

July 12, 1966

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STRIP FLATTENING DEVICE

3,260,093

Filed April 1, 1964

2 Sheets-Sheet 1

FIG. 1

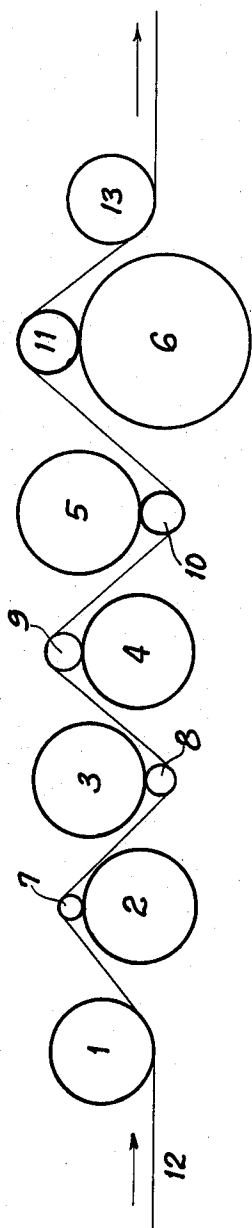
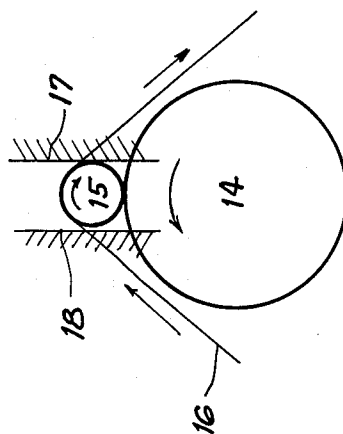


FIG. 2



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2 Sheets-Sheet 2

FIG. 3

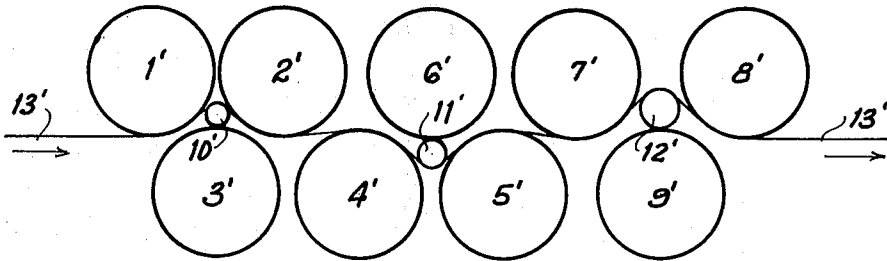


FIG. 4

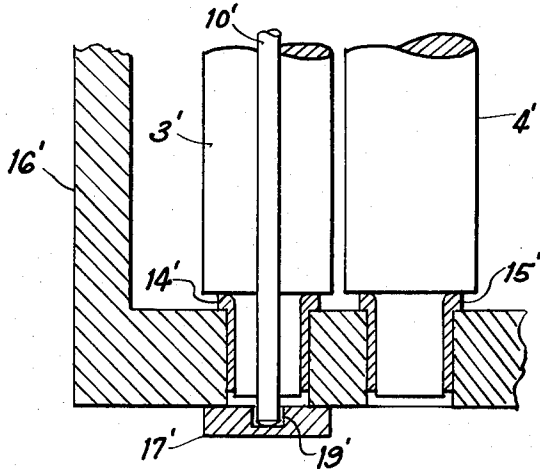
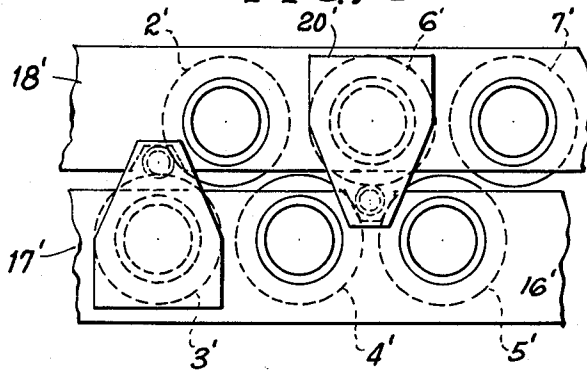


FIG. 5



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STRIP FLATTENING DEVICE

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Filed Apr. 1, 1964, Ser. No. 356,530

11 Claims. (Cl. 72-163)

This invention relates to constructions used for the flattening of metal strip. In particular, the invention is concerned with the flattening of light gauge strip including tin plate, stainless steel, brass or aluminum strip in thicknesses below .020 and particularly below .010 inch.

It is well-known that in the manufacture of thin metal strip, considerable difficulties are encountered in flattening operations, such as are necessary to eliminate defects including loose, over-rolled edges, buckled centers and so-called herringbone patterns. Roller levelers currently available for the flattening of strip are known to be inefficient or altogether ineffective on materials below 0.008 inch or so, due to the difficulties encountered in properly supporting the thin flexing rolls against deflection.

It is an object of this invention to provide strip flattening devices which are relatively simple in construction and which can be operated with a minimum of difficulty.

