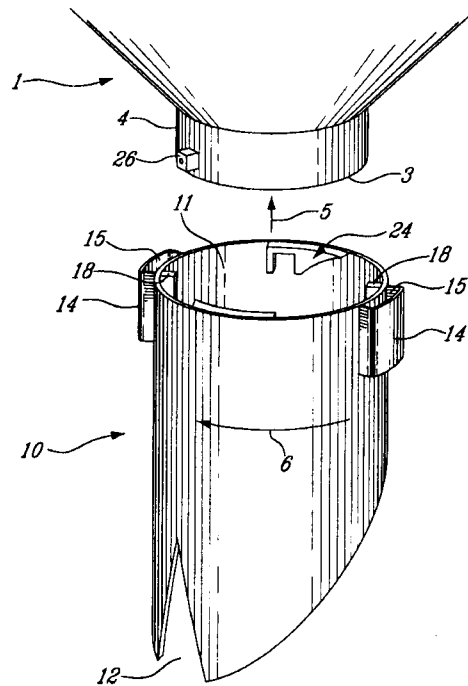


FIG. 1

I/WE CLAIM:

1. A removable spout for feeding a particulate from an outlet of a hopper to an aluminium electrolytic cell, the spout comprising:
 - a wall having an inner surface and an outer surface opposite the inner surface,
 - the inner surface defining a passage for the particulate between an upper inlet and a lower outlet; and
 - a pair of first coupling members located on opposed sides of the spout adjacent the upper inlet for removably connecting the spout to a corresponding pair of second coupling members on the hopper, wherein the first coupling members and the second coupling members engage to form a linkage with a fit that permits the spout to rock around the second coupling members and maintain the linkage.
2. The spout of claim 1, comprising a grip on the outer surface for handling the spout.
3. The spout of claim 2, wherein each of the first coupling members defines a catch between two projecting arms extending from a bearing surface, wherein the catch is adapted to receive a corresponding one of the second coupling members within.
4. The spout of claim 3, wherein each of the first coupling members comprises a ramped surface for

guiding the corresponding one of the second coupling members into the catch.

5. The spout of claim 4, wherein markings are provided on the outer surface of the wall of the spout to facilitate alignment of the first coupling members with the second coupling members on the hopper.
6. The spout of any one of claims 1 to 5, wherein the first coupling members are provided on the inner surface of the wall of the spout.
7. An assembly for feeding a particulate to an aluminium electrolytic cell, the assembly comprising
 - a hopper defining a hopper outlet discharging the particulate;
 - a spout removably mounted to the hopper, the spout comprising
 - a wall having an inner surface and an outer surface opposite the inner surface,
 - the inner surface defining a passage for the particulate between an upper inlet and a lower outlet;
 - an articulation between the hopper and the spout allowing relative movement therebetween, the articulation comprising a pair of first coupling members provided on said spout proximate said upper inlet and a pair of second coupling members provided on the hopper proximate said hopper outlet, wherein the first coupling members and the second coupling members engage to form a linkage

with a fit that permits the spout to rock around the second coupling members and maintain the linkage.

8. The assembly of claim 7, comprising a grip on the outer surface of the spout.
9. The assembly of claim 7, wherein each of the first coupling members defines a catch between two projecting arms extending from a bearing surface, wherein the catch is adapted to receive a corresponding one of the second coupling members within.
10. The assembly of claim 7, wherein each of the first coupling members comprises a ramped surface for guiding the corresponding one of the second coupling members into a catch.
11. The assembly of claim 7, wherein markings are provided on the outer surface of the spout to facilitate alignment of the first coupling members with the second coupling members on the hopper.
12. The assembly of any one of claims 7 to 11, wherein the first coupling members are provided on the inner surface of the wall of the spout.
13. The assembly of claim 7, wherein the second coupling members are engaged with the first coupling members by a rotational movement of the spout relative to the

hopper, the first and second coupling members being provided in the form a bayonet-like mount.

14. A kit for assembly and disassembly of a spout onto a hopper of an electrolytic cell having an overhead structure; the kit comprising a spout body defining a passage extending between an upper inlet and a lower outlet, the spout body having a grip provided on an outer surface thereof and a pair of first coupling members configured for mating engagement with a corresponding pair of second coupling members on the hopper, a handler for manipulating the spout body from a remote location during assembly and disassembly of the spout body onto the hopper, the handler comprising an elongated pipe having a spout body engaging end portion engageable with the handle, an anchor releasably mountable to the overhead structure of the electrolytic cell, the elongated pipe being suspended from the anchor by a lanyard.
15. The kit defined in claim 14, wherein the elongated pipe is slidably received in a ring provided at a lower end portion of the lanyard.
16. The kit defined in claim 14, wherein said lanyard has an adjustable length.
17. The kit defined in claim 14, wherein said spout body engaging end portion of the pipe comprises a curve surface adapted to embrace a corresponding curved outer surface of the spout body, and a blade engageable in a receiving slot defined between said grip and said curved outer surface of the spout body.

