PATENT SPECIFICATION (11) 1 577 368

1 577 368

(21) Application No. 19103/77 (22) Filed 6 May 1977 . (19)
(31) Convention Application No. 51/055 953
(32) Filed 14 May 1976 in
(33) Japan (JP)
(44) Complete Specification published 22 Oct. 1980
(51) INT. CL.³ B21D 5/14 F16C 33/06
(52) Index at acceptance
B3E 10E3 14G 1H4 1R 1Y CD
B3M 17X RD
F2A 113 117 119 151 192 D49

(54) METHOD OF PRODUCING RING-SHAPED OR ARCUATELY SHAPED ARTICLES

(71) We, DAIDO METAL COMPANY LTD., a Corporation organised under the laws of Japan, of 2, Sanage-cho, Kita-ku, Nagoya, Japan, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

The present invention relates to a method of producing ring-shaped or arcuately shaped articles.

Conventially, several methods as mentioned below have been proposed and actually used for the production of such articles.

(1) Punching out of the ring-shaped or acuately shaped article blank of required shape and dimension from plate material.

(2) Winding a flat bar in its breadthwise direction around a core.

(3) Producing a cylindrical article by bending a flat bar in its thicknesswise direction using a pair of forming rolls.

The method mentioned in the above item (1) has been found unsatisfactory because a large part of the plate material has to be uneconomically wasted.

In the methods of above items (2) and (3), the final product is apt to exhibit cracking in its peripheral portion as well as lack of dimensional accuracy in breadthwise and thicknesswise directions.

It is the object of the present invention to provide an economical method of producing from a flat bar ring-shaped or arcuately shaped articles which are less subject to peripheral cracking, thus reducing the proportion of rejects, and in which dimensional accuracy is so improved that further working subsequent to the forming operation can be dispensed with.

It is another object of the invention to provide a method by which ring-shaped or arcuately shaped articles can be mass-produced rapidly, employing a roll-forming machine of relatively simple construction.

According to the invention a method of producing a ring-shaped or arcuately shaped article comprises causing a blank flat bar to pass through a confined passage having a cross-section corresponding to the cross-section of the article and defined by a cylindrical surface and a flank surface of each of a pair of forming rolls, and bending the bar in its breadthwise direction by pressing it against a cylindrical surface of one of the forming rolls.

An embodiment of the invention will now be described by way of exampe with reference to the accompanying drawings, in which:—

Figures 1 to 3 show a method for forming a semi-annular thrust washer adapted for use as a thrust bearing, wherein:

Figure 1 is a perspective view of a blank flat bar which constitutes a starting material;

Figure 2 is a perspective view of the bar partially bent in its breadthwise direction;

Figure 3 is a perspective view of a completed thrust washer;

Figure 4 is an explanatory illustration of the method for forming the thrust washer by upper and lower forming rolls arranged as a pair, with the aid of auxiliary means, in which a bank flat bar starting material is partially bent in its breadthwise direction;

Figure 5 is a sectional view taken along the line C—D—E—F of Figure 4;

Figure 6 is a sectional view of a part of Figure 5 on a larger scale; and

Figure 7 is an explanatory illustration of a roll passage H of a confined cross-section, formed between the upper and the lower forming rolls arranged as a pair.

Referring at first to Figure 1, a flat blank bar P comprises a backing plate 1 with a layer of bearing material 2 bonded by casting or pressure-welded onto the backing plate 1.

The backing plate 1 may be made, for example, of steel, while the bearing material 2 may be, for example, of white metal, an aluminium alloy or a copper alloy.

The breadth A of the blank P must be larger than the radial width B of the completed thrust washer as shown in Figure 3. The breadth dimension A is selected suitably taking the mechanical properties, e.g. elongation ratio, hardness and tensile strength, of the blank material P into account.

The method of forming the thrust washer is as follows. First an electric power source switch (not shown) is closed. Then, as will be seen from Figures 4 and 5, an hydraulic cylinder 12 is actuated to lower housings 9, 10 supporting an upper forming roll 3 to a predetermined position. A curling block 5 fixed to the housings 9 and 10 is accordingly maintained at a fixed position relative to the roll 3.

