C. E. DUNCAN & J. FAWELL.

MANUFACTURE OF STRUCTURAL MATERIAL.

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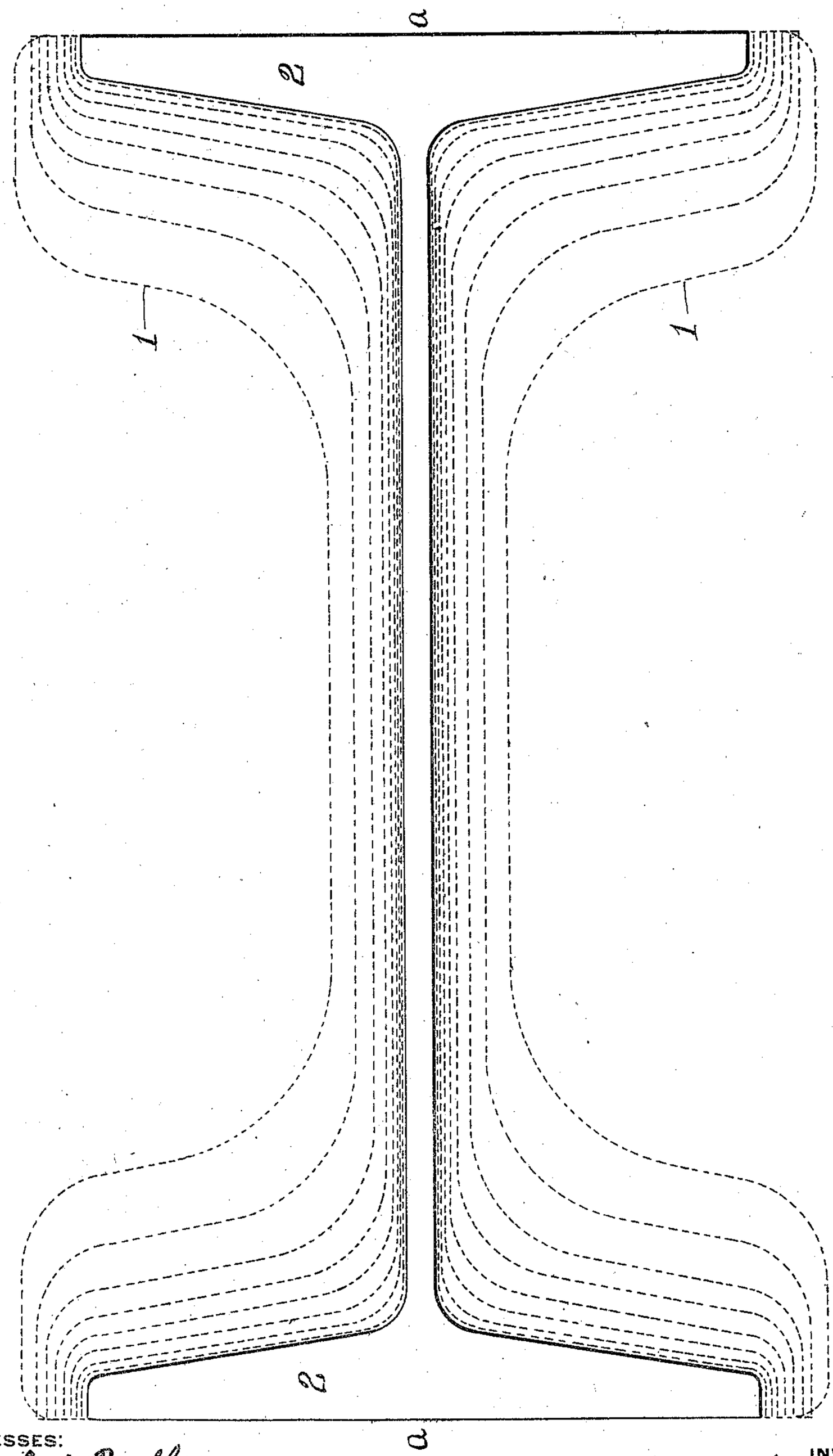
996,007. Patented June 20, 1911.

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# UNITED STATES PATENT OFFICE.

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## MANUFACTURE OF STRUCTURAL MATERIAL.

996,007. Specification of Letters Patent. **Patented June 20, 1911.**

Application filed February 13, 1911. Serial No. 608,458.

*To all whom it may concern:*

Be it known that we, CHARLES E. DUNCAN, residing at Sault Ste. Marie, Ontario, Canada, a citizen of the United States, and JOSEPH FAWELL, residing at Pittsburg, in the county of Allegheny and State of Pennsylvania, citizen of the United States, have invented or discovered certain new and useful Improvements in Manufacture of Structural Material, of which improvements the following is a specification.

As is well known to those skilled in the art, the lower flange of an I beam or other structural shape when arranged horizontally on separated supports, forms the most important element in sustaining the load and that such portion of such flange as is farthest from the neutral axis of the beam *i. e.* the lowermost portion of said flange will be subjected to the greatest strain. Hence in the manufacture of the beams care should be taken that no flaws or defects should occur in that portion of the flange and that the metal should not be put under injurious strains.