18. The kit defined in claim 14, wherein said first coupling members are provided on an inner surface of the spout body and each include a bottom open ended catch for engagement over the corresponding second coupling members on the hopper.
19. The kit defined in claim 18, wherein said first coupling members face each other from opposed sides of the inner surface of the spout body and are provided with ramp surfaces leading to said bottom open ended catch.

Dated this 19th day of January, 2012.


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19 JAN 2012

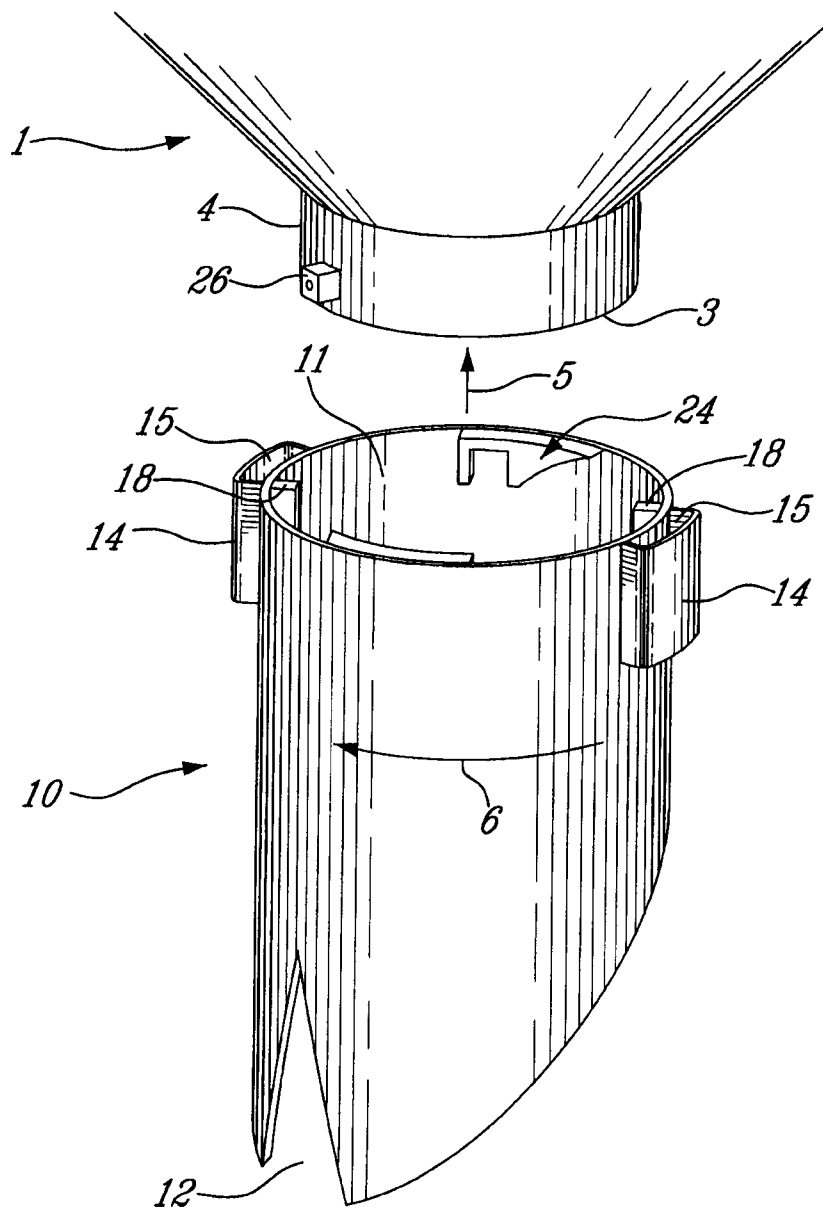
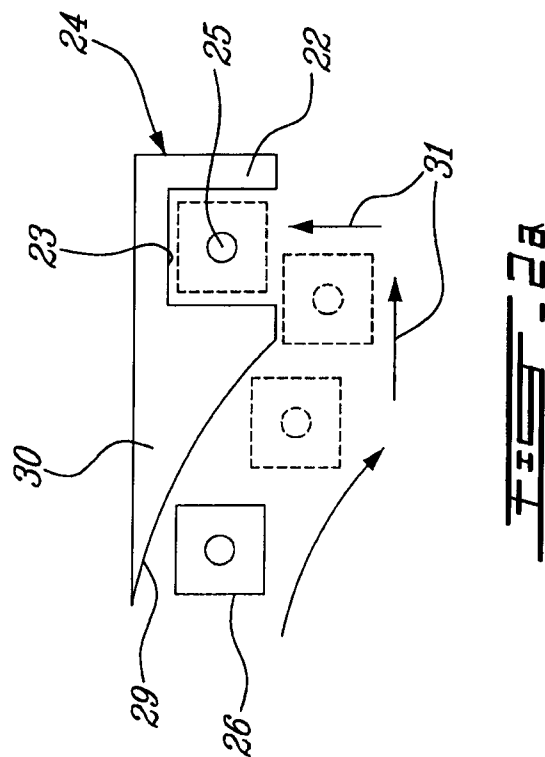
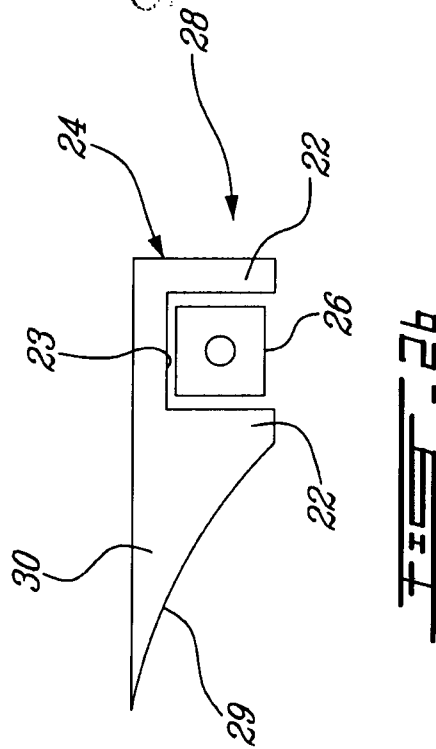


