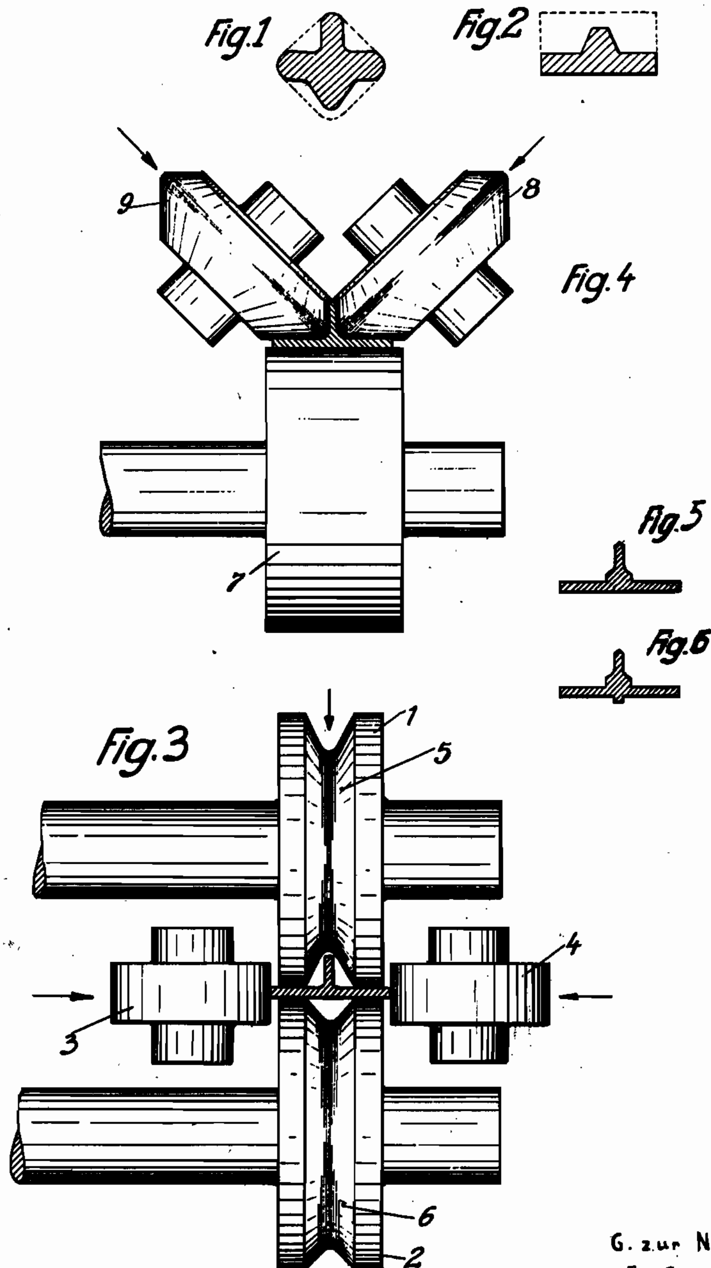
PUBLISHED
MAY 4, 1943.
BY A. P. C.

G. ZUR NEDDEN ET AL
METHOD OF ROLLING STRIP IRONS
Filed Feb. 9, 1940

Serial No.
318,112
4 Sheets-Sheet 1



Inventors
G. zur Nedden
E. Cords
By
E. a. Oam.
Agent

PUBLISHED	G. ZUR NEDDEN ET AL	Serial No.
MAY 4, 1943.	METHOD OF ROLLING STRIP IRONS	318,112
BY A. P. C.	Filed Feb. 9, 1940	4 Sheets-Sheet 2

