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2,787,046

ROLLING PROCESS AND APPARATUS

Filed Oct. 20, 1951

2 Sheets-Sheet 1

Fig. 1

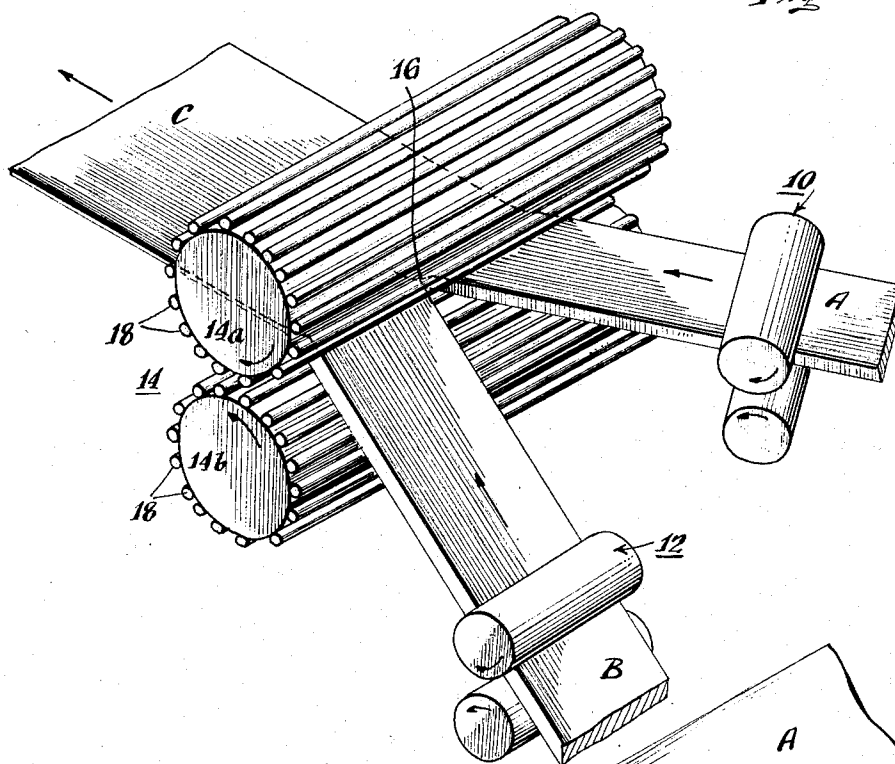
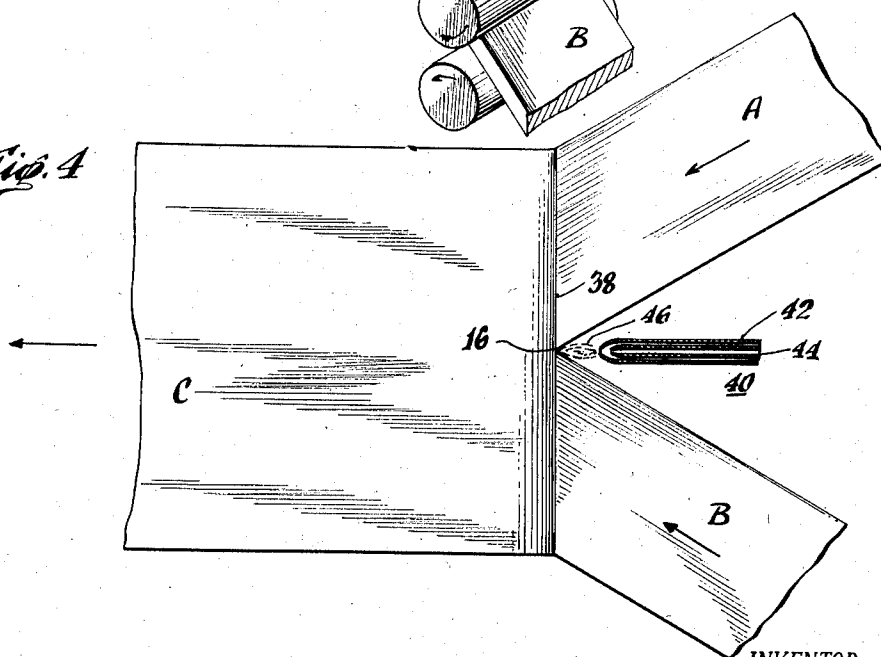