It is a further object of this invention to provide strip flattening devices which are economical in construction and operation, and which are particularly suitable for the flattening of metal strip in thicknesses below .020 inch and particularly below .010 inch.

These and other objects of this invention will appear hereinafter and, for purposes of illustration but not of limitation, specific embodiments of the invention are shown in the accompanying drawings in which:

FIGURE 1 is a diagrammatic elevational view of a flattening device characterized by the features of this invention;

FIGURE 2 is an enlarged detail view illustrating end support means for flexing rollers employed in a flattening device of the type shown in FIGURE 1;

FIGURE 3 is a diagrammatic elevational view of an alternative form of flattening device;

FIGURE 4 is an enlarged fragmentary sectional plane view illustrating support means for the back-up and flexing rollers of the flattening device of FIGURE 3; and,

FIGURE 5 is a fragmentary elevational view of the support means shown in FIGURE 4.

The constructions of this invention generally comprise a plurality of strip flexing rolls with each being rotatably mounted adjacent one large support roll. The flexing rolls are disposed in a generally horizontal plane and the strip to be flattened is adapted to be passed under tension over the rolls with the strip contacting opposite sides of adjacent rolls. Accordingly, the strip defines a more or less sinuous path with respect to the flexing rolls.

A support roll engages each flexing roll on the side opposite that side which is engaged by the strip. Accordingly, the strip bears down on the flexing rolls, and this pressure is opposed by the large support rolls contacting the opposite side of the flexing rolls. In an alternative form of this invention, additional deflection rolls are disposed on the side of the strip opposite the first mentioned support roll. These additional rolls are engaged by the strip, and they serve to stabilize the flexing rolls in the device.

The construction shown in FIGURE 1 consists of an idler roll 1 and a plurality of support rolls 2, 3, 4, 5 and 6. The support rolls are of relatively large diameter, and flexing rolls 7, 8, 9, 10 and 11 engage the support rolls and are located on opposite sides of adjacent support rolls. The strip 12 passes under tension beneath the idler 1 and then over the flexing rolls without ever contacting any of the support rolls. Suitable coil payoff means are

2

provided ahead of the idler 1 and suitable take-up means are located beyond the idler 13. The diameters of the flexing rolls are selected so that the ratio of the first flexing roll diameter to the strip thickness is preferably between 50 and 100:1 although both lower and higher ratios can be employed. A significant plastic strain will be produced in the strip by such a flexing roll and under the combined effect of bending and tension, the strip will be stretched slightly in its shorter portions to flatten the material. The amount of stretch required varies from a fraction of one percent to about two or three percent.

It is advantageous to gradually increase the diameter of the flexing rolls toward the exit end of the flattener since this reduces the amount of residual coil set, that is the tendency of the strip to coil or curl spontaneously. The diameter of the support rolls may also be increased roughly in proportion to the changing diameter of the respective flexing rolls.

Since the support rolls are mounted for rotation about fixed axes, a stable equilibrium of the flexing rolls cannot be reached by applying tension to the strip. Since deformation energy is consumed by plastic bending, the tension at the exit side of the device is always somewhat greater than at the entry. Consequently, each flex roll tends to roll in the direction of strip movement, over the support roll and into the angular space between the strip and the support roll periphery. This builds up a rearwardly directed force component which may or may not produce a stable condition in an off-center position of the flex roll. Otherwise, the flex roll may fall out entirely. To prevent this, they must be supported against moving with the strip, and one way of so doing is illustrated in FIGURE 2.

Here, one end of flexing roll 15 is loosely inserted into a vertical slot-type holder 17-18 made of, or lined with, a bearing material at least on holder plate 17, or the side of the flex roll 15 when the strip 16 leaves it. Holder plate 18 is provided just to keep roll 15 from falling out when the strip is slack or altogether removed. The other end of 15 is similarly confined.

The machine will usually consist of two frames, the upper carrying pairs 3-8, 5-10, etc., while the lower, pairs 2-7, 4-9, 6-11, etc. The two frames may be connected by a hinge on one side and swinging bolts on the other. This allows opening the machine for easy threading and for service.

Since the forces which tend to displace the flexing rolls toward the exit side are relatively small, such partial restriction of the flex roll ends secures satisfactory operation in most cases. With very wide strip, however, a positive drive may be connected to the appropriate backing roll and this will produce a force tangential at the contact between the support roll and its flex rolls, said force being directed toward the entry, thus balancing the differential tension and securing equilibrium of even the thinnest flex roll.

The construction shown in FIGURE 3 comprises a succession of roll clusters, each consisting of three relatively large diameter rollers arranged in a triangle, and a smaller flexing roll located in between the three support rollers. The clusters consist of support and deflector rollers 1'-2'-3', 4'-5'-6', 7'-8'-9', etc., each cluster containing flexing roll 10', 11', 12', etc., respectively. Each cluster resembles a letter Y, the large rolls being located at the tips of the arms with the small flexing roll at the center node. They are arranged in a line so that the Y-like roll sets are alternately "pointing" up and down.