Fig. 8

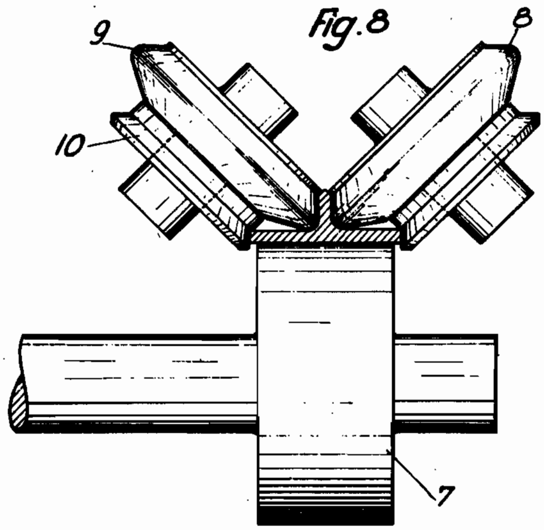
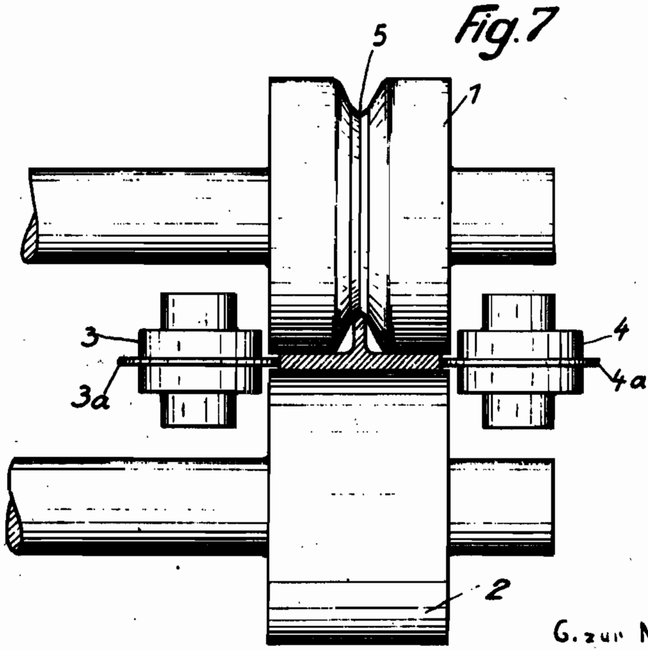


Fig. 7



Inventors
G. zur Nedden
E. Cords
By E. A. Ow...
Agent

PUBLISHED
MAY 4, 1943.
BY A. P. C.