Then a screw mechanism G is actuated to lift a base unit K comprising housings 17, 18, an auxiliary roll 6 and an hydraulic cylinder 7 up to a raised position. The housings 17, 18 support a lower forming roll 4.

Each forming roll 3, 4 has a step, and a flank surface normal to the roll axis extending outwardly from the step. In the state shown in Figure 7 the steps and flank surfaces of the upper and the lower forming rolls 3, 4 cooperate with each other to define therebetween a passage H of a confined cross-section, the passage having a height B and width W substantially equal to the corresponding dimensions B and W of the complete thrust washer shown in Figure 3.

A suitable gap S is maintained between the upper and the lower forming rolls 3, 4 (see Figures 5 to 7) so as to prevent the rolls from being damaged by peripheral contact with each other.

A switch (not shown) is closed for actuating hydraulic means to start hydraulic motors M which drive the upper and the lower forming rolls. The torque from the hydraulic motors M is transmitted to the upper and lower rolls 3, 4 through universal joints 13, 16 respectively, to rotate the rolls in the directions shown by respective arrows in Figure 4.

Subsequently, the blank flat bar P shown in Figure 1 is put on a table 20, and is fed towards the forming rolls by feeding means 8.

The blank flat bar P is forcibly fed into and passes through the passage between the upper and the lower forming rolls 3, 4 and is subjected therein to plastic deformation by a force exerted by the roll positions and the rolls' torque.

As mentioned before, the height B of the passage H is smaller than the breadth A of the flat blank P. This is to prevent cracking at the peripheral portion of the bar that is being bent during the rolling, as well as to obtain a uniform breadth of the final product.

As will be seen from Figures 5 to 7, the upper and the lower forming rolls 3, 4 are arranged to maintain between the said flank surfaces thereof a clearance W in the axial direction of the forming rolls substantially equal to the thickness W of the flat blank bar P, so as to ensure that the final product has a substantially uniform thickness over its entire length, preventing bulging of the blank beyond a predetermined tolerance.

Subsequently, the blank P having passed through the passage H between the forming rolls 3, 4 comes into contact with the curling block 5 and is bent downwardly, to assume a half-finished form as shown in Figure 2.

The speeds of the upper and the lower forming rolls 3, 4 are arranged so that the peripheral or circumferential velocity of the upper forming roll is always greater than that of the lower forming roll 4, thereby to smooth the bend of the blank concurrently with the actual bending of it.

Then, the half-finished blank is forced to pass between the lower forming roll 4 and an auxiliary roll 6 urged towards the roll 4 by a hydraulic cylinder 7, thereby to compress the blank against the roll 4 and to impart a uniform curvature to the blank so as to obtain a final thrust washer T having an accurate semi-annular configuration.

The formed thrust washer T is allowed to drop by gravity, as it trailing end leaves the auxiliary roll 6, thus completing the forming process.

Although there has been described by way of example a practical embodiment in which the method of the invention is applied to the production of arcuately shaped articles, i.e. semi-annular thrust washers for use as thrust bearings, the method of the invention is applicable also to the production of articles having shapes other than arcuate. Thus, for the production of ring-shaped articles, detachable auxiliary means such as a plurality of auxiliary rolls are additionally incorporated in combination with the upper and the lower forming rolls 3, 4.

As has been described, according to the invention, a blank bar is caused to pass through a confined passage defined between a pair of forming rolls and is then bent in the breadthwise direction of the bar. Therefore, no cracking is caused in the periphery of the final ring-shaped or arcuately shaped product.

In addition, the method of the invention provides a greatly improved dimensional accuracy or precision in the breadth and thickness directions of the final products, and enables economical mass-production of such articles.

