July 11, 1944. R. G. BENNEWITZ 2,353,289

METHOD AND APPARATUS FOR ROLLING STRIP METAL

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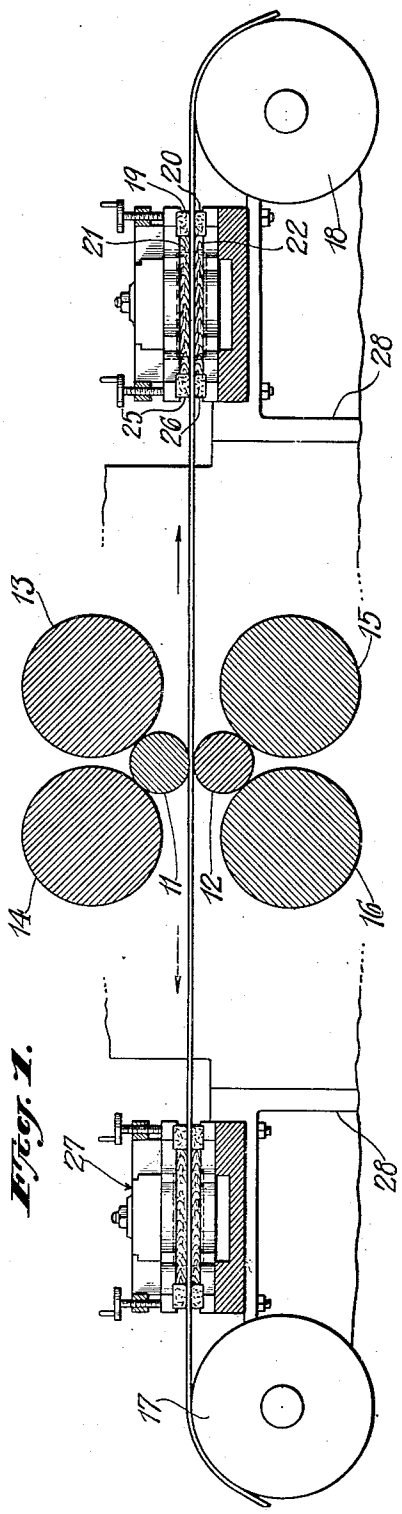


Fig. 1.

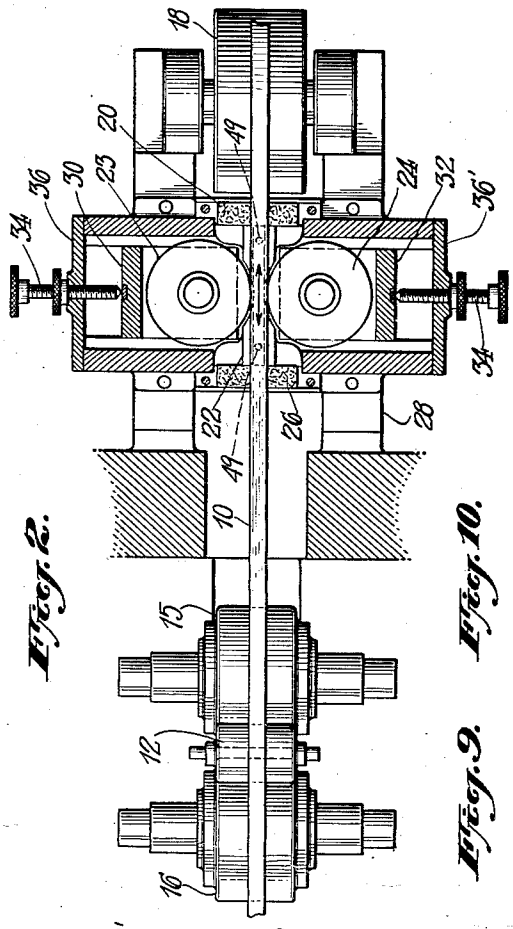


Fig. 2.

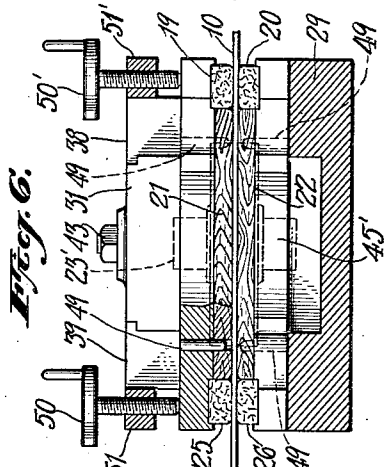


Fig. 6.