Fig. 4



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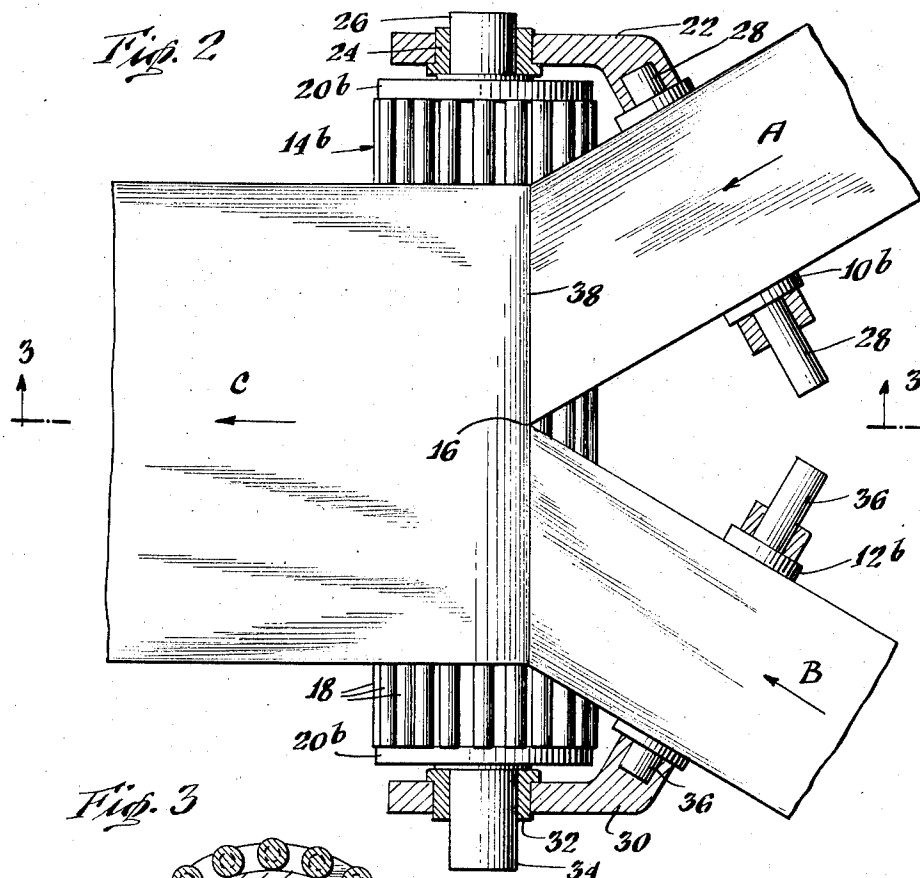
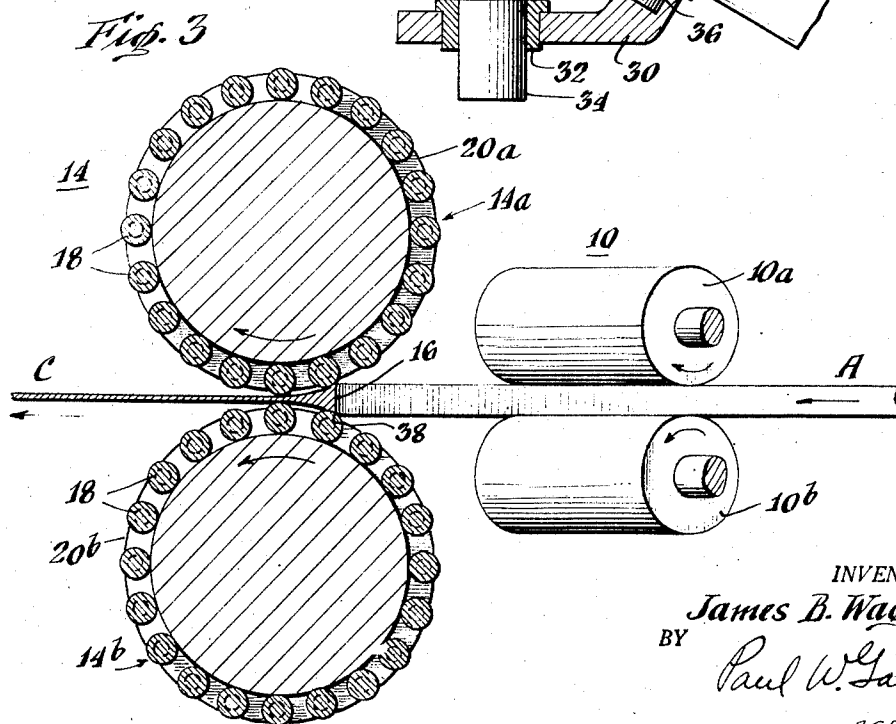
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2 Sheets-Sheet 2