G. ZUR NEDDEN ET AL
METHOD OF ROLLING STRIP IRONS
Filed Feb. 9, 1940

Serial No.
318,112
4 Sheets-Sheet 3

Fig. 9

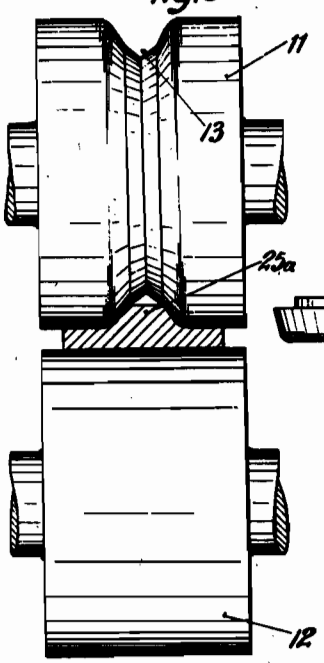


Fig. 10

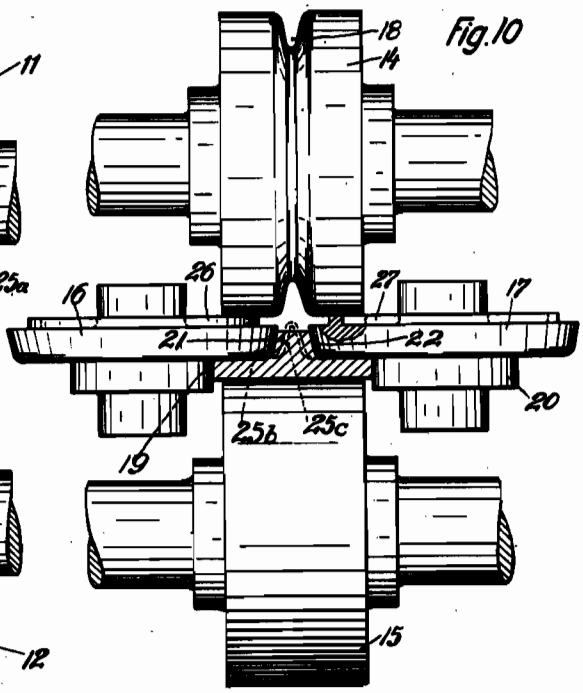


Fig. 12

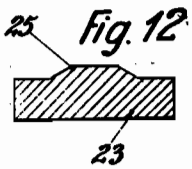
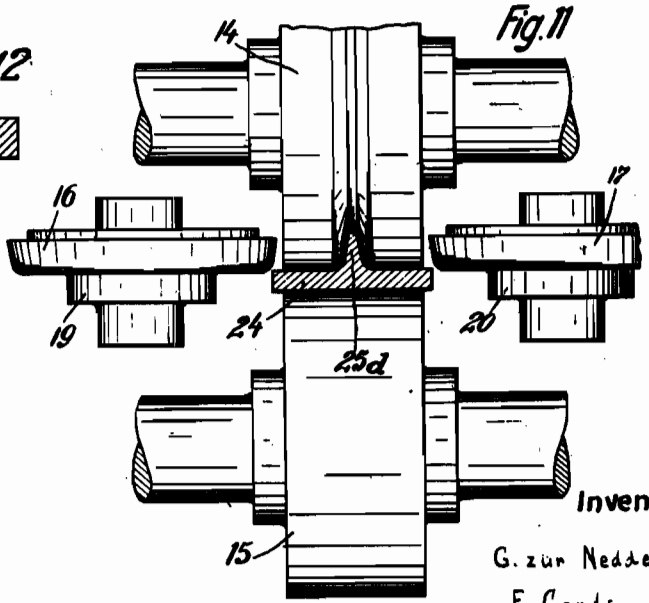


Fig. 11



Inventors
G. zur Nedden
E. Cords
E. A. Uhm.
Agent.

By

PUBLISHED
MAY 4, 1943.
BY A. P. C.

G. ZUR NEDDEN ET AL
METHOD OF ROLLING STRIP IRONS
Filed Feb. 9, 1940

Serial No.
318,112
4 Sheets-Sheet 4

Fig. 13

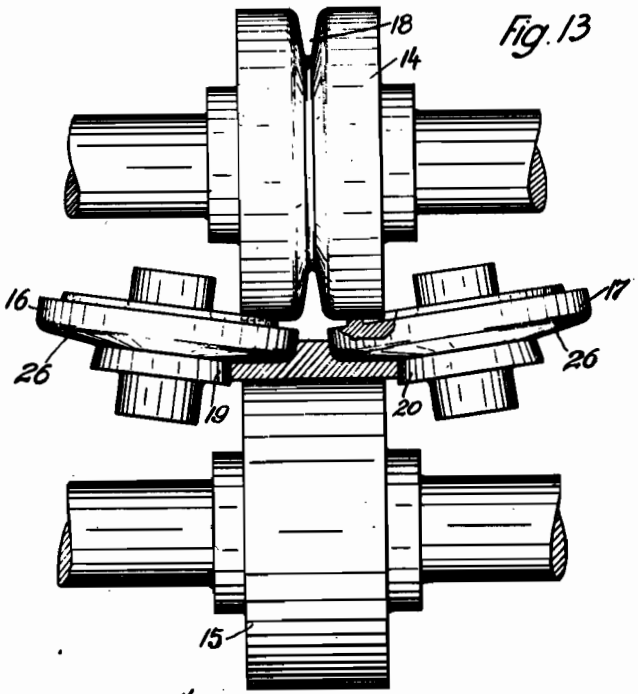
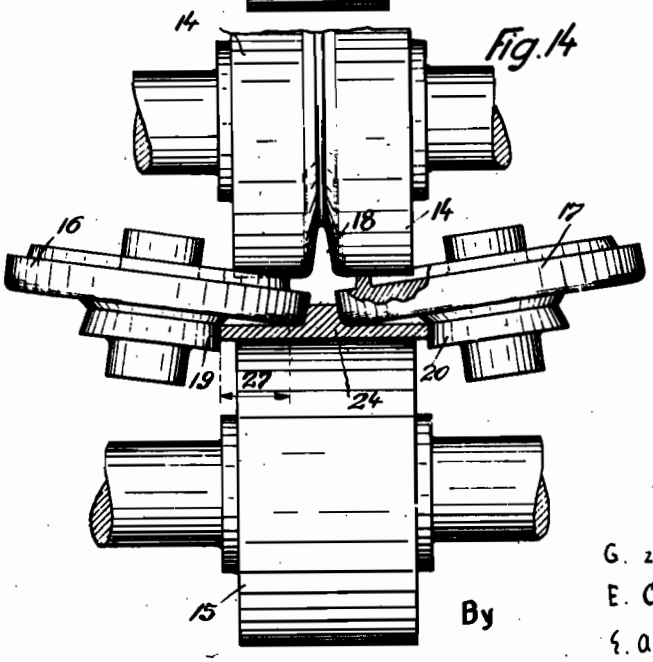


Fig. 14



Inventors
G. zur Nedden
E. Cords
E. A. Uhm.
Agent

By

Published May 4, 1943

Serial No. 318,112

ALIEN PROPERTY CUSTODIAN

METHOD OF ROLLING STRIP IRONS

Gerhard Zur Nedden and Erich Cords, Peine near Hannover, Germany; vested in the Alien Property Custodian

Application filed February 9, 1940

The present invention relates to the manufacture of strip irons or strip steels provided with a projection on one surface and adapted for the production of welded I- or H-irons.