Fig. 10.

Fig. 9.



Fig. 8.



Fig. 7.

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Fig. 3.

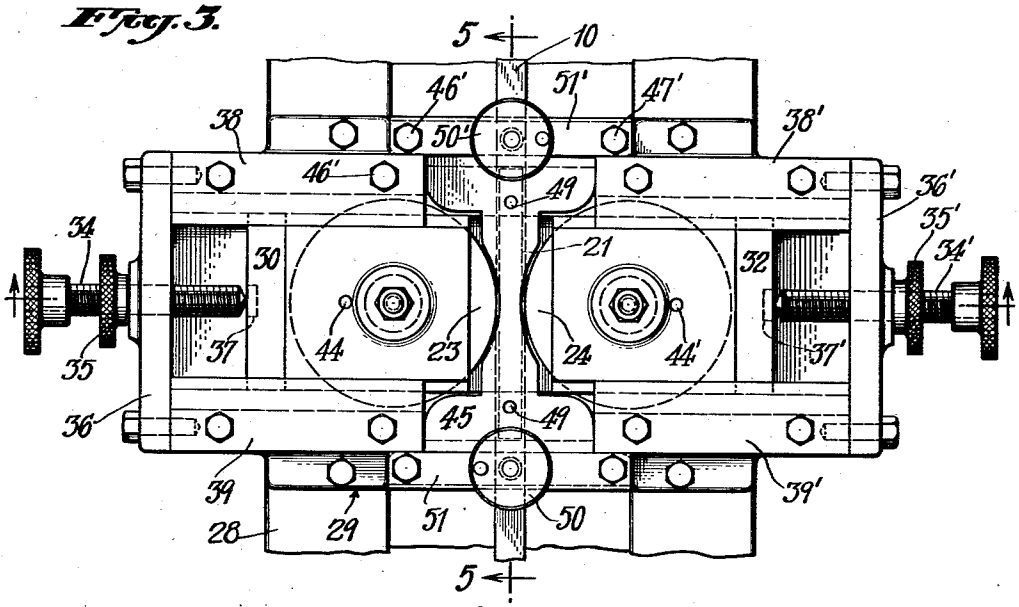


Fig. 4.

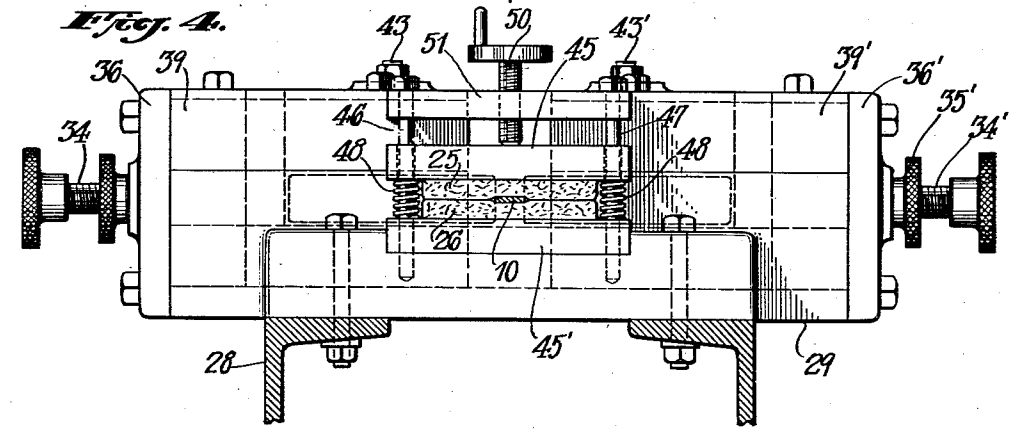
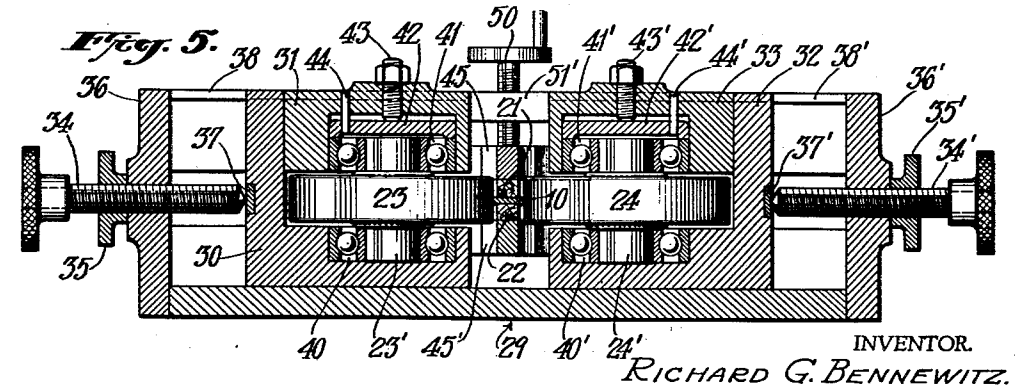


