Dec. 25, 1945. C. M. YODER 2,391,499

PROCESS OF AND APPARATUS FOR OPERATING ON SHEET METAL

Filed June 25, 1941 2 Sheets-Sheet 1

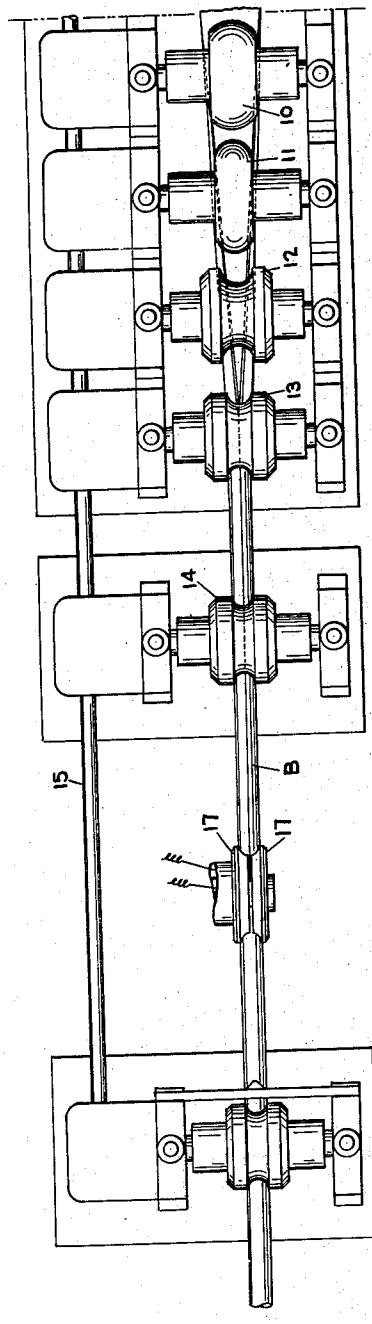


FIG. 1

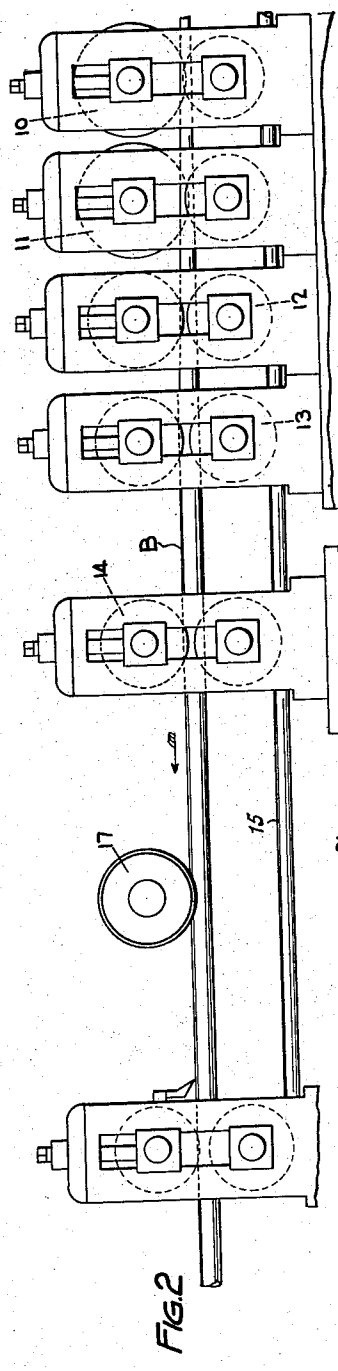


FIG. 2

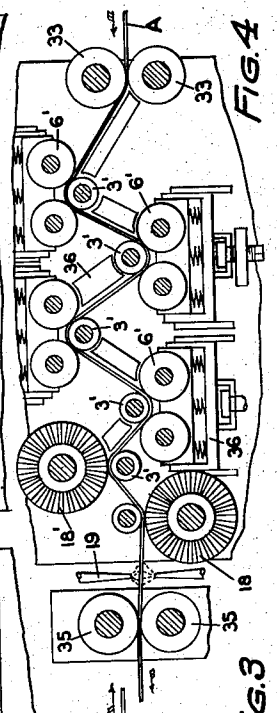


FIG. 4

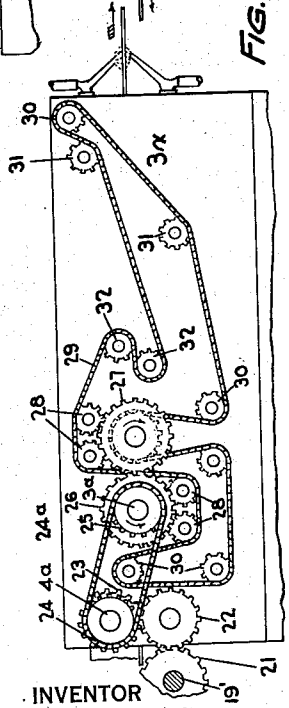


FIG. 3

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PROCESS OF AND APPARATUS FOR OPERATING ON SHEET METAL

Filed June 25, 1941 2 Sheets-Sheet 2

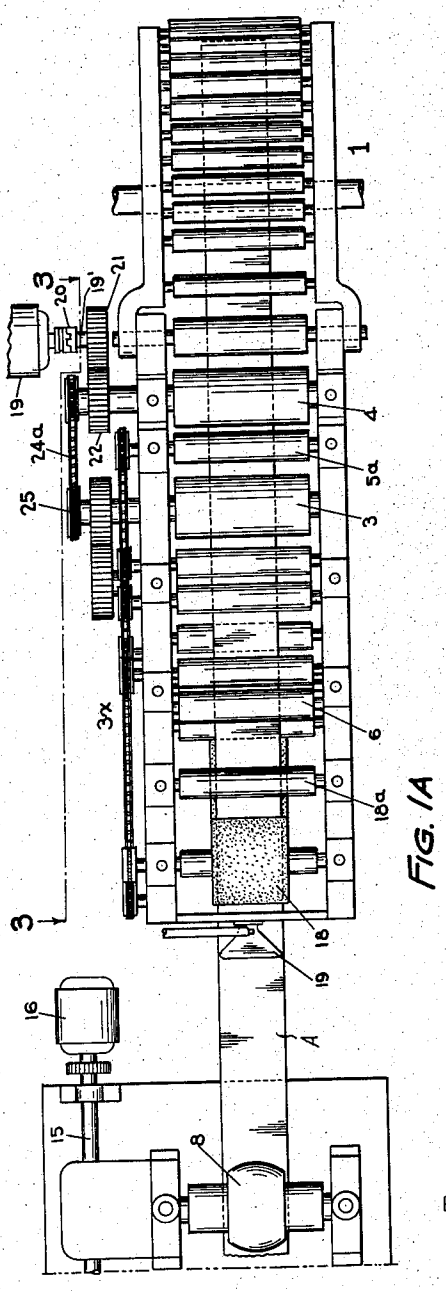


FIG. 1A

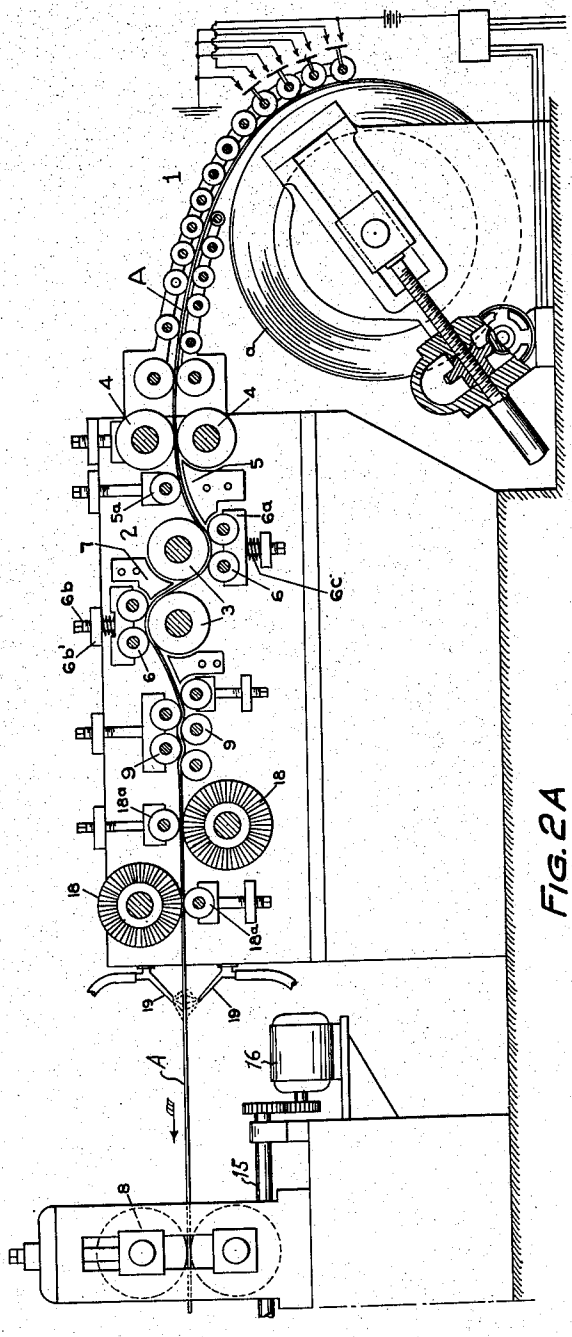


FIG. 2A

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2,391,499

PROCESS OF AND APPARATUS FOR OPERATING ON SHEET METAL

Carl M. Yoder, Lakewood, Ohio; Bertha L. Yoder executrix of said Carl M. Yoder, deceased

Application June 25, 1941, Serial No. 399,644

13 Claims. (Cl. 29—156)

This invention relates to a process of and apparatus for operating on sheet metal, wherein the sheet metal is supplied in sheets or sections or is continuously fed from a suitable source of supply, such as a coil. It is well known that the fibers of sheet metal, as the latter comes from the mill, are under tension or strains and in some instances buckles so that unless these characteristics are removed, that is, the fibers treated to bring them into a uniform relation or under equal tension, there is danger of imperfections