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(54) **METHOD OF MAKING A ROLLED ALUMINUM PRODUCT**

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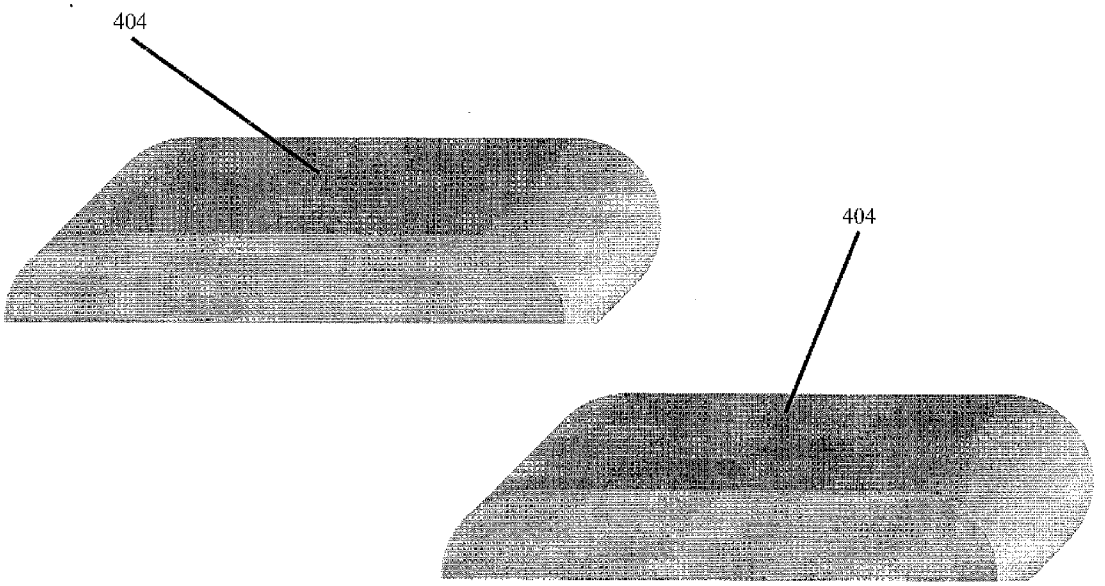
(57) **ABSTRACT**

A method of making a rolled aluminum product comprises sawing an aluminum ingot so that the ingot is separated into at least two separate aluminum slabs and rolling at least one of the slabs unclad and unbrazed. In some embodiments, the ingot is sawn horizontally, across its face, as so that, the slabs are equal in length to the ingot. In some embodiments, at least one of the slabs is rolled to form a one of a plate, sheet or foil. The rolling can be hot rolling or cold rolling. Some embodiments further comprise scalping the aluminum ingot. In some embodiments, the sawing of the ingot eliminates or reduces the need to scalp the aluminum ingot and scalping is not performed. Some embodiments further comprise sawing curved edges off the aluminum slabs.



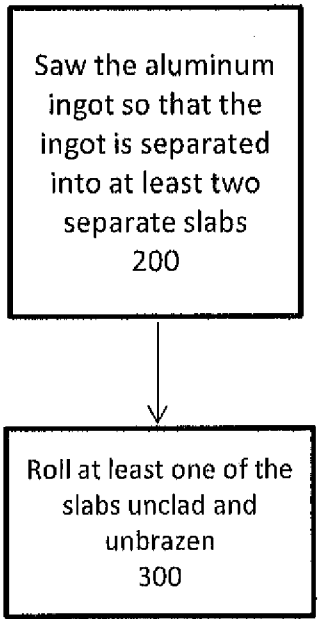

Saw the aluminum ingot so that the ingot is separated into at least two separate slabs
200
Roll at least one of the slabs unclad and unbrazen
300