Fig. 5.



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METHOD AND APPARATUS FOR ROLLING STRIP METAL

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Application September 24, 1940, Serial No. 358,115

5 Claims. (Cl. 80—32)

This invention relates to improvement in processes and apparatus for cold drawing and rolling of metal strips, bars and the like and more specifically to improvements enabling the edges of such strips or the like to be cold rolled and finished in desired shapes while the faces of the strips or bars are also being cold rolled.

Among other purposes, the features of this invention are particularly adapted for use in connection with the method and apparatus for rolling strip metal disclosed in my copending application Serial No. 350,789, filed August 3, 1940, reference to which is hereby made. Said application discloses a mill for cold rolling metal strip and the like and in which the strip is advanced through the mill solely by applying tension thereto for pulling the strip between a pair of relatively small reducing rolls, each of which reducing rolls is cradled by a pair of larger backing rolls mounted in anti-friction bearings. This type of mill has a number of important advantages which contribute largely to the feasibility of accompanying such a mill, according to the present invention, with equipment to also roll the edges of the strips or the like, to the desired shapes. That is, since in this type of mill the reducing rolls are held in proper alignment by the heavy backing rolls, the use of the usual friction bearings on the reducing rolls is avoided, thereby eliminating the steady flow of lubrication formerly required on the roll necks to prevent overheating of friction bearings. Hence the splashing of heated oil on the strip is avoided, making it possible to produce a strip having a bright lustrous cold rolled finish on its main faces, whereas with previous mills this was not generally possible. The present invention involves the use of edge shaping rolls with such mills, which at the same time make it possible to reduce the edges of the strip to the desired shape, for example with square, round or beveled edges and to give such edges also a bright cold rolled finish. Thus full advantage may be taken of the bright finish on the flat faces, in that all surfaces of the strip are given a bright finish, thus avoiding further finishing operations which would otherwise be necessary to trim or finish the edges of the strip despite the bright finish of the flat faces alone.

With the type of mill of my above mentioned application, where the strip is pulled through, since it is unnecessary to provide such heavy reducing rolls as would be required if they were driven, and since these rolls are firmly held in proper alignment by the backing rolls, it is possible to use reducing rolls of unusually small diameter. Hence due to the increased "bite" that can be employed effectively with such rolls, the stock may be quickly reduced to the desired dimensions with fewer passes through the mill than previously. But to make the most effective use of this advantage and its consequent savings in rolling costs, and patricularly to avoid irregular edges on the rolled stock, it is in general desirable to accompany the mill by the edge-rolling features of the present invention so that finished edges of the desired shape are produced notwithstanding the increased "bite" employed in producing the flat faces.

Furthermore, in the type of mill above referred to, since the stock is pulled through the mill with a minimized amount of frictional losses at the reducing rolls and without driving the reducing rolls, it is also feasible according to the present invention to position the edge-shaping rolls just in advance of the reducing rolls so that the stock is pulled through both sets of rolls at the same time. While the edge rolls in first shaping the edges cause the metal to bulge out somewhat near the edges of the flat faces of the strip, such bulging areas are immediately flattened out again by the reducing rolls before the strip is coiled. The reducing rolls may then cause the metal to bulge outwardly slightly at the edges of the strip, but upon the subsequent pass of the stock through the mill, this latter bulging is also eliminated. Repeated passes of the stock through the mill may gradually reduce the strip in both dimensions, step-by-step and finally result in rolling the stock accurately to the desired shape and dimensions both as to width and thickness. And this is accomplished without the necessity or expense and trouble of trimming the strip with consequent loss of metal stock, and without excessive distortion of the stock in any one step.