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ROLLING PROCESS AND APPARATUS

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7 Claims. (Cl. 29—18)

This invention relates to a process and apparatus for rolling sheets of ductile materials such as steel and, more particularly, the invention is directed to the rolling of sheets to effect not only a reduction in the thickness of the sheets but also an increase in the width thereof.

While there is extensive prior art on rolling processes and mills, it is curious that no one has thus far succeeded in devising a process and mill which would reduce the thickness or gauge of metal sheets and simultaneously increase the width of these sheets to an appreciable extent.

A primary object of this invention is to roll sheet materials in a manner to effect simultaneously reduction of thickness and increase of width of the sheets.

Another principal object is to roll at least two strips at the same time to produce a corresponding number of sheets of thinner gauge and greater width or to form a single sheet of thinner gauge and a width greater than the total width of the component strips fed to the rolling mill.

Additional objects and advantages of this invention will be evident in the description which follows.

In accordance with this invention, two separated strips of ductile material are moved in converging directions, and at substantially the point of convergence, are fed into a rolling mill, preferably one equipped with planetary rolls, so that each strip enters the mill at an acute angle to the line of discharge from the mill. As a result, the thickness of the sheets is reduced and simultaneously the rolled sheets issue from the mill as individually wider sheets than those fed thereto or as a single sheet wider than the sum of the widths of the strips entering the rolls. In the latter case of a single product sheet, it is sometimes advisable to assist the fusion of the converging feed strips as by placing a torch flame at the point of convergence. Other means such as induction heating may be employed to promote bonding of the feed strips to one another; also, a jet of a blanketing gas like nitrogen, argon or helium may be directed at the point of convergence of the two feed strips to prevent oxidation which would impede fusion of the strips. Conversely, when the feed strips naturally tend to stick together during the rolling operation but it is desired to produce as many thinner and wider strips as are fed to the rolls, an anti-sticking agent such as graphite or oil may be applied on those portions of the converging strips which abut one another.

To facilitate understanding of the invention, reference is now made to the illustrative drawings which form a part of this specification and of which:

Figure 1 is a perspective view schematically showing an arrangement of rolls and feed strips for carrying out the present invention;

Figure 2 is a top plan view of the arrangement shown in Figure 1 but with the upper rolls which contact the top side of the strips removed to show more clearly what occurs in the strips undergoing rolling in accordance with this invention;

Figure 3 is a side sectional elevation taken along the

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line 3—3 in Figure 2 through the set of planetary rolls in Figure 1; and

Figure 4 is a diagrammatic plan view of two strips being rolled in accordance with this invention into a single unitary sheet having a width greater than the sum of the widths of the two component strips; in this example, a torch flame is directed at the point of convergence of the two strips to facilitate the welding thereof.

The same reference numerals have been applied to corresponding elements in the several drawings.