resulting in the sheet metal, the sheet metal warping after it has been fabricated or portions thereof becoming distorted during fabrication. The herein disclosed process serves to eliminate these inherent characteristics from hot or cold rolled sheet metal to condition it for various kinds of fabrications or forming it into a predetermined shape, ready for welding and cutting into sections, or cutting into sections where the predetermined shape is such as not to require welding.

My process has peculiar advantages since it is applicable to remove scale in a simplified manner from hot rolled stock, where the latter (*a*) is to be subsequently cold rolled, (*b*) is to be fabricated into preformed shapes, more particularly where the latter, such as the seams of pipe, require welding, or (*c*) is to be galvanized, painted or otherwise treated.

Whether the material is to be cold rolled previous to fabrication thereof or used for fabrication without cold rolling, the scale must be removed. The methods and operations for removing the scale as heretofore employed, so far as my knowledge goes, consist in grinding or sand blasting the surfaces of the metal or subjecting it to pickling, which latter operation not only requires large and special equipment, but is objectionable on account of the atmospheric conditions incident to pickling, high cost of labor and the time consumed to effect pickling and removal of acid from the metal surfaces. In the employment of my process upon hot rolled sheet metal it not only conditions the metal for fabrication, but simultaneously removes the scale from both surfaces of the material, thereby eliminating the pickling operation or employing other means for removing the scale, and insuring substantial savings in time and labor costs. Furthermore, my process simplifies the fabrication of sheet metal since the hot rolled sheet metal, as it comes from the mill, may be conditioned, prepared and shaped as a continuous operation in substantially a unitary apparatus.

In cold rolled metal it is well known that the molecular structure on or adjacent the surface of the stock differs materially from the molecular structure interiorly of the stock so that the fibers of the metal are non-uniformly related and so long as this condition exists the material cannot be advantageously operated upon to adapt it for various uses.

In order to adapt sheet material to various mechanical operations, such as shaping, stamping, bending and drawing, these inherent characteristics must be removed or eliminated; that is, the molecular structure of the metal must be uniform throughout its entire area, so that when the sheet metal is subjected to any of these mechanical operations, the metal will flow evenly and not crack, buckle or pucker up.