FIG. 1

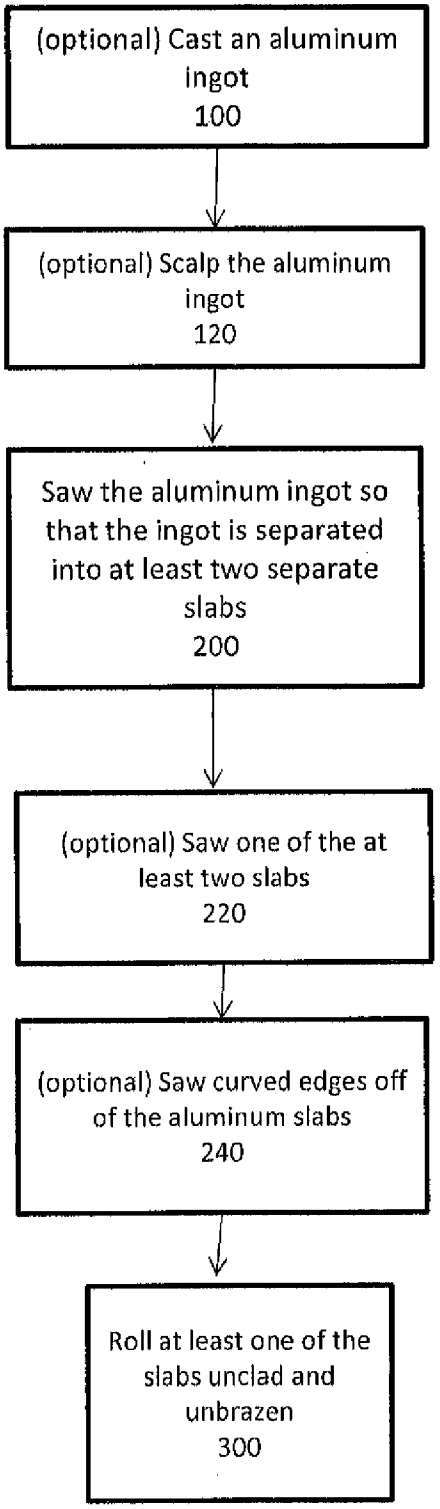

(optional) Cast an aluminum ingot
100
(optional) Scalp the aluminum ingot
120
Saw the aluminum ingot so that the ingot is separated into at least two separate slabs
200
(optional) Saw one of the at least two slabs
220
(optional) Saw curved edges off of the aluminum slabs
240
Roll at least one of the slabs unclad and unbrazen
300

FIG. 2

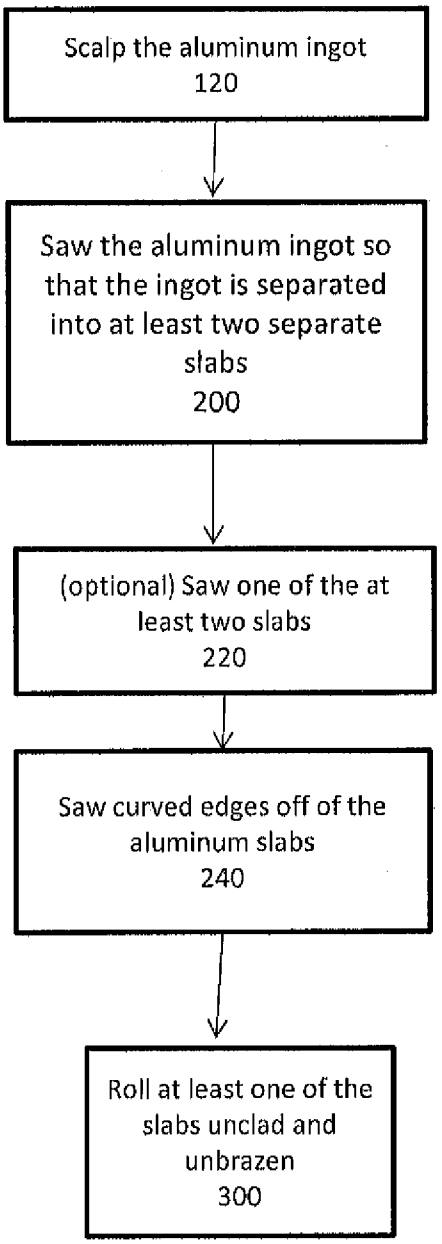

Scalp the aluminum ingot
120
Saw the aluminum ingot so that the ingot is separated into at least two separate slabs
200
(optional) Saw one of the at least two slabs
220
Saw curved edges off of the aluminum slabs
240
Roll at least one of the slabs unclad and unbrazen
300