Two forms or types of mills are now generally used in the manufacture of beams, etc. The first consists of two or three high rolls having grooves progressively varying in contour and dimensions. As is well known to those skilled in the art the reducing or shaping surfaces formed by the walls of the grooves vary greatly in peripheral speed, especially if the flanges to be formed are wide. By reason of the variation of portions of the reducing surfaces from the rate of movement of the article between the rolls, and the fact that the walls of the grooves which shape the flanges, differ most greatly from the rate of movement of the article, the metal of the flanges is subjected to great strains and there is a tendency to form cracks in the surfaces of the flanges especially the outer surfaces due to grinding and tearing action, when the reducing surfaces slip along the gradually cooling and stiffening metal. In the other form or type of mill generally known as a universal mill, consisting of horizontal and vertical rolls, the rolls are adjustable to effect the required variation of dimensions of the pass, as the article is fed back and forth between the rolls. In this mill the operative surfaces of the horizontal rolls are so shaped as to impart to the article, when the web has been reduced to the desired gage the required contour to the inner faces of the flanges. In other words the horizontal rolls are formed with a collar having cross-sectional shape and dimensions corresponding to the portions of the beam within the flanges. These collars displace the metal vertically to form the web of the beam. The sides of the collars do not effect any substantial lateral displacement of the metal, they simply serve as internal support for the flanges, while the latter are being shaped and brought to size by the vertical rolls, which are adjusted inwardly toward each other after each pass. In thus rolling the beam the largest periphery of the horizontal rolls will have the highest peripheral speed and the rate of movement of the article through the rolls will be approximately the same. But the peripheral speed of the sides of the collars is slower proportionally to their distance from the axes of the rolls, and hence will tend to have a retarding effect on the metal adjacent thereto. The vertical rolls, which operate on the outer faces of the flanges, will have a peripheral speed approximately equal to that of the article between the rolls. It will be readily understood that as the metal in contact with the sides of the collars must be dragged along by the conjoint pull of tops of the collars and the vertical rolls, there will be a constant tendency to tear the metal, producing cracks transverse of the direction of movement of the article. These cracks, if formed, are closed up and not visible, and even if not formed the tearing action of the rolls will have a weakening effect. This weakening of the web does not seriously affect the beam but the weakening of the outer faces of the flanges, when the beam is so placed that one of the flanges will be in tension, is believed to be detrimental.

The invention described herein has for its object the production of a structural shape in such manner that the outer faces of the flanges will be substantially free from cracks or injurious strains. The invention is hereinafter more fully described and claimed.

In the accompanying drawing our improved method is diagrammatically illustrated as applied to the manufacture of I beams.

In the practice of our invention, the ingot is broken down in a blooming or universal

mill and partially shaped. During this operation, reduction is effected at all points without any injury to the metal as it is so hot and plastic as to readily yield and flow under the pressure of the rolls without any tendency to tear. As the reduction continues the portions which go to form the flanges become thinner and cooler and the metal less plastic, so that in subsequent reductions the change of shape is due mainly to flow under pressure and to some extent to a tearing of the metal, producing cracks and strains. At about the time or preferably just before the metal reaches this critical temperature, which will be readily recognized by the skilled roller, the blank is reduced to a depth *i. e.* a transverse dimension through the web portion, substantially equal to the depth *i. e.* the distance between the points *a*—*a* in the drawing, required in the finished beam. At this time the blank will have a contour substantially similar to that indicated by the outer lines 1, and all subsequent reductions should be within planes coinciding with the outer faces of the flanges 2. These reductions may be effected in a two or three high mill having grooves or passes formed therein suitable for the progressive reduction of the blank, or in a universal mill in which only the upper horizontal roll will be shifted during reduction; and the vertical rolls having been adjusted a distance apart equal or substantially equal to the desired depth of the beam, the latter will not be substantially changed. While the desired reduction may as stated be effected in a universal or a two high mill, it is preferred to employ a universal mill of the type shown and claimed in the application of Charles E. Duncan and Joseph Fawell filed February 13th, 1911, Serial No. 608,459, in which the blank is reduced in a series of fixed passes each formed by two horizontal and two vertical rolls. When employing this mill the dimensions of the operative portions of the horizontal rolls are changed for each pass as indicated by dotted lines in the drawing. In addition to changes in dimensions there will be also such slight changes in contour as are required to properly shape the portions of the beam within the flanges.

It will be observed that in each pass a reduction of the web portion and also of the thickness and width of the flange portions of the blank, is effected but that the relative positions of the outer faces of the flanges are not substantially changed. As no substantial reduction of depth is effected the outer faces of the flanges will, in a two high mill, simply slide along the reducing faces of the rolls to an extent equal to the difference of speed of the article and the roll faces; and the same is true when a universal mill is employed but not to so great extent, hence there will not be any tendency to so tear the metal as to produce cracks or strains.

We claim herein as our invention:

1. The method herein described of manufacturing structural material which consists in first reducing an ingot or billet in one direction to or approximately to its final dimension and partially reducing the ingot or billet in other directions and then reducing such partially reduced portions to final dimensions.

2. The method herein described of manufacturing structural material which consists in forming a blank having a depth, equal or approximately equal to that desired in the finished article and reducing such blank to the finished article without materially changing the depth of the blank.

3. The method herein described of manufacturing structural material which consists in first forming a blank by reducing an ingot or billet in all directions, reduction in one direction being to or approximately to a finished dimension, and finally finishing the article by reductions of the blank between planes coinciding with the previously finished surfaces.

In testimony whereof, we have hereunto set our hands.

CHARLES E. DUNCAN.
JOSEPH FAWELL.

Witnesses:
OSCAR BRASHEAR,
E. H. HASLAM.