In the employment of my process upon cold rolled sheet metal the latter is conditioned for fabrication, particularly for stamping and deep drawing operations; that is, the fibers of the metal are brought into a uniform relation devoid of inherent stresses.

One object of the invention is to provide an improved process of conditioning sheet metal, whereby strains and stresses in its molecular structure are eliminated.

Another object of the invention is to provide an improved process of removing scale from hot rolled stock preparatory to cold rolling or fabrication.

Another object of the invention is to provide an improved process of conditioning sheet metal and forming it into predetermined shapes in cross section.

Another object of the invention is to provide an improved apparatus for continuously removing strains and stresses in sheet metal and fabricating it into predetermined shape.

Other objects of the invention will be apparent to those skilled in the art to which my invention relates from the following description taken in connection with the accompanying drawings illustrating suitable apparatus, partly diagrammatic, capable of carrying out the steps of my process, wherein Figs. 1 and 1A together show a plan view thereof.

Figs. 2 and 2A together show a side elevation, a portion of the latter view being a diagrammatic section on the line 2A—2A of Fig. 1A.

Fig. 3 is a diagrammatic view on the line 3—3 of Fig. 1A.

Fig. 4 is a fragmentary view showing a different form of mechanism.

The sheet metal A is preferably supplied from

a coil *a*, which is automatically moved in a guided direction to maintain its outer convolution in a predetermined relation to a guide means, indicated as an entirety at 1, to prevent any break in the sheet metal between the coil and the conditioning means indicated as an entirety at 2. The supporting and moving means for the coil *a* and the guide means 1 form the subject-matter of my co-pending application, Ser. No. 420,639, filed November 27, 1941, for which reason such mechanism is not claimed herein. Where conditions permit, as the material is supplied from a coil, the inner terminating end of one coil may be welded to the advancing end of the next coil to provide for continuity of the material. The next step consists in conditioning the sheet metal, that is, subjecting the material to a kneading operation, to remove strains or stresses in the fibers thereof and where hot rolled material is employed removing all scale from its opposite surfaces. In carrying out this step, the sheet metal passes to and is wrapped around portions of a plurality of rolls 3, 3, disposed in closely related side by side relation, the material engaging one side of each roll and the opposite side of the adjacent roll or rolls and held in engagement with the surface of each roll, the effect of which is to maintain the material in closely wrapped relation to all of the rolls 3 and to control its movement directly from each roll to the adjacent roll. In passing around these rolls, contiguous portions of the metal are bent or flexed in one direction about or on a relatively short radius and immediately bent or flexed in the opposite direction on a relatively short radius, so that the fibers of the sheet metal A are successively subjected to bending operations on transverse lines and to a stretching or tension and compression and hence are relatively distorted and broken down, the effect of which is to remove strains or stresses existing in the metal fibers. As a result of these operations, the molecules or fibers of the metal throughout its entire area assume a uniform relation or a substantially uniform molecular structure, so that the metal may be subjected to various mechanical operations and readily fabricated into any predetermined shape.

To simplify the positioning of the advancing end of the sheet material in operative relation to the rolls 3, I provide a pair of guide rolls 4, guide devices 5, 5*a*, a set of guide rolls 6 in operative relation to each roll 3 and a guide 7 between the rolls 3. Rearwardly of the rolls 3 I provide adjustably mounted leveling rolls 9 and adjustably mounted wire brushes 18. Each set of rolls 6 is preferably mounted on a base 6*a*, the latter in turn being slidably mounted on a rod 6*b* having a collar 6*b'*, which forms the abutment for a spring 6*c* normally acting on the adjacent base 6*a* to yieldingly press the rolls 6 toward the adjacent roll 3. After the material has been positioned in the machine, the rolls 6, leveling rolls 9 and wire brushes may be adjusted for operative relation to the material.