For the sake of simplicity these strip irons or strip steels are called "strip iron" or "strip steel" in the following specification.

As a rule strip irons or strip steels having the cross section of a flat rectangle and a bulb or rib at the middle of the one broad side to which a web plate is welded for instance by means of an X-seam are used for the manufacture of welded I- or H-irons. Such flat strip steels provided with a bulb or rib, however, have certain disadvantages, because often cracks were formed close to the welding seam. These cracks are due to the fact that on the one hand during welding of the neck seams the heat is conducted too fast to the thick flange profiles which at the point of welding and in the neighborhood thereof are strongly hardened and that, moreover, triaxial states of stresses occur during welding of the neck seams enhancing as is well known, separating fractures. Finally due to difficulties in the rolling technics it is impossible to produce the bulb or rib of the thick bulb profiles in a manner free of objection.

To avoid the above mentioned difficulties it has been proposed to locate the neck seams away from the cross section of the flange surface by using half broad flange irons or special T-profiles to be produced in mills for rolling shapes. If the neck seams are located in such a position, there is no danger of too fast a heat conduction and, therefore, of a harmful hardening. Moreover, with such V- or X-seams no undesired multi-axial states of stresses occur as in connection with neck seams when using broad flange irons or special profiles which have the seams directly arranged at the flange surfaces.

Now, broad flange irons as a rule have flanges of a width of 300 mm only and for reasons of rolling technics it is not possible to produce considerably broader flanges. The I- or H-irons used at present in constructing bridges, however, often have flanges of a width of 500–700 mm so that the proposed methods are not adapted to obviate the difficulties. The second proposal to roll I- or H-irons in mills for rolling shapes also is accompanied by difficulties, because I- or H-steels represent the most difficult profiles to be produced by mills for rolling shapes.

According to the invention the above mentioned difficulties are overcome by treating the flange surfaces of I- or H-steels of big cross section in one stand and the web in a second stand by the pressure of adjustable lateral rolls. According to a preferred modification of this method the rod to be rolled is several times alternately passed through both stands. The web formed hereby may freely pass through a corresponding circumferential groove in the upper roll of the first stand or the circumferential groove of this upper roll may be so formed that the web is upset when passing through this stand.

The edges of the flange may be treated either by lateral rolls of the first stand, constructed as a universal stand, or also may be formed by the lateral rolls of the second stand.

It has been found that when carrying out the new method the lateral rolls of the second stand preferably are inclined under an angle of about 45°. These lateral rolls may be formed as friction rolls and be composed of a plurality of operating parts. The lateral rolls of the second stand may, moreover, be supported by an upper roll and may be so constructed as not to come into contact with the outer parts of the upper surfaces of the flange.

According to a particular suitable modification of the method forming the subject matter of the invention, the web is pressed downwardly in the first passes of the first universal stand only, whereupon it is alternately treated in the stand provided with the inclined rolls and preferably formed as a three high stand and the edges of the flange are treated in the universal stand. The stands preferably are arranged one close behind the other.

The advantage of the method according to the invention consists therein that T-irons may be rolled in the desired width. The point of change-over between the web and the flange may exhaustively be treated so that rolling faults hardly may occur at this particular important point. With regard to mills for rolling shapes the new method has the advantage that the thickness as well as the width of the flanges may be regulated by different adjustments of the rolls so that various profiles may be produced with the same set of rolls. By exchanging the lateral rolls acting upon the web any desired widths of profiles may be obtained in between certain limits.