FIG. 3

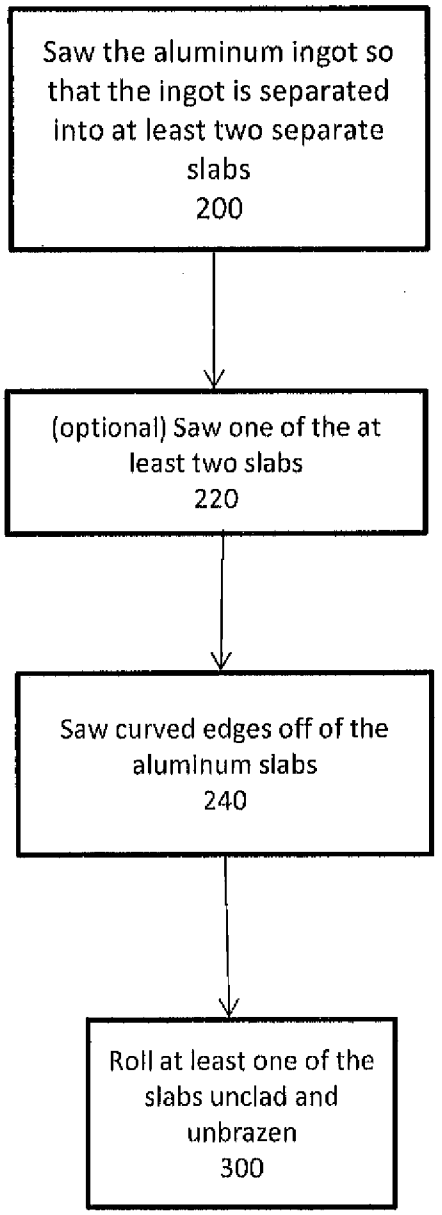

Saw the aluminum ingot so that the ingot is separated into at least two separate slabs
200
(optional) Saw one of the at least two slabs
220
Saw curved edges off of the aluminum slabs
240
Roll at least one of the slabs unclad and unbrazen
300