The flexing rolls within successive clusters increase in size from the entry to the exit of the flattener, the smallest being as little as $\frac{3}{16}$ " or even $\frac{1}{32}$ " diameter for strip about 0.002" thick, about $\frac{1}{4}$ " to $\frac{3}{8}$ " for 0.003" to 0.006" strip and proportionally larger for thicker material. A

typical sequence is $\frac{1}{4}$ — $\frac{3}{8}$ — $\frac{1}{2}$ — $\frac{3}{4}$ —1— $1\frac{1}{4}$ — $2\frac{1}{2}$ ". The last two rolls are so thick and rigid that a cluster may not be needed and they may be unsupported unless the strip is wider than 10". In the latter case, backing support for them as well as for the outer rollers in each cluster may be required.

The strip passing through the machine enters at left, wraps around deflector roll 1', then, without touching support roll 3', wraps in the opposite direction over flexing roll 10', over deflector rolls 2' and 4', over flexing roll 10', etc.

The mounting of the various rollers in the machine is illustrated in FIGURES 4 and 5. The lower set of rolls 3', 4', 5', 9', etc. is rotatably mounted in bearings 14', 15', etc., located in lower frame 16'. The flexing rolls 10' (also 12' and every other alternate) are also mounted in 16' by means of support plates 17' bolted to opposite sides of 16' and equipped with oversize blind holes 19'. The upper frame 18' is similarly constructed, this including support plates 20' containing roll 11', etc. It can be hinged on one end of the lower frame 16' for easy access to the interior and also for threading the strip. A pair of swing-out bolts is used on the other end to hold the upper frame down in operation.

It is important to note that the locating holes (like 19') in the side plates do not positively fix the position of each flexing roll but just contain it loosely, with ample all-around clearance. Once back and front tension are applied to the strip, these thin rolls find their own equilibrium positions without rubbing against the sides of the recesses in their respective holding plates.

It will be apparent that the construction of this invention is relatively simple in nature, and, therefore, a large investment will not be required when it is desired to utilize its concepts. The illustrated constructions are considered of great value in view of the fact that thin gauge strip, particularly tin plate, is being used to a large extent in thicknesses between .003 inch and .006 inch. The need to flatten them after rolling raises considerable technical and economic problems and the devices of this invention comprise means capable of solving them.

It will be understood that various changes and modifications may be made in the above described devices which provide the characteristics of this invention without departing from the spirit thereof particularly as defined in the following claims.

That which is claimed is:

1. A device for the flattening of metal strip comprising a plurality of strip flexing rollers, adjacent flexing rollers being disposed along a generally horizontal plane whereby said strip can be fed through said device in a substantially sinuous path for flexing in alternate directions over consecutive flexing rolls, large support rolls engaging said flexing rolls on the side opposite the side in contact with the strip, and wherein said flexing rolls are loosely confined at their ends against displacement in the direction of strip movement.

2. A device for the flattening of metal strip comprising a plurality of strip flexing rollers with adjacent flexing rollers being disposed along a generally horizontal plane whereby said strip can be fed through said device in a substantially sinuous path for flexing in alternate direc-

tions over consecutive flexing rolls, large support rolls engaging said flexing rolls on the side opposite the side in contact with the strip, said flexing rolls being loosely confined at their ends against displacement in the direction of strip movement, and wherein said flexing rolls are supported in vertical channels and are free to rotate and to move vertically therein.

3. A device for the flattening of metal strip comprising a plurality of strip flexing rollers with adjacent flexing rollers being disposed generally along a common plane whereby said strip can be fed through said device in a substantially sinuous path for flexing in alternate directions over consecutive flexing rolls, large support rolls engaging said flexing rolls on the side opposite the side in contact with the strip, said flexing rolls being loosely confined at their ends, and including two additional relatively large deflector rolls straddling each flexing roll and located on the side of each flexing roll opposite its respective back-up roll, said strip engaging said additional rolls during passage through said device.

4. A device in accordance with claim 3 wherein said support rolls are free to rotate with said flexing rolls.

5. A device in accordance with claim 3 wherein each combination of a support roll and two additional deflector rolls comprises a cluster in the shape of a Y and wherein said clusters alternate between upright Y's and inverted Y's along the length of said device.

6. A device in accordance with claim 3 wherein said flexing rolls progressively increase in diameter from the entry end to the exit end of the device.

7. A device in accordance with claim 6 wherein the first flexing roll has a diameter approximately between 50 and 100 times greater than the thickness of said strip.

8. A device in accordance with claim 6 wherein the diameter of said support rolls increases in substantially the same proportion as the changing diameter of the respective flexing rolls.

9. A device in accordance with claim 3 wherein said support rolls comprise driven rolls.

10. A device in accordance with claim 9 wherein said driven support rolls provide horizontal forces offsetting differences in tension in portions of the strip to thereby maintain said flexing rolls in substantially constant positions relative to said support rolls.

11. In a device for the flattening of metal strip wherein at least one flexing roll is provided for flexing the strip as it passes over the roll, the improvement comprising a large support roll engaging the flexing roll on the side opposite the side of the flexing roll which is in contact with the strip, and including two additional relatively large deflector rolls straddling said flexing roll and located on the side of each flexing roll opposite said support roll, said strip engaging said additional rolls during passage through said device.

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