Referring to Figure 1, a set of feed rolls 10 driven by suitable power means (not shown) engage and push forward a metal strip A, while another set of feed rolls 12 similarly advance a second metal strip B. Strips A and B have the same composition, physical properties and dimensions. In being pushed forward by their respective feed roll sets, the strips A and B are forced into the nip of a set of rolling planetary rolls 14. The strips A and B are fed angularly to the rolling rolls 14 and converge at a point 16 in the nip of rolls 14.

The two sets of feed rolls 10 and 12 are disposed as close as possible to the set of rolling rolls 14 and their respective axes form equal acute angles with the axes of rolls 14. Since the metal strips A and B move through feed rolls 10 and 12, respectively, in directions at right angles to the axes of these feed rolls, it follows that the directions of the two strips A and B likewise form equal acute angles with the direction of the rolled sheet C discharging from the planetary rolls 14; the acute angle selected will vary with the type of metal strips undergoing rolling, their dimensions, and like factors, and in general will fall in the range of about 5° to 45°, preferably about 10° to 30°. Obviously, the angle of convergence of the two strips A and B is twice the selected acute angle. For example, if strips A and B move in directions forming equal acute angles of 17½° with the direction of sheet C, the angle of convergence of the two strips A and B is 35°.

The process of this invention is advantageously carried out when the feed strips passing through the rolling rolls are subjected to a substantial reduction in thickness, say, reduction to at least about ½ of the original thickness or gauge of the feed strips. To attain such substantial reduction of thickness with a single set of rolls, planetary rolls are very effective. For this reason, there is illustrated in Figure 1 a set of planetary rolls 14 comprising an upper master roll 14a and a lower master roll 14b, each provided with a multiplicity of rollers 18 arranged around the periphery of the master roll.

As shown in Figures 2 and 3, the rollers 18 are spaced uniformly around the periphery of each master roll with their axes parallel to that of the master roll. The ends of rollers 18 find their bearings in a pair of ring supports 20a and a pair of ring supports 20b mounted at the opposite ends of master rolls 14a and 14b, respectively. While the master rolls 14a and 14b are power driven, the rollers 18 rotate freely in their bearings as do likewise the pairs of ring supports 20a and 20b mounted at the ends of master rolls 14a and 14b; in other words, the rollers 18 and rings 20a and 20b are not connected to power means to cause the rotation of these members. However, the rotation of ring 20a at each end of the planetary rolls 14 is mechanically intermeshed with the rotation of the ring 20b at the same end of the rolls 14. This intermeshing is so designed that a roller 18 on the bottom of master roll 14a and a roller 18 on the top of master roll 14b pass simultaneously through the plane containing the axes of the master rolls 14a and 14b as is clearly shown in Figure 3.

There is schematically shown in Figure 2 a sectional view of a frame 22 which supports a bearing 24 which holds the end 26 of master roll 14b. Frame 22 also

holds the opposite ends 28 of feed roll 10b. Similarly, a frame 30 supports a bearing 32 for the other end 34 of master roll 14b and holds the opposite ends 36 of feed roll 12b.

As the metal strips A and B enter the nip of the planetary rolls 14, reduction of the thickness of these strips immediately proceeds. The upper flat surfaces of strips A and B are depressed at the nip as can be seen in Figure 3, the flat portions and the curved depressed portions of these strips meeting along the line 33 which is best shown in Figure 2. The lower flat surfaces of the feed strips A and B are likewise depressed as they advance through the planetary rolls 14.

In Figure 4, an acetylene-oxygen torch 40 comprising concentric, spaced tubes 42 and 44 for conveying the two gases is positioned so that the flame 46 impinges at the point of convergence 16 of the two metal strips A and B and thus facilitates the welding of these strips into a unitary sheet C which has a width greater than the sum of the widths of the component strips A and B. Where it is desired to prevent the fusion of strips A and B, torch 40 may be replaced by a spray nozzle for injecting an oil or like anti-sticking agent into the point of convergence 16 of strips A and B.