In one modification of the new method according to which the web and the edges of the flange are treated in the three high stand provided with two lateral rolls inclined under an angle of about 45°, and the surfaces of the flange are treated in a four high stand, the most difficult

rolling operation, i. e. the rolling of the flanges is effected by the more powerful four high stand. The vertical rolls of this stand serve as a guide for the rod only and need not perform a rolling operation, and, therefore, may eventually be replaced by guides. In three high stands the web and the edges of the flange are treated while no pressure is applied to the upper surface of the flange. If the inclined rolls are not driven they preferably are, as mentioned already, composed of a plurality of parts so that they may adapt themselves to the rolling speed in spite of the different diameters. Furthermore, it is of no importance whether the friction rolls are journalled upon pivots or upon a continuous shaft.

The second stand to be used according to the invention may also be built as a four high stand and in this construction the axes of the lateral rolls may be inclined a few degrees inwardly for preventing sliding of the vertically arranged lateral rolls upon the upper surface of the flange. The lateral rolls thereby have the form of a flat truncated cone the circumferential wall of which is in contact with the plain surface of the flange of the I- or H iron along a straight line only. Therefore, the lateral rolls may roll upon the flanges of said I- or H irons without sliding.

If special broad strip irons are to be produced the difference in speed of the individual points of the just mentioned straight line causes great wear of the rolls. To prevent this disadvantage the inclined lateral rolls could also be constructed in such a manner that they operate upon the web projection and the middle portion of the flange as well as upon the vertical edges of the flange, whereas the outer flange surfaces freely pass through these rolls.

In the accompanying drawings some constructions of stands and rolls for carrying out the method according to the invention are shown by way of example.

In these drawings:

Figures 1 and 2 show cross sections of ingots obtained by blooming mill trains adapted to preferably be treated in the stands illustrated in Figures 3 and 4;

Fig. 3 shows a diagrammatic front elevation of a first stand adapted for carrying out the method according to the invention;

Fig. 4 shows a front elevation of a second stand constructed as a three high stand;

Figures 5 and 6 illustrate special profiles which according to the invention may be rolled and which are provided with projections for facilitating welding of reinforcing laminations;

Fig. 7 shows a diagrammatic front elevation of a modified construction of the first stand;

Fig. 8 shows a diagrammatic front elevation of a modification of the second stand provided with three rolls and belonging to the stand illustrated in Fig. 7;

Fig. 9 illustrates a diagrammatic front elevation of a further modification of the first stand;

Fig. 10 shows a diagrammatic front elevation of the corresponding second stand formed as a four high stand;

Fig. 11 shows the stand according to Fig. 10 with displaced lateral rolls operating then as a two high stand;

Fig. 12 shows a cross section of a preliminary profile which may further be rolled in the stands according to Figures 9 and 11, and

Figures 13 and 14 show modified constructions of the stand according to Figures 10 and 11.

The stand shown in Fig. 3 is formed as a four high or universal stand having the driven upper roll **1**, the driven lower roll **2** and the non-driven lateral rolls **3** and **4** (friction rolls). The latter as well as the upper roll may be brought into position in the direction of the arrows. The rolls **1** and **2** are provided with circumferential grooves **5** and **6** which allow the web formed to freely pass. The second stand illustrated in Fig. 4 is provided with a driven lower roll **7** and with two lateral rolls **8** and **9** each inclined about an angle of about 45°. The lateral rolls may be formed as friction rolls or as driven rolls which may be brought into position in the direction of the arrows shown in the drawing.

The rolling operation in the stands shown in Figures 3 and 4 is about as follows:

In the cogging roll preliminary forming of the ingot is effected for instance by rolling down the ingot to a square cross section having a diagonal which is a little smaller than the width of the strip steel to be produced. Before the last pass is reached the ingot is edged for 45° and a cross shaped profile is produced as shown in Fig. 1. It is also possible to start with a T-shaped profile as illustrated in Fig. 4. In the latter case the lower roll **7**, however, has no groove **6**. These preliminary profiles are pressed down in the four high stand and the three high stand in which particularly the web is treated and the rolls of which stand continuously are adjusted. After each two passes in this stand two passes in the four high stand follow to obtain clean edges of the flanges again. Special profiles such as shown for instance in Figures 5 and 6 may be produced by correspondingly profiling the rolls **8** and **9** or **7**, **8** and **9** respectively.

In the modifications of stands shown in Figures 7 and 8 the elements corresponding to those illustrated in Figures 3 and 4 are designated with the same reference characters. In these stands the flange surfaces are treated by the stand according to Fig. 7 the upper roll **1** of which is provided with such a circumferential groove that the web rolled upwardly is somewhat upset. The lateral rolls **3** and **4** serve the purpose only of guiding the rolling stock by the narrow ring discs **3a** because the edges of the flange are treated by the inclined rolls of the three high stand according to Fig. 8. A loose ring **10** serves for treating the edges of the flange. The inclined rolls **8** and **9** are, as may be seen from the drawings, composed of a plurality of parts. In this modification of the invention the web and the edges of the flange are treated in the three high stand and the surfaces of the flange in the four high stand.