Where the invention is used in connection with a reversing type mill such as disclosed in my above mentioned application, pairs of the edge-shaping rolls may be conveniently mounted at both ends of the mill so that in pulling the stock through, it is first engaged by a pair of edge-shaping rolls, then its faces are engaged by a pair of reducing rolls and these may be followed again by a pair of edge-shaping or finishing rolls. In this case according to the invention, each time the stock is pulled through the mill, one may use either both pairs of edge rolls or only the pair preceding the reducing rolls. In the latter event either pair of edge rolls may be adjusted for shaping engagement with the stock, depending upon which direction the stock is being pulled through the mill. In the event both sets of edge rolls are used at the same time, the pair subsequent to the reducing rolls may be so adjusted as to merely reduce or eliminate the edgewise bulging caused by the reducing rolls or may be adjusted for a deeper bite for materially reducing the number of passages of the stock through the mill required for shaping the edges.

The invention further involves improved means

for mounting the edge-shaping rolls and associated guiding and wiping means for the strip.

Various further and more specific objects, features and advantages of the invention will appear from the detailed description given below, taken in connection with the accompanying drawings forming a part of this specification and illustrating merely by way of example certain embodiments of the invention. The invention consists in such novel features, methods, arrangements and combinations of parts as are shown and described herein.

In the drawings Fig. 1 is a view, somewhat diagrammatic, showing edge roll apparatus embodying the invention as applied to a rolling mill of the type disclosed in my above mentioned copending application;

Fig. 2 is a plan view partially in section of the central and righthand portions of the apparatus of Fig. 1;

Figs. 3, 4, 5 and 6 respectively comprise plan, side, longitudinal and transverse sectional views for an assembled edge-rolling unit embodying the invention; and

Figs. 7 to 10 inclusive show in general the cross-sectional shape of a flat band or strip of metal at various stages during the process of cold-rolling the same according to the invention.

In Figs. 1 and 2 the metal strip being rolled is indicated at 10 and in the example shown comprises a flat band with square edges, although it will be understood that strips of various other cross sections may be rolled according to the invention, depending upon the shape of the reducing rolls and edge rolls used in the apparatus. Reducing rolls are indicated at 11 and 12, each being backed by a pair of heavy backing rolls as at 13, 14 and 15, 16. The strip may be pulled toward either end of the mill over drums as at 17, 18 and wound on a suitable winding block at one end of the mill while being unwound from another winding block or coil at the other end of the mill. For further details of construction and operation of the parts of Figs. 1 and 2 thus far referred to, reference may be had to my said copending application Ser. No. 350,789.

Assuming that the strip is being drawn toward the left as viewed in Fig. 2, after passage over drum 18, it will first pass between a pair of felt wipers as at 19, 20 and then between a pair of wooden guide strips as at 21, 22. While retained firmly in proper alignment against vertical displacement by these guide strips, the edges of the metal strip respectively will then be engaged by edge-shaping rolls as at 23, 24. Upon leaving the guide strips 21, 22 the metal strip may be immediately passed between another pair of felt wipers as at 25, 26. The strip then passes on between the reducing rolls 11 and 12. Thereafter if desired the strip may be passed through another assembled unit of the edge-rolling apparatus as indicated generally at 27 at the left hand portion of Fig. 1. This assembly may be the same or similar to that above described at the righthand end of Figs. 1 and 2.

