Dec. 1, 1964 L. H. RUPLE 3,159,199

CLUSTER ROLL ASSEMBLY FOR TUBE MILLS

Filed July 30, 1962 2 Sheets-Sheet 1

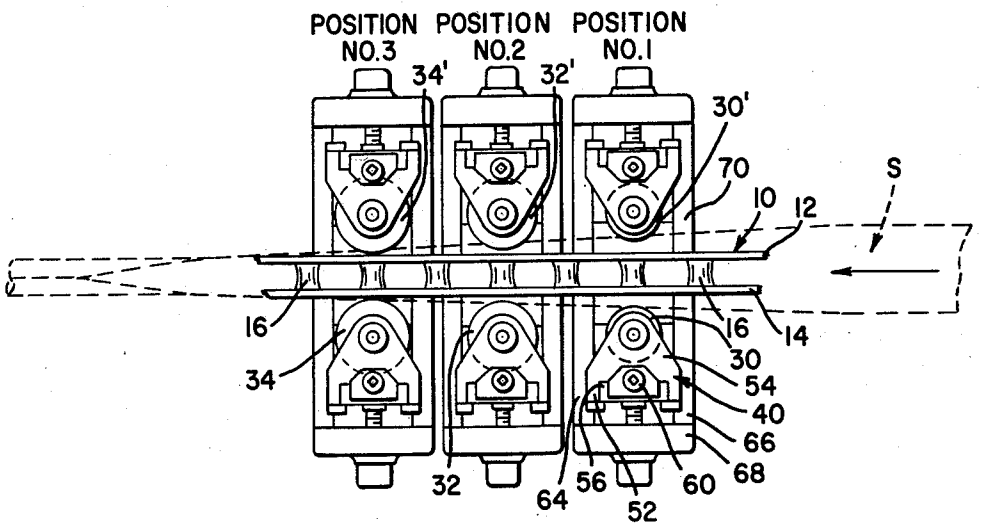

Fig. 1

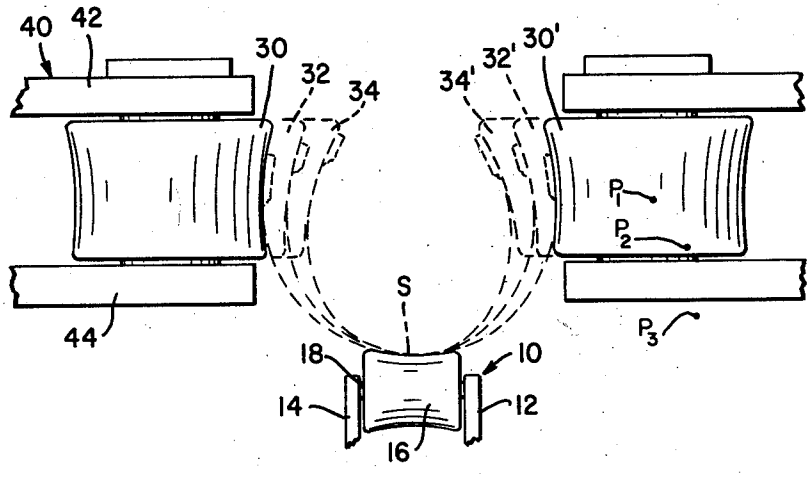

Fig. 2

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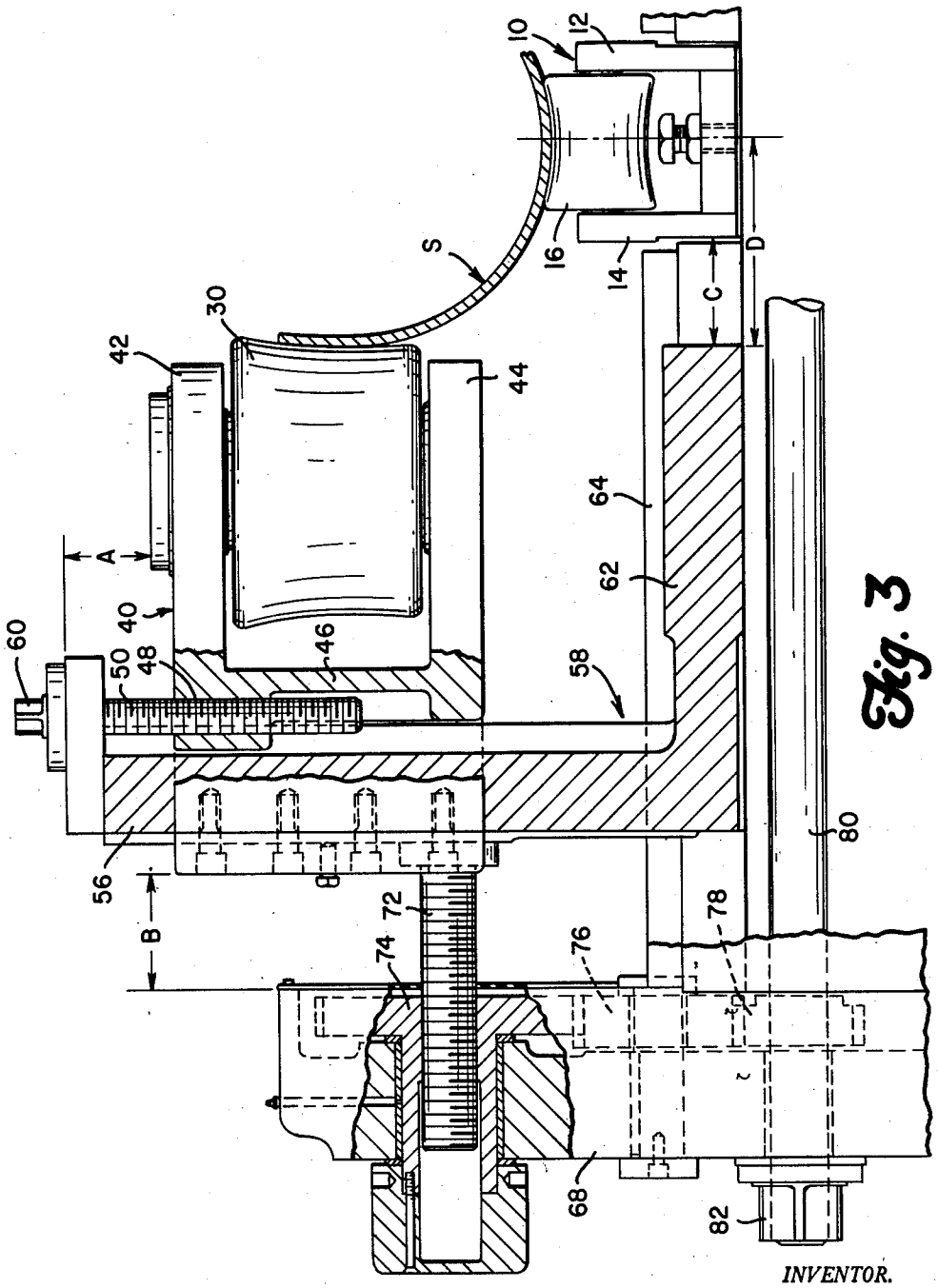

Fig. 3

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CLUSTER ROLL ASSEMBLY FOR TUBE MILLS

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The present invention relates to a method and apparatus for manufacturing tubing from a relatively flat strip of material.

In the conventional tube mills for manufacturing metal tubing from a source of strip stock, the metal strip is caused to travel through the various forming stages of the mill wherein the initially flat strip of metal is gradually formed into a tubular shape. At the output end of the mill, the free edges of the strip of metal are brought into contact with one another and are suitably joined together typically by a butt seam welding operation. Finally, the continuous tube is cut into desired lengths completing the manufacturing cycle.

The diameter of the tubing being manufactured is determined typically by a final forming station positioned near the output end of the mill. Conventionally, this forming station includes an assembly of cooperating forming rolls which are contoured to form a particular diameter tube. This group of forming rolls is sometimes referred to as a "cluster assembly." When it is desired to manufacture a different diameter tubing, the mill operation is stopped; the cluster assembly is removed from the mill; and another entire cluster assembly having rolls contoured to form the desired diameter tube is inserted.

The individual roll members of the cluster assembly are typically fabricated of relatively expensive alloys and are of the full-roll type. By "full-roll," it is meant that the roll is contoured to contact substantially the entire under or outer surface of the strip being formed as the strip passes between cooperating roll members. Due to the size of the roll members, the resulting cluster assembly is not only very costly but also is heavy and cumbersome to handle.