FIG. 1

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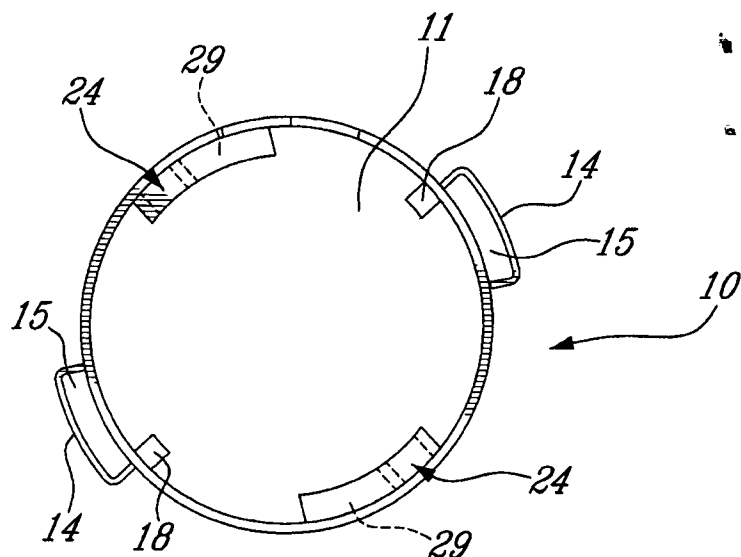