Each of the edge-rolling assemblies may be mounted upon brackets as at 28 at the ends of the mill and as shown in Figs. 4 to 6, may include a housing frame or supporting base as at 29. This housing is adapted to receive two pairs of bearing block or housing members as at 30, 31 and 32, 33. These housing members as shown are adapted to be adjusted in position by sliding horizontally in the housing 29 in a direction perpendicular to the path of the strip. That is, for this purpose a pressure screw 34 with a lock nut 35 may be threaded through a pressure screw plate 36 bolted to the end of the housing 29. The inner end of the pressure screw 34 may bear against a hardened steel insert 37 mounted in the bearing housing part 30. Thus by screwing in the pressure screw 34, the bearing housing parts 30, 31 may be adjusted under pressure in a direction toward the edge of the strip 10. Similarly the bearing housing parts 32, 33 may be adjusted under pressure toward the other edge of the strip 10 by screw means as shown at the righthand side of Figs. 3 to 5 and identified by the same reference characters accompanied by prime marks.

At each end of the housing frame 29, at its upper edges, pairs of guide strips as at 38, 39 and 38', 39' may be bolted in place as shown. These will serve to retain in proper slidable position the several parts of the bearing housings or blocks 30, 31 and 32, 33.

The bearing blocks 30, 32 as shown in Fig. 5, may be of a generally L-shaped cross section so that the vertical portions of these blocks provide means for engagement with the pressure screws 34, 34' while the base portions are shaped to receive lower ball bearings as at 40, 40' for edge roll arbors 23', 24'. The upper bearing blocks 31, 33 are adapted to be slidably embraced on two opposite sides by the guide strips as at 38, 39 and 38', 39'. The outer faces of the blocks 31, 33 are shown engaged by the vertical portions of the blocks 30, 32 respectively. The blocks 31, 33 are also shaped to receive upper roller bearings as at 41, 41' for the upper ends of the arbors 23', 24'. Each of the bearings 41, 41' may also be accompanied by a bearing thrust adjusting disc as at 42, 42', these discs in turn being engaged by threaded studs as at 43, 43' which pass through the top of the bearing blocks 31, 33. These discs may be retained against rotation as by pins 44, 44'.

The wooden guides 21, 22 and wipers 19, 20, 25, 26 may all be held in place by a pair of clamping members or plates as at 45, 45'. Each of these clamping members may be generally of an I-shape, the central portions being cut away to the extent necessary for clearance with the edge rolls 23, 24. Each of the ends of these clamping members may be retained in position on the housing 29 as by a pair of vertically extending bolts or pins as at 46, 47 and 46', 47' (Figs. 3, 4), which freely pass through suitable aligned holes in the ends of the clamping members. Springs as at 48 may be mounted on these bolts for normally tending to raise the clamping member 45 in respect to the member 45'. In order to hold the clamping member 45 down with the desired pressure on the strip 10, there may be provided at each end of the member 45 manually operable clamping screws as at 50, 50' having threaded engagement with pressure bar members as at 51, 51', the latter in turn being held in place by the head portions of the bolts 46, 47 and 46', 47'. Thus, by turning down the screw members 50, 50', the clamping members 45, 45' may have the desired amount of pressure applied thereto for simultaneously pressing the felt wipers into firm wiping contact with the metal strip and for applying to wooden guide strips 21, 22 a sufficient pressure so that they will firmly retain the metal strip against vertical displacement at any point just before, during and after its passage between the edge rolls 23, 24. The wood strips 21, 22 may be retained against sliding in respect to

the clamping members 45, 45' as by pins 49 (Fig. 6).

In operating the apparatus, assuming that metal strip stock with a cross section such as shown in Fig. 7 is pulled into the mill toward the right as viewed in Fig. 1, then the edge rolls in the unit 27 may be adjusted with a spacing such that they will engage the edges of the strip and cause the same to be shaped for example substantially as shown in Fig. 8. That is, if the edge rolls have for example, plain cylindrical surfaces as shown in Fig. 5, then each edge of the strip will be so rolled as to be made accurately vertical and with a bright finish. At the same time, as shown in Fig. 8, some of the metal stock will bulge outwardly from the flat faces of the strip adjacent its edges. The strip in this form will then pass on through the reducing rolls as at 11 and 12 where its faces will again be flattened and the strip reduced substantially in thickness, substantially as shown for example in Fig. 9. At the same time, as indicated in this figure, the metal stock may bulge outwardly somewhat at the edge surfaces. After passing between the reducing rolls 11 and 12 if desired, the strip may have its edges made true again as shown in Fig. 10, by adjusting the edge rolls at the righthand end of Fig. 1 with a spacing just sufficient to eliminate such edge bulging as of Fig. 9. On the other hand, if the desired shape of the finished stock is to be such that considerable working of the metal at the edges is necessary, the edge rolls at the righthand end of Fig. 1 may be adjusted to give a deeper "bite" to again form edges more nearly like that of Fig. 8 for example. Again, the edge-rolling device at the righthand end of Fig. 1 if desired may be so adjusted that when the strip is passing toward the right, its rolls will not engage the strip at all. In that event, when the direction of movement of the strip is reversed, these rolls may be adjusted to then give a result such as indicated in Fig. 8, while the assembly 27 is adjusted so that its rolls do not contact with or do not change the shape of the strip edges. It is thus apparent that the apparatus is capable of a wide variety of adjustments, depending upon the desired cross-sectional shape of the finished strip or bar and also a variety of adjustments may be made from time to time during the progress of rolling a single strip. That is, as the strip is repeatedly reversed in direction, the edge rolls may be readjusted to the extent necessary to either gradually produce or to retain the desired edge formation.