Where the sheet metal is pulled through and between the rolls 3, 3, for example by a pair of driven rolls 8, the sets of rolls 3, 6 may be mounted to freely rotate and thus be rotated by the sheet material; in this operation the tension on the material between the guide means 1 and rolls 8 will insure engagement of the material with the rolls 3. Where the sheet metal is fed forwardly, for example, by applying power to the rolls 4 to drive them, I prefer to positively drive the rolls 3, 6, by a suitable drive means such as indicated as an entirety at 3*x*.

Where leveling of the sheet metal A is found desirable, it feeds from the rolls 3, to a plurality of upper and lower leveling rolls 9, which serve to straighten the sheet metal in a well known manner. The leveling rolls are arranged to engage the upper and lower surface of the material, the periphery of each upper roll 9 being disposed in a plane below the peripheries of the adjacent lower rolls 9. In the accompanying drawings I have shown two upper rolls related to three lower rolls, but I may provide additionally related rolls when found desirable.

The next step consists of subjecting the conditioned sheet metal to shaping devices while being fed forwardly, to impart to the sheet metal a predetermined cross sectional shape, such devices being shown by way of example as sets of shaping rolls 10, 11, 12, and 13 co-operatively related to form the sheet metal into tubular shape, as shown at B, with its seam edges in close relation. The shape B feeds from the shaping devices to and through suitable sizing rolls 14 and may then be welded.

The shaping rolls of each set are driven through suitable gearing drivingly connected to a shaft 15, which is driven by a motor 16.

The welding step may be carried out by means of two electrodes 17, 17, supplied with current from any desired source, the electrodes having engagement with the shape B at opposite sides of its seam to effect a resistance weld.

The process as above described may be carried out where cold rolled or hot rolled sheet metal is employed. Where hot rolled sheet metal A is employed, the manipulation thereof, that is, the successive flexing or bending of contiguous portions of the sheet metal in opposite directions, as already set forth, not only processes the metal to effect a uniform fibrous condition therein throughout its entire area, but simultaneously disintegrates the scale and loosens it on the opposite surfaces of the material, whereby it may entirely be removed by suitable means. As the metal of the material is of a ductile character and the scale is brittle, the scale is loosened or disengaged from the sheet metal and broken up ready for removal. The sheet metal A then passes between a pair of suitable scraping or agitating devices, shown herein as consisting of driven wire brushes 18, 18, which remove the loosened scale, and next the sheet metal surfaces are subjected to a washing operation wherein a cleaning solution is applied preferably under pressure. In the present disclosure, the washing operation is effected by means of steam jets delivered from suitable nozzles 19, the pressure of the steam in connection with its water content serving to wash off any scale or grit and foreign matter not removed from the metal surfaces by the brushes 18.

The wire brushes 18 are spaced from each other longitudinally of the sheet metal A so that provision may be made for an adjustable pressure roll 18*a* opposite each brush 18 to insure effective engagement of the latter with the adjacent surface of the material.

In the form of construction shown in Figs. 1, 1A, 2 and 2A, I employ rolls having a three inch diameter and the sheet metal conditioned thereby has a thickness of three-sixteenths of an inch. Where the sheet metal to be conditioned is relatively thin, for example, sixteen gage, I employ rolls having a diameter of one and one-quarter inches, such as shown at 3' in Fig. 4.

In this arrangement, in order to insure the engagement of the material A with a large portion of the rolls 3' as well as to provide room to accommodate the guide rolls 6', the adjacent rolls 3' are disposed in different planes.

It will be obvious that it is desirable to successively flex the material on as short radii as possible so that the diameter of the conditioning rolls have an operative relation to the thickness of the metal being operated upon.

In the disclosed arrangements, which I have found produce satisfactory and successful results, the rolls and sheet metal have a ratio of approximately 20 to 1; that is, the diameter of each conditioning roll is approximately 20 times the thickness of the metal; but the invention is not to be considered as limited to such ratio.