FIG. 3a

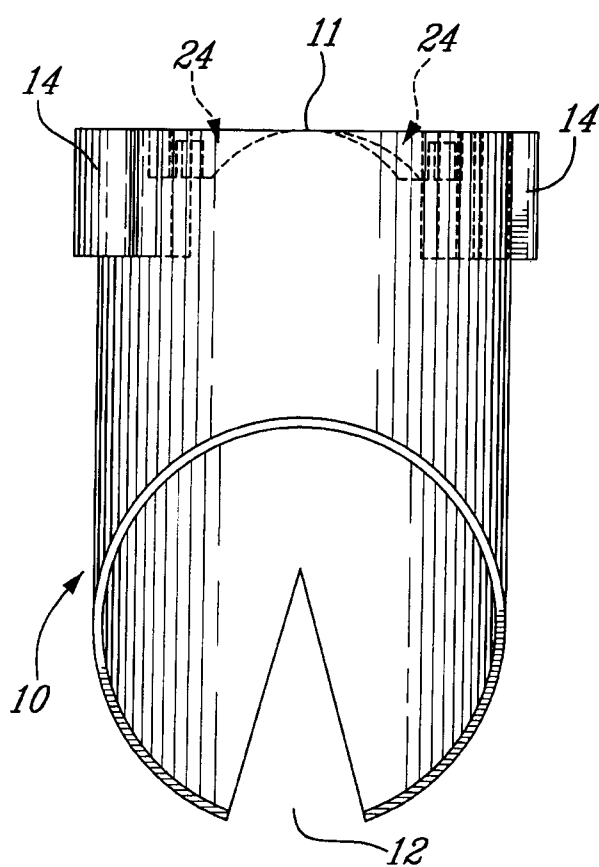


FIG. 3b

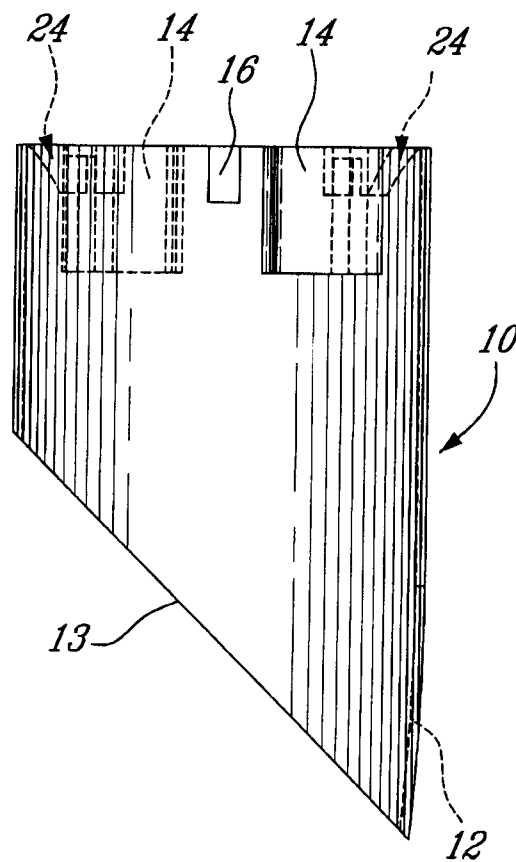


FIG. 3c


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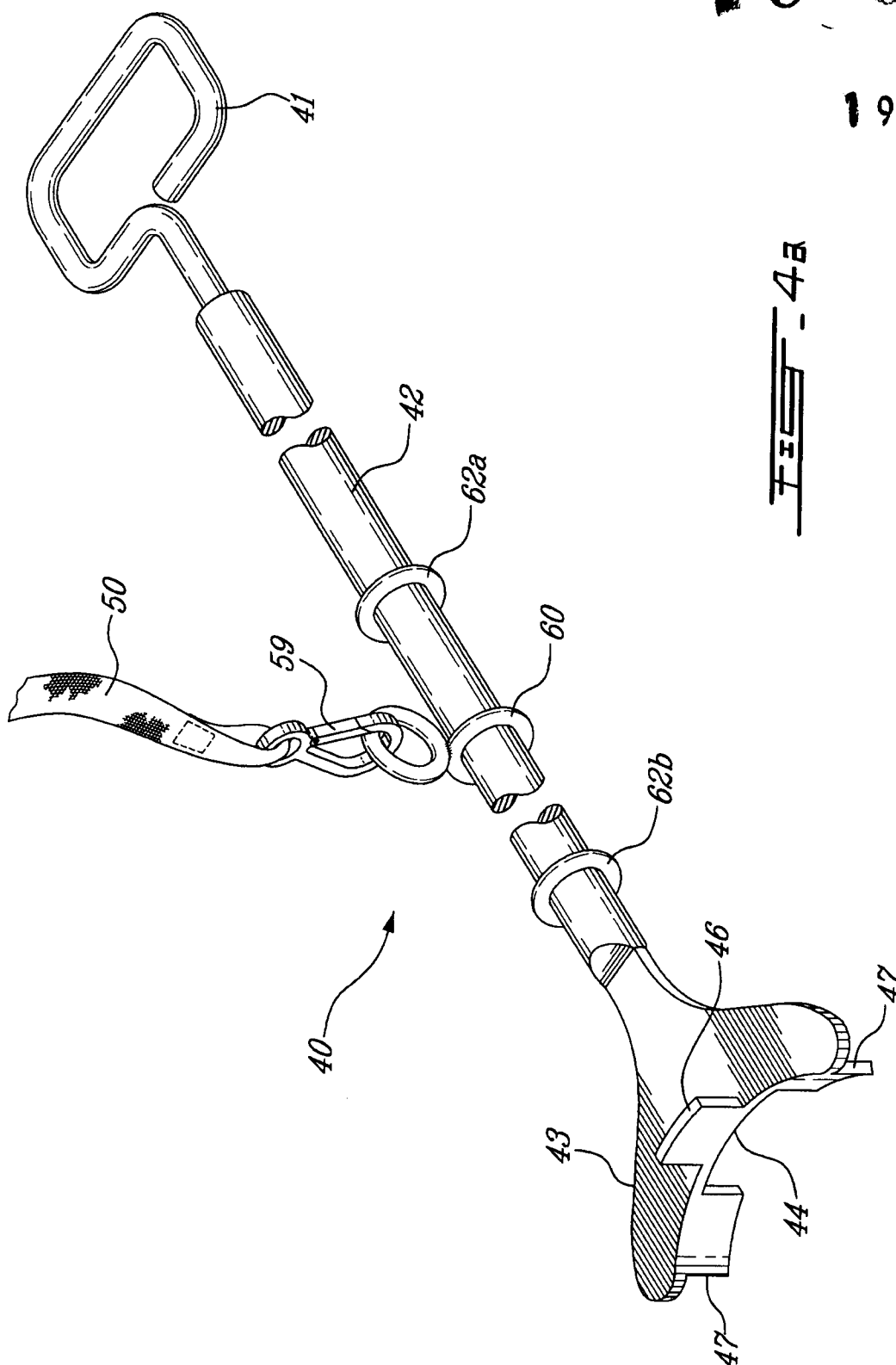