While the invention has been described in detail with respect to a particular preferred example, it will be understood by those skilled in the art after understanding the invention that various changes and modifications may be made without departing from the spirit and scope of the invention, and it is intended therefore in the appended claims to cover all such changes and modifications.

What is claimed as new and desired to be secured by Letters Patent is:

1. In a process employing successively arranged pairs of edging, reducing and edging rolls for simultaneously cold rolling and edging continuous metal strip, the steps which comprise: pulling the strip alternately back and forth between all of said roll pairs simultaneously, and, during each such pulling operation, adjusting the spacing of the pair of edging rolls which are first in the direction of pull, to apply sufficient pressure to cause the metal to bulge somewhat from the faces of the strip adjacent its edges, and adjusting the pressure between said reducing rolls to eliminate said bulging and to reduce the thickness of the strip.

2. In a process employing successively arranged pairs of edging, reducing and edging rolls, for simultaneously cold rolling and edging continuous metal strip, the steps which comprise: pulling the strip simultaneously between all of said roll pairs progressively, adjusting the spacing of the first pair of edging rolls in the direction of pull to apply sufficient pressure to cause the metal to bulge somewhat from the faces of the strip adjacent its edges, adjusting the pressure between said reducing rolls to eliminate said bulging, to reduce the thickness of the strip, and to cause the metal at its edges to bulge edgewise somewhat, and adjusting the spacing between the second pair of edging rolls in the direction of pull to apply sufficient pressure to substantially eliminate said edgewise bulging.

3. In an apparatus for simultaneously cold rolling and edging continuous metal strip, the combination of a pair of reducing rolls each cradled between and supported in free rolling contact against an associated pair of anti-frictionally journalled backing rolls, a pair of anti-frictionally journalled edging rolls spaced therefrom, all of said rolls being free of driving connections, and power driven means for pulling the strip between said reducing and edging rolls concurrently, whereby the strip is progressively reduced and edged in one pulling operation.

4. In an apparatus for simultaneously cold reducing and edging continuous instant strip, the combination of: a first pair of edging rolls, a pair of reducing rolls, and a second pair of edging rolls arranged in succession, said edging rolls being journalled in anti-friction bearings, and each of said reducing rolls being cradled between and supported in peripheral rolling contact against an associated pair of spaced, anti-frictionally journalled backing rolls, said reducing rolls being provided only with said thrust bearings, all of said rolls being idling rolls, and power driven means for pulling the strip between said successive pairs of edging, reducing and edging rolls, whereby the strip is progressively edged, cold reduced and reedged in one pulling operation.

5. In an apparatus for concurrently cold reducing and edging continuous metal strip, the combination of: a pair of relatively small reducing rolls, each cradled between and supported in peripheral engagement against an associated pair of spaced anti-frictionally journalled backing rolls, said reducing rolls being provided only with end thrust bearings, a pair of cooperating anti-frictionally journalled edging rolls spaced apart and disposed substantially at right angles to said reducing rolls, all of said rolls being idling rolls, power driven means for pulling the strip between said reducing and edging rolls concurrently, whereby the strip is progressively reduced and edged in one pulling operation, and means including a pair of cooperating guide strips extending between said edging rolls and resiliently engaging the opposite faces of said strip for preventing buckling thereof during edging.

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