According to a further modification of the new method the first stand is formed as shown in Fig. 9. This stand comprises a pair of driven horizontal rolls **11**, **12** the lower one of which is smooth, whereas the upper one is provided with a circumferential groove **13** which has about the shape of the projection to be formed which, however, is of a greater width. The upper roll may be adjusted or be brought into position. The width of the body of these rolls is broader than the broadest profile to be rolled.

The second stand shown in Figures 10 and 11 has a pair of driven horizontal rolls **14**, **15** and a pair of non-driven vertical lateral rolls **16**, **17**. The width of the body of the horizontal rolls is smaller than the smallest profile to be rolled. The lower roll **15** is smooth and the upper roll adapted to be adjusted or to be brought into position has a circumferential groove **18** which corre-

sponds to the final shape of the welding projection. The lateral rolls **16**, **17** also may be adjusted or brought into position and this in a horizontal direction as well as in a vertical direction. The form of the lateral rolls is steplike. The lower sections **19** and **20** respectively are cylindrical. The upper sections **21** and **22** respectively have the shape of the flange of the projection to be formed at the strip iron or the strip steel. The lateral rolls **16**, **17** may be constructed in two parts in such a manner that the sections **19**, **20** respectively and **21**, **22** respectively each consist of one part which for use may be assembled by suitable means.

The rolling method using the just described stands shown in Figures 9–11 is carried out about as follows:

A preliminary profile **23** (Fig. 12) rolled by a preliminary roll or prepared in an other manner is produced in a width substantially in accordance with the width of the final profile **24** at a corresponding thickness. To facilitate the later rolling the preliminary profile may already have a more or less pronounced projection **25**. This preliminary profile **23** with the projection **25** is rolled in the stand according to Fig. 9. The thickness of the preliminary profile is reduced in a plurality of passes, whereby the circumferential groove **13** of the upper roll is filled and simultaneously broadens the profile. During these passes the rolls of the stand shown in Figures 10 and 11 are moved away from each other, the upper roll **14** is moved upwardly and the lateral rolls **16**, **17** outwardly, so that these rolls at the beginning are not operating. If the circumferential groove **13** is filled the stand shown in Figures 10, 11 operates also. The lateral rolls **16** and **17** are adjusted so far that a lateral upsetting of the lateral surfaces of the profile is caused by the members **19** and **20** and the flanks of the projection **25***a* are upset by the members **21** and **22** of the lateral rolls. The lower sides of the members **21** and **22** of the lateral rolls **16** and **17** are slightly pressed upon the profile so that it may draw the lower roll **15** between the lateral rolls **16** and **17**. For producing this pressure the upper roll **14** may be pressed against the annular wear ledges **26**, **27** of the lateral rolls **16** and **17**. The diameters of the members **19** and **20** and **21** and **22** are so chosen with respect to each other that as soon as the desired width of the profile is obtained the required thickness of the projection **25***a*, **25***b*, **25***c* also is obtained. During lateral upsetting roughing of the projection is effected towards the upper free side. By means of one or more passes in the stand according to Fig. 9 the roughing in the groove **13** of the upper roll **11** and the upsetting at the projecting parts of the profile not seized in the stand according to Fig. 10 may be rolled back again. Finally in a special pass in the stand according to Fig. 11 the projection may receive the final shape **25***d* necessary for welding, the lateral rolls **16** and **17** being moved away from each other and the upper roll acting under slight pressure. During this operaton the projection is formed by the circumferential groove **18** in the upper roll **14**.

In Figures 13 and 14 the same reference letters are used to indicate corresponding elements shown in Figures 10 and 11. According to the construction shown in Fig. 13 the lateral rolls **16**, **17** are slightly inclined towards the interior and formed at **26** as truncated cone. The surface **26** is in contact with the upper surface of the flange. Fig. 14 shows a construction of the lateral rolls according to which the portion **27** of the flange is not touched by the lateral rolls and freely passes the rolls. The member **20** may in this construction also be formed as a loose ring similar to that shown at **10** in Fig. 8.

GERHARD ZUR NEDDEN.
ERICH CORDS.