Fig. 4a

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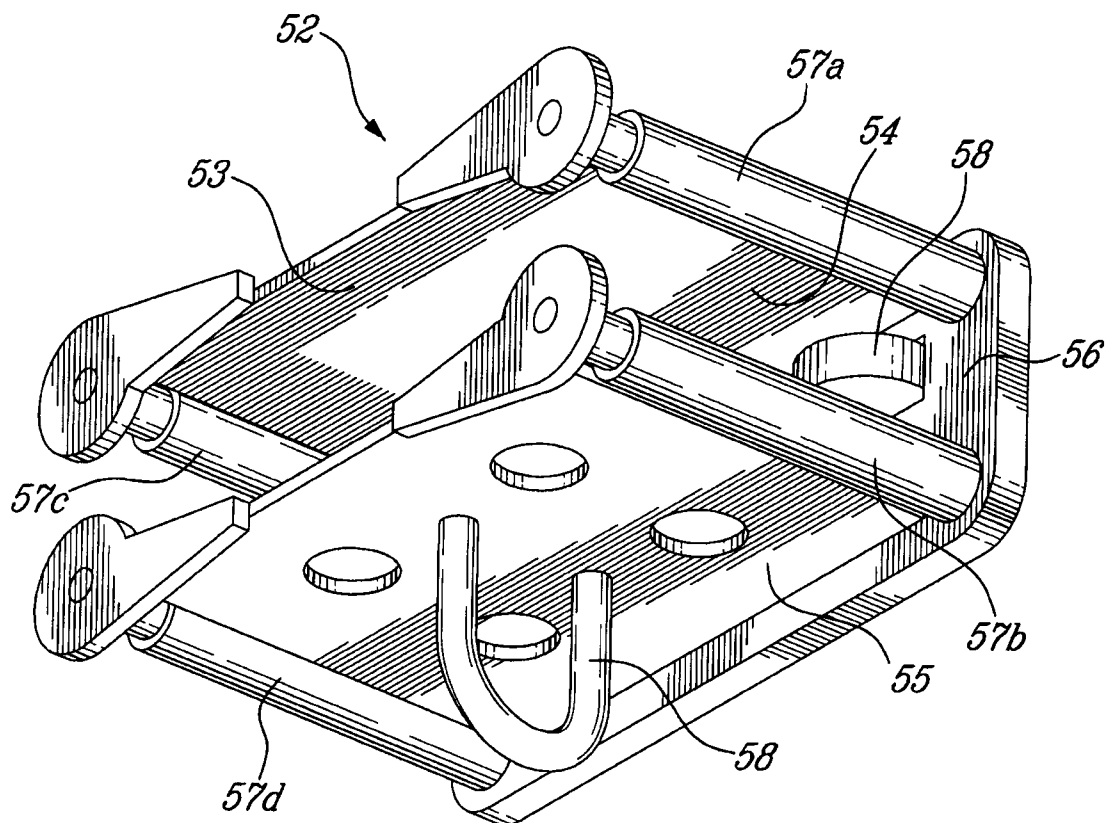


FIG. 4b

REMOVABLE SPOUT FOR A HOPPER

TECHNICAL FIELD

The technical field concerns feeding particulate solids from a hopper through a removable spout into an electrolytic cell.

BACKGROUND ART

Electrolytic cells for aluminium production can be supplied with various types of powder or particulate materials, including crushed electrolyte, alumina and aluminium fluoride.

Each electrolytic cell has a plurality of spaced-apart hoppers fixedly mounted to a superstructure above the cell. Spouts are fixed to the hoppers for directing particulate or powder products at the upper surface of the cell between anodes.

The equipment in the area of the headspace above the electrolytic cells further includes crustbreakers that penetrate any frozen electrolyte between the anodes thus allowing the particulate materials to enter the molten bath and feed the cell to produce aluminium. Clearly, the headspace above an electrolytic cell where the spouts are located is a cramped space.

In Alcan Pechiney "AP" type electrolytic cells, the spouts for particulate material are typically screwed, bolted or otherwise fastened to the hoppers in a rigid and fixed manner. The rigid/screw type of spout attachment requires that the operator enter the cramped headspace to replace the spouts. The spouts are regularly replaced for various

types of maintenance and operational reasons usually while the electrolytic cells are in operation.