FIG. 4

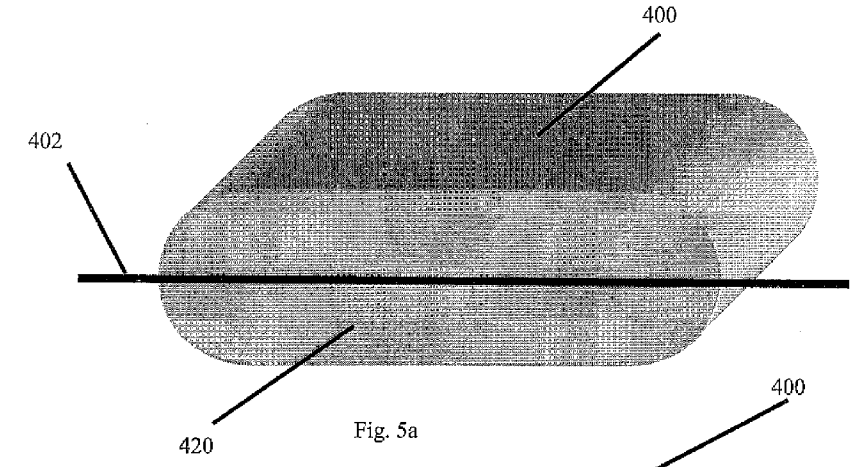


Fig. 5a

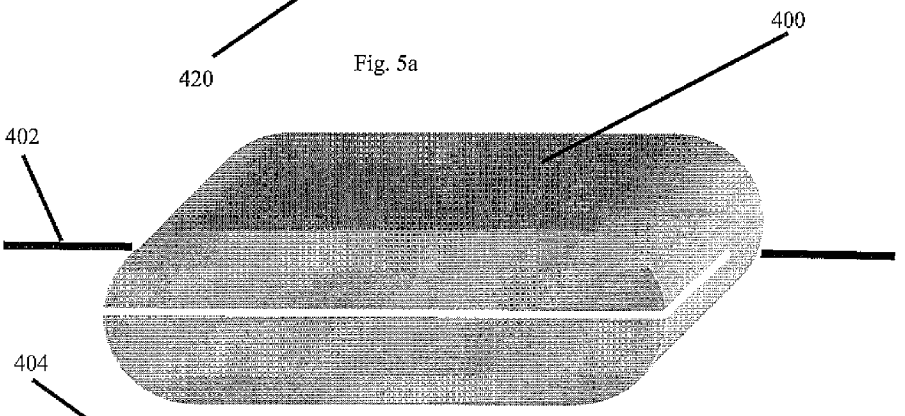


Fig. 5b

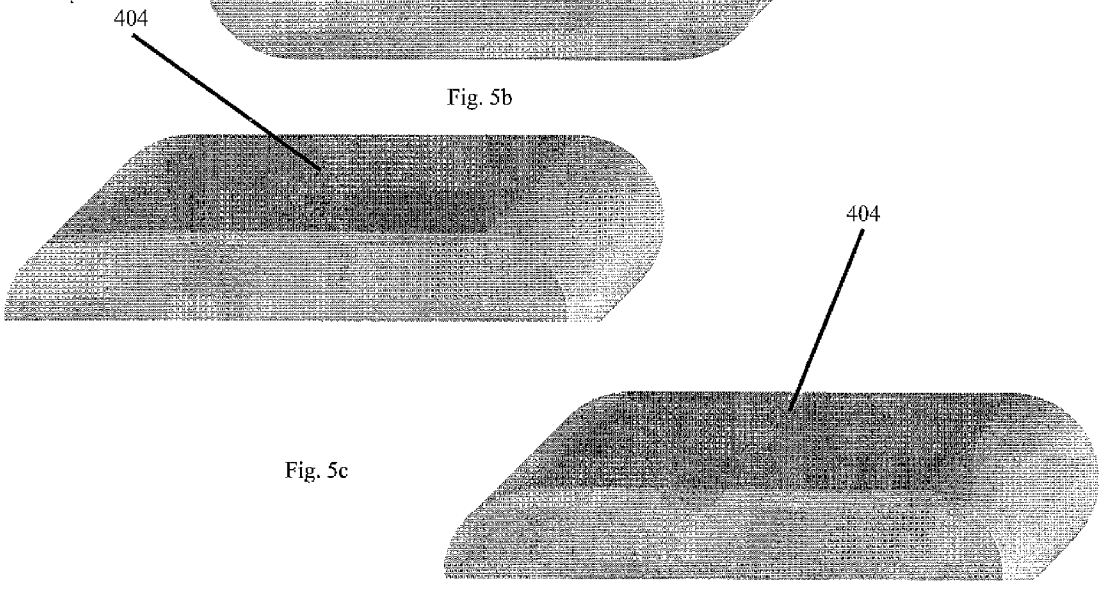


Fig. 5c

METHOD OF MAKING A ROLLED ALUMINUM PRODUCT

BACKGROUND

[0001] Rolled aluminum is used in a variety of products. Many steps are performed to produce rolled aluminum products from an ingot of aluminum. Also, a substantial portion of aluminum in the ingot ends up as waste.

SUMMARY

[0002] Referring to FIG. **1**, a method comprises sawing an aluminum ingot so that the ingot is separated into at least two separate aluminum slabs **200** and rolling at least one of the slabs unclad and unbrazed **300**.

[0003] Sawing means slicing or cutting. Sawing can be done using a band saw, circular saw, laser, water or by any means or apparatus capable of sawing an aluminum ingot. In some embodiments, the sawing is done with a horizontal band saw **402**, shown in FIGS. **5***a*-**5***c*. A horizontal band saw includes an endless-type band saw which cuts while rotating with its blade set parallel to the ground. The full length of the saw blade can be aligned with the full width or length of an ingot. In some embodiments, the ingot is sawn horizontally, across its face **420**, so that the slabs **404** are equal in length to the ingot, as shown in FIGS. **5***a*-**5***c*. An ingot **400** may be sawn by putting the edge of the band saw **402** on one of the front or back faces of the ingot **400**, then by rotating the edge to cut the ingot and moving the band saw **402** toward the other side of the back or the front face of the ingot **400**. Wedges may be placed at the openings of the sawn area to hold up the upper half of the ingot so that the weight of the upper half is not placed on the saw blade during the sawing.