The drive means 3x may be of any desired construction, that shown consisting of a motor 19a adapted to be connected to a shaft 19' by a suitable clutch 20. The shaft 19' is provided with a gear 21 in mesh with a gear 22 fixed to the shaft for the lower guide roll 4, the latter gear in turn meshing with a gear 23 on the shaft 4a of the upper guide roll 4. The shaft 4a is provided with a sprocket 24 which through an endless chain 24a drives a sprocket 25 of the shaft 3a for the forward roll 3. The shaft 3a is provided with a gear 26, in mesh with a gear 27 fixed to the shaft 3a of the adjacent roll 3. One of the gears 26, 27, meshes with pinions (preferably both gears) fixed to the shafts for the adjacent rolls 6, which shafts are provided with sprockets 28. The sprockets 28 are engaged by an endless chain 29. The chain 29 runs around idlers 30, and engages sprockets 31 fixed to the shafts for the brushes 18 and sprockets 32 fixed to certain of the leveling rolls 9.

Referring to Fig. 4, the material passes between a pair of guide rolls 33 to the conditioning rolls 3', which loosen the scale on the opposite surfaces of the material A, in the manner already set forth. The upper surface of the material is acted upon by a wire brush 18' which is shown in opposed relation to the rearmost conditioning roll 3', whereas the lower surface of the material A is acted upon by a wire brush 18' which is shown in opposed relation to a guide roll 34. The material A then passes through and between a pair of driven rolls 35, which serve to pull the material endwise and past the conditioning rolls 3'. Between the scale removing devices 18', 18' and the rolls 35, I provide the steam nozzles 19 which wash off the loose grit and other foreign matter.

The guide rolls 6' are mounted similarly to the guide rolls 6, except that each set of guide rolls is mounted on a support 36, which may be adjusted toward and from the adjacent conditioning roll 3' (the mounting for only one set of rolls 6' is shown, the remaining rolls 6' being shown diagrammatically). The rolls 6' and guide devices 37 serve to guide the advancing end of the material into and around the rolls 3'; but after the material A is positioned, the rolls 6' may be moved away from the rolls 3' into an inoperative position.

It will be understood that the process herein disclosed may be carried out on material of any width.

What I claim is:

1. The herein disclosed process which consists in feeding flat sheet metal, continuously passing it around the remote sides of adjacent rolls and by separate means simultaneously applying pressure at spaced points and inwardly radially of the rolls to contiguous portions of the sheet metal while such portions are in engagement with each roll, thereby wrapping such portions around the rolls and flexing the sheet metal in reverse directions on transverse lines to loosen the scale on the surfaces of the sheet metal and remove strains in its molecular structure, continuously passing the sheet metal through and between a set of staggered rolls to level the sheet metal, continuously feeding the sheet metal relative to and in engagement with brushing elements to remove the loosened scale, and finally subjecting the sheet metal to sets of shaping elements to form the flat sheet metal into a predetermined cross sectional shape.

2. The herein disclosed process employing spaced rolls, which process consists in feeding sheet metal material, and then subjecting contiguous portions of the material during feeding thereof to flexing or bending operations about the rolls first in one direction and then in the reverse direction and by separate means simultaneously applying pressure at spaced points to such portions substantially radially inwardly of the rolls during bending thereof to remove strain in its molecular structure.

3. The herein disclosed process employing spaced rolls, which process consists in feeding sheet metal material, and then subjecting contiguous portions of the material during feeding thereof to flexing or bending operations about the rolls first in one direction and then in the reverse direction and by separate means simultaneously applying pressure at spaced points to such portions substantially radially inwardly of the rolls during bending thereof to remove strains in its molecular structure and loosen the scale on the opposite surfaces of the sheet metal and finally removing the scale from said surfaces.

4. The herein disclosed process which consists in feeding flat sheet metal, continuously passing the sheet metal around the remote sides of adjacent rolls and by separate means simultaneously applying pressure at spaced points and inwardly radially of the rolls to wrap contiguous portions of the sheet metal around the rolls while such portions are in engagement therewith, thereby flexing the sheet metal in reverse directions on transverse lines to loosen the scale on the surfaces of the sheet metal and remove strains in its molecular structure, continuously feeding the sheet metal relative to and in engagement with brushing elements to remove the loosened scale, and finally progressively shaping the flat sheet metal into a predetermined shape in cross section.

5. The herein disclosed process which consists in continuously feeding flat sheet metal alternately around rolls each having a diameter approximately twenty times the thickness of the sheet metal to successively bend contiguous portions of the metal first in one direction and then in the reverse direction and simultaneously applying pressure inwardly substantially radially of the rolls to the contiguous portions of the sheet metal as such portions feed around the rolls.