One such operational reason is the periodic replacement of the anodes themselves. It is preferable that the spouts remain in position when the anodes are replaced. However, leaving the spouts attached to the hoppers causes a further problem that during the manipulation of these large and heavy anodes, the spouts often come into contact with the anodes and are jarred. When this occurs, the rigid type fasteners often break with the result that the spouts fall into the molten bath, producing a further unfavourable consequence that the molten electrolyte and the aluminium produced are contaminated.

Therefore, there is a need for a removable spout that is attached to the hoppers above an electrolytic cell that can be replaced without an operator entering the electrolytic cell and getting exposed to serious risks of burning and inhaling dangerous gases. Furthermore, there is a need for a new spout and hopper connection allowing spouts to remain in place when the anodes of an electrolytic cell are replaced and withstand some potential contact between anodes during the anode replacement operation and that without falling into the molten bath.

SUMMARY

In one aspect of the present application, there is provided a removable spout for feeding a particulate from an outlet of a hopper to an aluminium electrolytic cell, the spout comprising: a wall having an inner surface and an outer surface opposite the inner surface, the inner surface defining a passage for the particulate between an upper

inlet and a lower outlet; and a pair of first coupling members located on opposed sides of the spout adjacent the upper inlet for removably connecting the spout to a corresponding pair of second coupling members on the hopper, wherein the first coupling members and the second coupling members engage to form a linkage with a fit that permits the spout to rock around the second coupling members and maintain the linkage.

In another aspect of the application, there is provided an assembly for feeding a particulate to an aluminium electrolytic cell, the assembly comprising: a hopper defining a hopper outlet discharging the particulate; a spout removably mounted to the hopper, the spout comprising a wall having an inner surface and an outer surface opposite the inner surface, the inner surface defining a passage for the particulate between an upper inlet and a lower outlet; an articulation between the hopper and the spout allowing relative movement therebetween, the articulation comprising a pair of first coupling members provided on said spout proximate said upper inlet and a pair of second coupling members provided on the hopper proximate said hopper outlet, wherein the first coupling members and the second coupling members engage to form a linkage with a fit that permits the spout to rock around the second coupling members and maintain the linkage.

According a further aspect, there is provided a kit for assembly and disassembly of a spout onto a hopper of an electrolytic cell having an overhead structure; the kit comprising a spout body defining a passage extending between an upper inlet and a lower outlet, the spout body having a handle provided on an outer surface thereof and a

pair of first coupling members configured for mating engagement with a corresponding pair of second coupling members on the hopper, a handler for manipulating the spout body from a remote location during assembly and disassembly of the spout body onto the hopper, the handler comprising an elongated pipe having a spout body engaging end portion engageable with the handle, an anchor releasably mountable to the overhead structure of the electrolytic cell, the elongated pipe being suspended from the anchor by a lanyard.

In yet a further aspect of the application, there is provided a method of mounting a removable spout to a hopper outlet for feeding particulate matter to an aluminium electrolytic cell, the method comprising: a) aligning the spout below and adjacent the hopper outlet; b) raising the spout towards the outlet; and c) rotating the spout around its axis to engage a first part of a coupling on the spout to a second part of the coupling on the hopper outlet, wherein the rotation engaging the first part and the second part of the coupling.

BRIEF DESCRIPTION OF THE DRAWINGS

Reference is now made to the accompanying figures, in which:

Fig. 1 is a schematic exploded perspective view of a spout and hopper assembly in accordance with an embodiment of the present invention, illustrating a preferred method of attachment with arrows;

Fig. 2(a) is a schematic view of a coupling that can be used to detachably mount the spout to the upper, the arrows indicating relative movements of the coupling parts;

Fig. 2(b) is a schematic view of the two parts of the coupling shown in Fig. 2(a) indicating their position when engaged to retain the spout on the hopper;

Fig. 3(a) is a top view of the spout shown in Fig. 1;

Fig. 3(b) is a front view of the spout;

Fig. 3(c) is a side view of the spout;

Fig. 4(a) is a perspective view of a spout handler that can be used to manipulate the spout during installation and removal manoeuvres; and

Fig. 4(b) is a perspective view of chariot adapted to be releasably connected to the overhead or superstructure of the cell in order to suspend the spout handler while the same is being used to replace a spout in an electrolytic cell.

DETAILED DESCRIPTION

Fig. 1 illustrates an embodiment of a spout 10 for dispensing particulates into an electrolytic cell (not shown). The spout 10 is designed to fit onto a hopper 1 at a hopper outlet 3 from which particulate material discharges, in this case, alumina. The hopper outlet 3 includes a collar 4 onto which the spout 10 can be removably mounted for replacement, as necessary.