A specific example will be given to further illustrate the present invention. Two strips of the same steel, each 18 inches wide and $\frac{3}{4}$ inch thick, are preheated to a temperature of about 2300° F. and rolled in apparatus of the type shown in the drawings. Specifically, the planetary rolls 14 are 4 feet long and are driven at a speed of 800 revolutions per minute. The master rolls 14a and 14b are 18 inches in diameter. Twenty rollers 18 of 2 inch diameter surround each of the master rolls 14a and 14b. The two strips of steel, which are fed to the planetary rolls 14 with a convergence angle of 60°, issue from the planetary rolls as a single sheet having a width of about 42 inches and a thickness of 0.08 inch.

Other important metals which can be processed in accordance with this invention include copper, brass and aluminum.

In view of the various modifications of the invention which will occur to those skilled in the art on consideration of the foregoing disclosure without departing from the spirit or scope thereof, only such limitations should be imposed as are indicated by the appended claims.

What is claimed is:

1. In the process of rolling sheets of ductile materials, the improvement of producing a sheet of decreased thickness and increased width which comprises moving two separated sheets of a ductile material in converging directions, said converging directions forming therebetween a convergence angle of at least 10°, and subjecting said two sheets in abutting but non-overlapping relationship to a rolling operation beginning substantially at the point of convergence of said two sheets to effect simultaneously a decrease in the thickness and an increase in the width of said two sheets.

2. An improved process of rolling sheets of ductile materials for effecting simultaneously a decrease in the thickness and an increase in the width thereof, which comprises moving two such sheets in the same plane and in converging directions, starting the rolling of said two sheets substantially at the point of convergence thereof, and continuing the rolling of said two sheets to decrease the thickness thereof while discharging the rolled portions of increased width of said two sheets in a common direction which forms equal angles of at least 5° with each of said converging directions and is concurrent with said converging directions.

3. The process of claim 2 wherein the equal angles between said common direction and each of said converging directions have a magnitude in the range of about 5° to 45°.

4. A rolling apparatus to alter the dimensions of ductile sheet material by rolling, which comprises two reducing rolls with their axes in parallel and with their peripheries spaced to receive said sheet material and to reduce the thickness thereof, a pair of feed rolls disposed with their axes in parallel and to force a strip of said sheet material in a direction at right angles to their axes into the nip of said two reducing rolls, the plane of the axes of said pair of feed rolls forming an acute angle with the plane of the axes of said two reducing rolls, and a second pair of feed rolls disposed with their axes in parallel and to force a second strip of said sheet material in a direction at right angles to the axes of said second pair of feed rolls into said nip of said two reducing rolls, the plane of the axes of said second pair of feed rolls forming an acute angle with the plane of the axes of said two reducing rolls, the two mentioned acute angles being of equal magnitude, and the two mentioned pairs of feed rolls being positioned so that the longitudinal edge of one of the two mentioned strips converges with the longitudinal edge of the other of the two mentioned strips substantially at said nip of said two reducing rolls, each of said two reducing rolls being of a width greater than the sum of the widths of the two mentioned strips.

5. The rolling apparatus of claim 4 wherein each of the two reducing rolls comprises a master roll of relatively large diameter and a plurality of rollers of relatively small diameter arranged in parallel contact with said master roll and spaced uniformly around the periphery of said master roll.

6. The rolling apparatus of claim 4 wherein the magnitude of each of the two mentioned acute angles is in the range of about 5° to 45°.

7. In the process of rolling sheets of ductile materials, the improvement of producing a sheet of decreased thickness and increased width which comprises moving two separated sheets of a ductile material in converging directions into edge-to-edge contact at the point of convergence and providing said edges with clean surfaces sufficient for welding, said converging directions forming therebetween a convergence angle of at least 10°, subjecting said two sheets in abutting but non-overlapping relationship to a rolling operation beginning substantially at the point of convergence of said two sheets to effect a decrease in the thickness of said two sheets and to force the edges of said two sheets together under pressure, and conducting said rolling operation to create sufficient pressure to effect welding of said edges and thereby creating a unitary sheet having a width greater than the sum of the widths of said two sheets.

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