6. The herein disclosed process of removing scale from continuous moving flat sheet metal employing a plurality of transverse rolls in line with the moving sheet metal, which process consists in feeding the sheet metal to the remote sides of adjacent rolls to alternately simultaneously stretch and compress the fibers on opposite surfaces of the sheet metal throughout con-

tiguous portions thereof and by separate means simultaneously applying pressure at spaced points radially inwardly of the rolls while such portions are in engagement therewith and during the stretching and compressing of the sheet metal fibers, whereby the scale is loosened, and finally removing the loosened scale from one surface of the sheet metal.

7. The herein disclosed process of shaping sheet metal, which consists in supplying and continuously feeding flat sheet metal, then passing the sheet metal between the peripheries of a main roll and spaced spring operated rolls to wrap the sheet metal around a portion of the main roll in one direction, then passing the sheet metal between the peripheries of a second main roll and spaced spring operated rolls to wrap the sheet metal around the second main roll in the opposite direction, whereby scale on the surfaces of the sheet metal is loosened and molecular strains in the metal removed, then passing the sheet metal relative to and in engagement with brushing elements to remove the loosened scale, and finally progressively shaping the flat sheet metal into a predetermined shape in cross section.

8. In apparatus of the class described, the combination with supporting means and means for continuously supplying flat sheet metal, of means for simultaneously loosening scale on the surfaces of the sheet metal and removing strains in its molecular structure, said means comprising a plurality of rolls, to which the sheet metal is supplied, disposed in vertical planes spaced longitudinally of said supporting means, the sheet metal being arranged to pass around a portion of each said roll at one side of its axis and that portion of the succeeding roll at the remote side of its axis, and spaced pressure devices engaging the sheet metal during its engagement with each said roll to maintain contiguous portions thereof in wrapped relation therewith throughout an arcuate portion of the roll.

9. An apparatus as claimed in claim 8 wherein the spaced pressure devices consist of a pair of spaced spring operated rollers engaging the sheet metal in opposed relation to the periphery of the adjacent roll.

10. An apparatus as claimed in claim 8 wherein the diameter of said rolls is substantially equal to 20 times the thickness of the sheet metal.

11. An apparatus as claimed in claim 8 wherein adjacent rolls are arranged in different horizontal planes.

12. The herein disclosed continuous process of pre-treating and fabricating sheet metal employing transversely arranged conditioning rolls in line with the feed thereof, which consists in continuously supplying flat sheet metal and passing it around the remote sides of adjacent rolls to successively bend contiguous portions of the sheet metal in reverse directions and simultaneously applying pressure radially inwardly of the rolls on contiguous portions of the sheet metal during engagement of such portions therewith to loosen scale on the surfaces of the sheet metal and relieve strains in its molecular structure, passing the flat sheet metal relative to and in engagement with brushing elements to remove the loosened scale, and finally progressively bending the flat sheet metal on longitudinal lines during feeding thereof into a predetermined shape in cross section.

13. In apparatus of the class described, the combination of driven shaping members, a support for a coil of flat sheet metal, means for continuously uncoiling the material from the coil and delivering it to said set of shaping members, curvilinear guide means for guiding sheet metal from the outer convolution of the coil to said guide rolls to prevent coil breaks in the sheet metal, means for simultaneously loosening scale on the surfaces of the sheet metal and removing molecular strains therein, the last said means comprising a plurality of spaced transverse rolls, the sheet material during movement thereof engaging a portion of each roll at one side of its axis and a portion of the succeeding roll at the remote side of its axis, devices outwardly of said rolls for removing the loosened scale from the surfaces of the sheet metal, said uncoiling means being disposed outwardly of said scale removing device for moving the sheet metal relative to said rolls and said devices, and spaced spring operated rolls for engaging the sheet metal during engagement of contiguous portions thereof with each of said first mentioned rolls to maintain said portions engaged with the roll throughout an arcuate area thereof, said set of driven members being operable to bend the sheet metal on longitudinal lines into a predetermined cross sectional shape.

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