The spout 10 has a generally cylindrical body defining a passage from an upper spout inlet 11 to a lower spout outlet 12. As can be appreciated from Figs. 1 and 3(a) the passage has a substantially circular cross-section. As shown in Fig. 3 (b), the outlet 12 can take the shape of a triangle along a side wall of the spout 10. As best shown

in Fig. 3(c), the spout 10 has an inclined surface 13 that helps to direct the particulate material through the passage 11 and out through outlet 12. In another embodiment for feeding aluminium fluoride(not shown), the outlet 12 of the spout 10 may include a downwardly angled pipe projecting from the spout 10 in lieu of the illustrated triangular opening. The angled discharged pipe would typically have a smaller diameter than the spout 10 itself.

When the spout 10 and hopper 1 are connected, the particulate matter flows downward from the hopper 1 through the passage in the spout 10 and leaves by the outlet 12.

The spout 10 can be mounted to the hopper 1 by a pair of couplings 28 (only one pair being shown in Fig. 2(b)) respectively provided on opposed sides of the spout 10 and the hopper 1. Each coupling 28 has a first part 24 on the spout 10 and a second part 26 on the hopper 1. The first part 24 is provided on the inner surface of the upper part of the spout 10 adjacent the spout inlet 11, while the second part 26 is provided on the outer surface of the collar 4 of the hopper 1 adjacent the hopper outlet 3.

As shown in Fig. 2(a), the first part 24 can be provided in the form of a bayonet-like mount 30 having a ramp surface 29 leading to a receiving notch or catch 25. The second part 26 of the coupling 28 can be provided in the form of a lug projecting outwardly from the outer surface of the collar 4 of the hopper 1. In the example illustrated in Figs. 1 and 2, the second part 26 or lug corresponds to the blocks typically provided on opposed sides of the outlet collar of existing hoppers in order to receive set screws

for connecting the spouts to the hoppers. The use of existing blocks on the hopper 1 to suspend the spout 10 from the hopper 1 advantageously provides for a simple and economical spout mounting arrangement. In this way, spouts equipped with bayonet-like coupling parts 24 (such as the ones shown in Fig. 1) can be retrofitted to existing hoppers originally designed for fixed spout attachments. It is however understood that the second part 26 of the coupling 28 can take various other forms or shapes. Alternate shapes for part 26 include: circular, hexagonal and octagonal.

Referring concurrently to Figs. 1, 2a and 2b, it can be appreciated that the ramp surface 29 of the first part 24 is adapted to guide the second part 26 into the catch 25 during a rotational movement (represented by arrow 6 in Fig. 1) of the spout 10 relative to hopper 1. The ramp surface 29 may be linear or curved as exemplified in Fig. 2(a).

The catch 25 has a downwardly facing open end and is defined by a top abutment or bearing surface 23 extending between two downwardly projecting arms 22. In the illustrated example, the arms are coterminous. The configuration of the catch 25 is selected to generally correspond to that of the second part 26 of the coupling 28. The catch 25 is slightly oversized with respect to the second part 26, such that the second part 26 is in a loose fit within the catch 25, as shown in Fig. 2(b). This loose fit or tolerance allows the spout 10 to withstand being jarred and moved during an anode replacement operation, and that generally without falling into the bath of the electrolytic cell.

The movement of the first part 24 relative to the second part 26 that causes the first part to capture second part 26 is indicated by arrow 31 in Fig. 2(a). Fig. 2(b) represents the position of the two parts 24 and 26 of each coupling 28 once operatively engaged in order to hold the spout 10 in place on the hopper 1. When the two couplings 28 are engaged, the main forces that maintain the spout 10 suspended, are the force of gravity downward and an equal an opposite reaction force upward from part 26.

The coupling 28 is designed to move if jarred by an object such as an anode. It is understood that when the diametrically opposed couplings 28 are attached, the force vectors retaining the spout 10 in place are directed from the abutment surfaces 23 through the second parts 26 of the couplings 28 on the hopper 1. When jarred the spout 10 will pivot or rock around the second parts 26 that will act as a fulcrum. The downwardly projecting arms 22 of the first part 24 of the couplings 28 will serve to retain the second parts 26 within the catches 25, and thus hold the spout 10 on the hopper 1. Thus, the coupling 28 will allow the spout 10 to pivot or rock back and forth and maintain the linkage between spout and hopper. Only if the spout 10 is jarred past a point where the arms 22 no longer retain the second parts 26 within the catches 25 will the spout 10 fall off the hopper 1. It is understood that the position of the parts 24, 26 on the spout 10 and the hopper 1 can be inverted such that the parts 24, 26 are positioned respectively on the hopper 1 and spout 10. However, this does not apply to existing hoppers already having retainer blocks extending laterally outwardly from the collar of the hoppers.

Referring to Figs. 1, 3(a), 3(b) and 3(c), it can be seen that the spout 10 is provided on its outside surface with diametrically opposite grips 14 that can be selectively used to manipulate or hold the spout 10 while being positioned on the hopper 1, as will be described hereinafter. Lugs 18 are positioned adjacent to the grips 14 on the interior surface of the spout 10 for aligning and spacing the spout 10 as it receives the collar 4 of the hopper outlet 3.