WHAT WE CLAIM IS:—

1. A method of producing a ring-shaped

or arcuately shaped article comprising: causing a blank flat bar to pass through a confined pasage having a cross-section corresponding to the cross-section of the article and defined by a cylindrical surface and a flank surface of each of a pair of forming rolls, and bending the bar in its breadthwise direction by pressing it against a cylindrical surface of one of the forming rolls.

2. A method of producing a ring-shaped or arcuately shaped article as claimed in Claim 1 wherein the breadth of the blank flat bar is greater than the height of the passage and the thickness of the blank flat bar is substantially equal to the width of the passage.

3. A method of producing a ring-shaped or arcuately shaped article as claimed in Claim 1 or Claim 2 wherein the tangential velocity of the said one forming roll is lower than that of the other forming roll.

4. A method of producing a ring-shaped or arcuately shaped article as claimed in any of the preceding Claims wherein a curling block and an auxiliary roll engage the bar after it emerges from the passage between the forming rolls to hold the bar in close engagement with the said one forming roll, the curling block and the auxiliary roll being so arranged that the bar emerging from the passage engages the curling block and is deflected thereby to pass through a passage defined by the auxiliary roll and the said one forming roll.

5. A method of producing a ring-shaped or arcuately shaped article as claimed in Claim 4, wherein at least one additional auxiliary roll is provided to hold the bar in close engagement with the said one forming roll.

6. A method of producing a ring-shaped or arcuately shaped article as claimed in any of the preceding Claims, wherein the said cylindrical surface of each of the forming rolls is a step of a breadth substantially equal to that of the article and the said flank surface of each of the forming rolls is normal to the roll axis and extends outwardly from the step, these steps and flank surfaces cooperating to define the said passage when the forming rolls are in predetermined relative positions.

7. A method of producing a ring-shaped or arcuately shaped article as claimed in any of the preceding Claims wherein the blank flat bar consists of a bearing material backed with a backing metal.

8. A method of producing a ring-shaped or arcuately shaped article, substantially as described with reference to the accompanying drawings.

9. Ring shaped and arcuately shaped articles which have been produced by a method as claimed in any of the preceding Claims.

KILBURN & STRODE,
Chartered Patent Agents,
Agents for the Applicants.

Printed for Her Majesty's Stationery Office by Burgess & Son (Abingdon), Ltd.—1980.
Published at The Patent Office, 25 Southampton Buildings, London, WC2A 1AY
from which copies may be obtained.

1577368 COMPLETE SPECIFICATION

4 SHEETS *This drawing is a reproduction of the Original on a reduced scale*

Sheet 1

FIG. 1

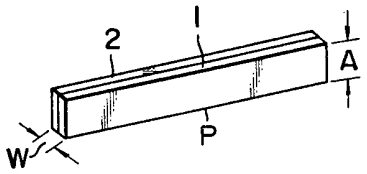


FIG. 2

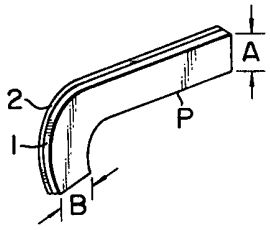
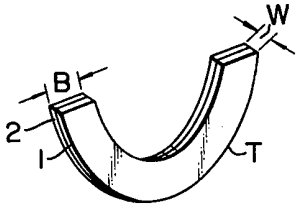


