

CLAIMS

1. A flash welding method for welding together steel billets having down cut ends to form endless bar for continuously rolling into a rolled product, each down cut end comprising a deformation in a cross section of the billet by one side surface of the billet extending increasingly inwardly into a profile of the billet in an end region of the billet relative to a normal square cross sectional profile of the billet away from the end region of the billet, the method using a flash welding device and one or more shaving cutters for removing excess weld material, the method comprising steps of:

determining an orientation of a down cut end of a front of a billet to be welded to a rear of a previously welded billet;

determining, based on the orientation, whether the billet to be welded to the previously welded billet needs to be rotated around a longitudinal axis of the billet to align the down cut end at the front of the billet to a down cut end of the rear of the previously welded billet, so that a flash welded joint to be formed by the flash welding device can be deburred by the shaving cutters, such that all excess weld material is removed,

operating a billet rotation means, based on the determined orientation, to rotate the billet around the longitudinal axis of the billet; flash welding the aligned billets using the flash welding device; and

deburring the flash welded joint with the one or more shaving cutters, such that all excess weld material is removed from the endless bar.

2. A method as claimed in claim 1, wherein the down cut end of each billet is characterised by:

the side surface extending inwardly into the profile of the billet by at least 25 mm or by at least 10% of a thickness of the normal square cross sectional profile of the billet.

3. A method as claimed in claim 1 or 2, wherein the end region comprises at least 10 centimetres at an end of the billet.

4. A method as claimed in claim 1 or 2, further comprising controlling a flash time and an upsetting distance of the flash welding device to be sufficient such that the excess weld material protrudes out of the profile of the billets on the side surface to allow the flash welded joint to be deburred by the one or more shaving cutters, such that all excess weld material is removed.

5. A method as claimed in claim 1 or 2, wherein the shaving cutters are configured to cut inside the profile of the normal square cross section of the endless bar on at least the side surface in order that the depth of the cut is sufficient to remove all excess weld material from the flash welded joint.

6. A method as claimed in claim 1 or 2, wherein the rotation of the billet, to be welded to a previously welded billet, around its longitudinal axis is to complementarily align the down cut ends of the billets to be welded together in the same direction, or oppositely align the down cut ends of the billets to be welded together in an opposite direction, so that the flash welded joint can be deburred by the shaving cutters, such that all excess weld material is removed.

7. A method as claimed in claim 1 or 2, wherein the endless bar is rolled in a one or more rolling stands such that the rolled product contains no surface imperfections from the excess weld material.

8. A flash welding apparatus for welding together steel billets having down cut ends to form endless bar for continuously rolling into a rolled product, each down cut end comprising a deformation in a cross section of the billet by one side surface of the billet extending increasingly inwardly into a profile of the billet in an end region of the billet relative to a normal square cross sectional profile of the billet away from the end region of the billet, the apparatus comprising:

a billet orientation determining means for determining an orientation of a down cut end of a front of a billet to be welded to a rear of a previously welded billet, and determining, based on the orientation, whether the billet to be welded to the previously welded billet needs to be rotated around a longitudinal axis of the billet to align the down cut end at the front of the billet to a down cut end of the rear of the previously welded billet;

a billet rotation device configured to rotate the billet, based on the determined orientation, around the longitudinal axis of the billet to achieve the alignment;

a flash welding device for flash welding the aligned billets to form the endless bar,

one or more shaving cutters for deburring a flash welded joint between the billets, such that excess weld material is removed;

the determined orientation, determined in use by the billet orientation determining means, being such that the flash welded joint can be deburred by the shaving cutters, such that all excess weld material is removed.

9. Apparatus as claimed in claim 8, wherein the billet rotation means in use rotates the billet, to be welded to the previously welded billet, around its longitudinal axis is to complementarily align the down cut ends of the billets to be welded together in the same direction, or oppositely align the down cut ends of the billets to be welded together in an opposite direction, so that the flash welded joint can be deburred by the shaving cutters, such that all excess weld material is removed.

10. Apparatus as claimed in claim 8 or 9, wherein the flash welding device is configured such that a flash time and an upsetting distance of the flash welding device are sufficient such that the excess weld material protrudes out of the profile of the billets on the side surface to allow the flash welded joint to be deburred by one or more shaving cutters, such that all excess weld material is removed.

11. Apparatus as claimed in claim 8 or 9, further comprising a reheat furnace arranged for heating each billet before flash welding so that the endless bar is sufficiently malleable to be rolled into rolled products.
12. Apparatus as claimed in claim 11, wherein the billet orientation determining means comprises one or more cameras coupled to one or more processors, positioned between the reheat furnace and the flash welding device, for determining the orientation of the down cut end of a billet.
13. Apparatus as claimed in claim 8 or 9, further comprising one or more rolling stands used to continuously roll the endless bar into rolled products.
14. Apparatus as claimed in claim 8 or 9, wherein the shaving cutters comprise separate cutting means for each profile surface of the endless bar.
15. Apparatus as claimed in claim 8 or 9, wherein the shaving cutters are configured to cut inside the profile of the normal square cross section of the endless bar on at least the side surface in order that the depth of the cut is sufficient to remove all excess weld material from the flash welded joint.
16. Apparatus as claimed in claim 8 or 9, wherein the one or more shaving cutters deburr the flash welded joint such that the endless bar can be continuously rolled into rolled products, by one or more rolling stands, without surface imperfections from excess weld material.