[0004] An aluminum ingot is a block of aluminum or an aluminum alloy, typically oblong in shape.

[0005] Rolling is a fabrication technique where an aluminum alloy body, slab in this case, is decreased in thickness, generally via pressure applied by rollers. In some embodiments, at least one of the slabs is rolled to form a one of a plate, sheet or foil. The rolling can be hot rolling or cold rolling. In cold rolling, the aluminum alloy body enters the rolling equipment at a temperature below that used for hot rolling, i.e. not greater than 205° C. In one embodiment, the aluminum alloy slab enters the rolling equipment at ambient conditions, i.e., the cold rolling step is initiated at ambient conditions. The rolling step may be completed in one or more rolling passes. In one embodiment, the rolling step rolls the aluminum alloy slab from an intermediate gauge to a final gauge. The rolling step may result in a sheet, plate, or foil product. In some embodiments the aluminum alloy slab is hot rolled and enters the rolling equipment at a temperature greater than 205° C.

[0006] Unclad and unbrazed means the slab is not layered with another metal alloy or any other article, other than lubrication and incidental impurities, during rolling.

[0007] A slab is a portion of the ingot.

[0008] Referring to FIG. **2**, some embodiments further comprise casting an aluminum ingot **100**. Some embodiments further comprise scalping the aluminum ingot **120**. In some embodiments, the sawing of the ingot eliminates or reduces the need to scalp the aluminum ingot and scalping is not performed. Scalping is removing crystallized matter and/or an oxide formed on the surface of the ingot. Scalping can be done by any means known in the art including using a scalper.

[0009] In some embodiments, the ingot is sawn in half to form two slabs having thicknesses that are approximately equal. Approximately equal means varying by no more than 20 mm. In some embodiments, the thicknesses of the slabs are not approximately equal. In some embodiments, the ingot is sawn into more than two separate aluminum slabs **220**.

[0010] Some embodiments further comprise sawing curved edges, or a "D-radius", off of the aluminum slabs **240**. The D-radius refers to the curvature of the ingot sides which look like a "D". In some embodiments, after sawing the curved edges off the aluminum slabs, the aluminum slabs have a substantially rectangular cross-section.

[0011] In some embodiments, the edges are sawn at an angle other than 90 degrees plus or minus 2 degrees resulting in angular facets.

BRIEF DESCRIPTION OF THE DRAWINGS

[0012] FIG. **1** is a flow chart illustrating an embodiment of a method of making a rolled aluminum product.

[0013] FIG. **2** is a flow chart illustrating another embodiment of a method of making a rolled aluminum product.

[0014] FIG. **3** is a flow chart illustrating yet another embodiment of a method of making a rolled aluminum product.

[0015] FIG. **4** is a flow chart illustrating yet another embodiment of a method of making a rolled aluminum product.

[0016] FIG. **5***a* shows a perspective view of an ingot before it is sawn in half with a horizontal band saw.

[0017] FIG. **5***b* shows a perspective view of an ingot as it is being sawn in half with a horizontal band saw.

[0018] FIG. **5***c* shows a perspective view of two slabs of aluminum.

DESCRIPTION

[0019] Referring to FIG. **3**, in one embodiment, a thick as-cast ingot is scalped **120** on the top and bottom sides by running a scalping blade down the length of the ingot to remove up to 25 mm of ingot thickness per side, depending on cross section and alloy types. The ingot is then sawn **200** at half thickness using a horizontal band saw to produce two halves (slabs), each with approximately half the thickness of the original ingot after scalping. For example, for a 500 mm thick by 1200 mm wide cross section ingot, the resulting 2 slabs will each be 250 mm plus allowable tolerances (plus or minus 20 millimeters) thick and 1200 mm wide, The resulting curved edges on both sides are sawn off **240** to straighten the edges. Therefore, the resulting slabs or half ingots will have square edges on all six sides. In some embodiments, the resulting curved edges on both sides are sawn at an angle so that the resulting slabs or half ingots will have square edges on four sides and angular edges on 2 sides. The amount of edges taken off will be determined by ingot initial cross section and alloy type. The exact amount will encompass a range to minimize wastage of the material for the different cross sections and alloy types yet remove sufficient amount to square the edges. These slabs will have varying surface roughness as one surface was scalped and the other was sawn. The slabs will then be sent to the hot mill for pre-heating followed by rolling **300**. Which surface is facing down or up during rolling is not relevant, Subsequent processes such as heat treatment, stress relieving, etc. will be as per existing processes for typical hot roll products.