The grips 14 are provided at the upper end of the spout 10 and placed so as to be circumferentially offset relative to the bayonet-like connecting part 24 (see Fig. 3a). Each grip 14 has a C-shaped profile and cooperates with the outside surface of the spout 10 to define an open ended receiving slot 15. The slot 15 is designed for receiving a blade 46 of a handler 40 (Figs. 4(a) and (b)) that can be used for holding and rotating the spout 10 in position on the hopper 1.

As shown in Figs. 4(a) and 4(b), the handler 40 comprises an elongated and sturdy pipe 42 capable of supporting the weight of the spout 10. The length of the pipe 42 is selected to permit reaching into an electrolytic cell from the plant floor which is typically a relatively short height above the level of the electrolytic bath. At one end of the pipe 42 is a handle 41 used to manipulate the handler 40. The opposed working end of the pipe 42 is a generally U-shaped part 43 defining a shallow curve portion 44 generally matching the outer curvature of the spout 10 to provide for uniform bearing engagement therewith. The blade 46 projects upwardly at right angles to the pipe 42 from a central region of the shallow curve portion 44 and is sized and configured to be received in a selected one of

the receiving slots 15 formed between the spout 10 outer wall and the grips 14. For greater stability, the handler 40 may also include a pair of downwardly extending tongues 47 disposed on opposed sides of central blade 46 (see Fig. 4(a)). Other suitable blade and tongue arrangements are considered as well.

In order to facilitate manipulation of the spout 10, the handler 40 can be suspended from the superstructure (not shown) supporting the hoppers above the vessel of the electrolytic cell using an attachment support which includes a lanyard 50 and a chariot 52 (shown in Fig 4(b)). The chariot 52 has a generally C-shaped configuration and comprises a moveable linkage that grasps a horizontal member (typically associated with the superstructure associated to electrolytic cell) in a space 53 defined between top and bottom plates 54 and 55 interconnected by an end plate 56. The chariot 52 is adapted to roll along the horizontal structural member (not shown) of the cell by a combination of rollers 57a,b,c,d and ball bearings 58 (only one of which is shown) and fixed to the plates 54, 55 and 57 for rolling contact with the structural member. The lanyard or strap 58 is attached to hook 58 fixed to the bottom plate 55 of the chariot 52 and may include means for adapting its length such that the handler 40 will be suspended at different heights from the structural member on which the chariot 52 is mounted. The strap 58 has a snap hook 59 shown in Fig 4(a) at the free end thereof opposite the chariot 52 to hook into a double looped connector 60 that glidingly receives the pipe 42 of the handler 40 between two axially spaced stop rings 62a,b. One loop of the connector 60 includes a metal ring having an internal diameter greater than that of the pipe 42. The

handler 40 allows for replacing the spout 10 from a distance and without the operator having to enter into the cramped headspace of the electrolytic cell.

In use, an operator must first manually mount the chariot 52 to a structural member of the superstructure of the cell near the hopper 1 where the spout 10 is to be mounted. The chariot 52 is slid on the structural member to a proper position near the outlet 3 of the hopper 1. After, the handler 40 has been so suspended or hooked from the superstructure of the cell, the spout 10 is placed into position at the working end 43 of the handler 40, with the blade 46 inserted in a selected one of the receiving slots 15. The handler 40 is thereafter manipulated so as to axially align the spout 10 below and adjacent the hopper outlet 3. The spout 10 is subsequently raised towards the outlet 3, as depicted by arrow 5 in Fig. 1. The handler 40 is then manipulated by the operator to rotate the spout 10 around its cylindrical axis to engage the first parts 24 of the couplings 28 to the second parts 26 of the couplings 28, as represented by arrow 6 in Fig. 1. Although this movement is represented as a pure rotational movement it is understood that the rotation will also have a component of upward movement along the first parts 24 of the couplings 28 as a result of the engagement of the ramp surfaces 29 on the second parts 26 of the couplings 28. In order to ensure proper alignment between the spout 10 and the hopper 1 prior to rotating the spout 10 in position, a fluorescent reference strip 16 (see Fig 3(c)) or other suitable markings can be applied to the exterior surface of the spout 10 which is spaced the required distance from the lugs or pre-existing blocks (i.e. second parts 26 of the couplings 28) on the hopper 1 to allow the lugs to slide into position

from the ramp surfaces 29 and into the catches 25 of the bayonet mounts, as shown in Figs. 2(a) and 2(b).

It is understood that the spout 10 can be readily dismounted from the hopper 1 by reversing the above-described procedure.

All the above operations can be manually and effectively carried out from outside of the electrolytic cell with a minimum set up time and with minimum risk of injury to the health and safety of operators.

The embodiments of the invention described above are intended to be exemplary only. The scope of the invention is therefore intended to be limited solely by the scope of the appended claims.