FIG. 3



1577368 COMPLETE SPECIFICATION
4 SHEETS *This drawing is a reproduction of the Original on a reduced scale*
Sheet 2

FIG. 4

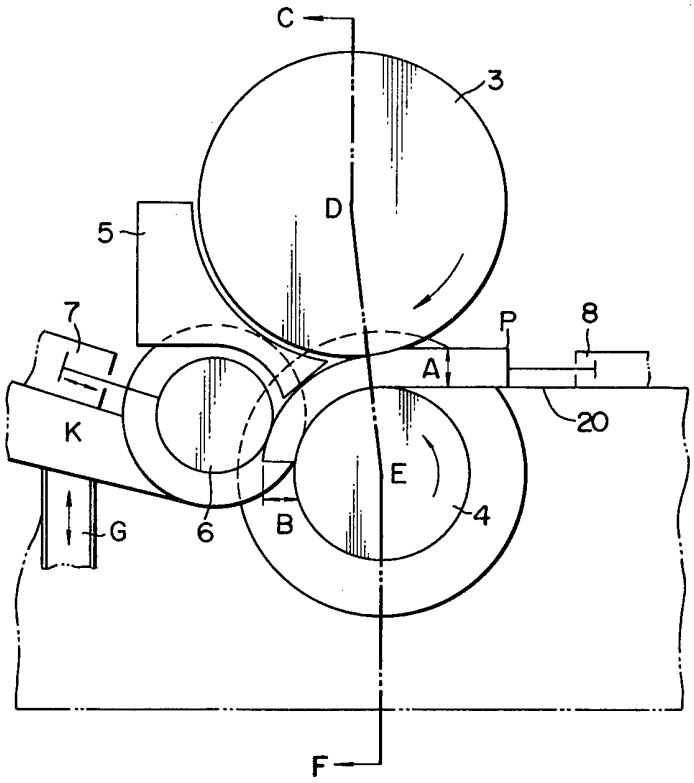


FIG. 5

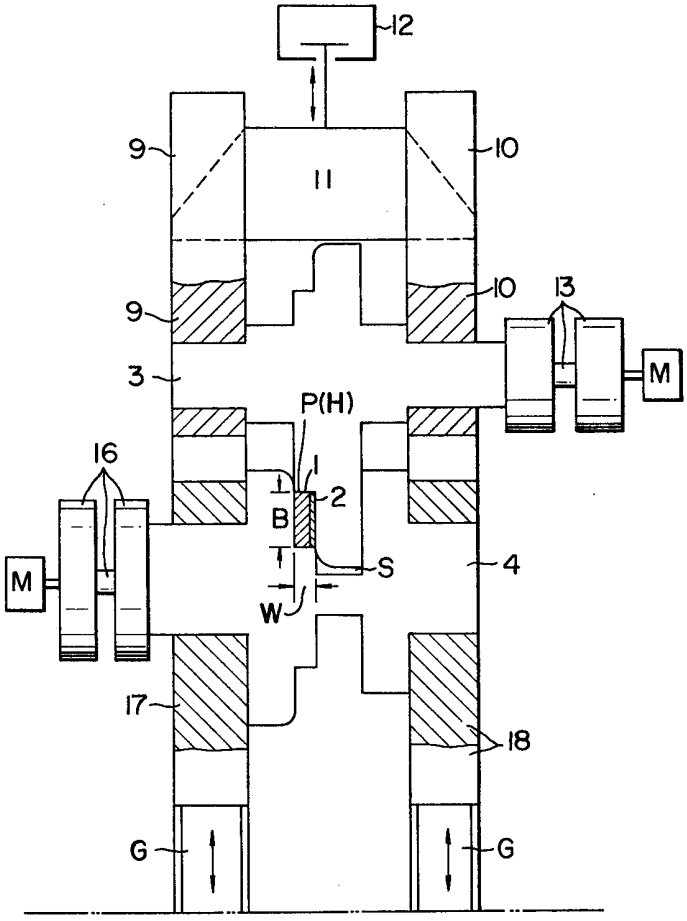


FIG. 6

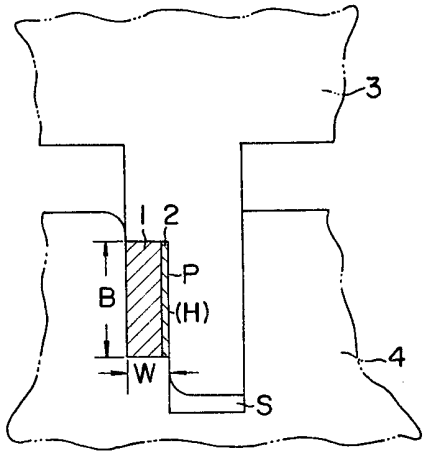


FIG. 7