[0020] The above technique can also be used to saw ingots into multiple slabs that are even thinner than half the thickness of the original ingot. In some embodiments, instead of sawing the ingot into two halves, the ingot is sawn at least one additional time into more than two slabs **220**.

[0021] In some embodiments, the ingot is a cast 7xxx alloy ingot.

[0022] Referring to FIG. **4**, in another embodiment, the ingot is not scalped. A thick as-cast ingot is sawn **200** up to 25 mm each from top and bottom, depending on alloy type and at half thickness using the horizontal saw to produce two halves, each with half the thickness of the original ingot. For example, for 500 mm thick by 1200 mm wide cross section, the resulting two ingots will each be 250 mm plus allowable tolerances (plus minus several millimeters) thick and 1200 mm wide. The resulting curved edges on both sides are sawn off **240** to straighten the edges. Therefore the resulting slabs will have square edges on all six sides. In some embodiments, the resulting curved edges on both sides are sawn at an angle so that the resulting slabs or half ingots will have square edges on four sides and angular edges on two sides. The amount of edges taken off will be determined by the ingot initial cross section and alloy type. The exact amount will encompass a range of values in order to minimize wastage of the material for the different cross sections and alloy types yet remove sufficient amount to square the edges. The slabs will then be sent to the hot mill for pre-heating followed by rolling **300**. Which surface is facing down or up during rolling is not relevant. The pre-heating, rolling and subsequent processes such as heat treatment, stress relieving, etc. will be as per existing processes for typical hot roll products. The above technique can also be used to saw ingots into multiple slabs that are even thinner than half the thickness of the original ingot. In some embodiments, instead of sawing the ingot into two halves, the ingot is sawn at least one additional time into more than two slabs **220**.

[0023] While various embodiments of the present disclosure have been described in detail, it is apparent that modifications and adaptations of those embodiments will occur to those skilled in the art. However, it is to be expressly understood that such modifications and adaptations are within the spirit and scope of the present disclosure.

[0024] All features disclosed in the specification, including the claims, abstracts, and drawings, and all the steps in any method or process disclosed, may be combined in any combination, except combinations where at least some of such features and/or steps are mutually exclusive. Each feature disclosed in the specification, including the claims, abstract, and drawings, can be replaced by alternative features serving the same, equivalent or similar purpose, unless expressly stated otherwise. Thus, unless expressly stated otherwise, each feature disclosed is one example only of a generic series of equivalent or similar features.

[0025] Any element in a claim that does not explicitly state "means" for performing a specified function or "step" for performing a specified function should not be interpreted as a "means or step for" clause as specified in 35 U.S.C. §112.

1. A method comprising:

sawing an aluminum ingot so that the ingot is separated into at least two separate aluminum slabs; and

rolling at least one of the slabs unclad and unbrazed.

2. The method of claim **1** wherein the rolling is at least one of hot rolling and cold rolling.

3. The method of claim **1** further comprising scalping the aluminum ingot.

4. The method of claim **1** wherein the two separate aluminum slabs have thicknesses that are approximately equal.

5. The method of claim **1** wherein sawing an aluminum ingot so that the ingot is separated into at least two separate aluminum slabs comprises sawing an aluminum ingot so that the ingot is separated into more than two separate aluminum slabs.

6. The method of claim **1** wherein the sawing is done with a horizontal saw.

7. The method of claim **1** further comprising sawing curved edges off the aluminum slabs

8. The method of claim **8** wherein after sawing the curved edges off the aluminum slabs the aluminum slabs have a substantially rectangular cross-section.

9. The method of claim **1** further comprising sawing or machining the edges at an angle.

10. The method of claim **10** wherein after sawing or machining the edges off the aluminum slab, the aluminum slabs have a substantially angular cross-section.

11. The method of claim **1** wherein at least one of the slabs is rolled to form a one of a plate, sheet or foil.

12. The method of claim **1**, wherein the ingot is sawn horizontally.

* * * * *