It is an object of the present invention to produce an apparatus for manufacturing tubing from strip material which will form tubing of a wide range of diameters from a single cluster forming assembly.

Another object of the invention is to produce a cluster forming assembly consisting of a series of curved shaping members or rollers which are substantially smaller in size than those of the conventional tube mills.

A further object is to produce a cluster roll assembly which engages only the edge portion of the metallic strip and is adjustably mounted to adapt same for the formation of different size tubes.

The above objects and attendant advantages of the invention may be achieved with a preferred embodiment of the invention which comprises means for supporting the strip of material to be formed along the longitudinal axis thereof; a plurality of pairs of opposed shaping members decreasing in distance in a direction normal to the direction of travel of the strip to thereby cause the free edges of the strip to approach one another, such roll members being contoured to contact substantially only a small portion of the under surface of the strip; and means for varying the relative spacing between the supporting means and the shaping members to thereby manufacture tubular stock of different diameters.

Other objects and advantages of the invention will become apparent from the following detailed description of an embodiment of the invention when considered together with the attached drawing, in which:

FIG. 1 is a top plan view of a cluster roll assembly of a tube mill;

FIG. 2 is an end elevational view of the apparatus

illustrated in FIG. 1 taken in the direction of tube travel; and

FIG. 3 is a fragmentary end view, partly in section, illustrating the specific details of a roll member of cluster assembly of a tube mill.

Referring to FIGS. 1 and 2 there is illustrated a cluster roll assembly for effecting a terminal forming operation on the strip of metal being manufactured into a tubular shape. The strip S of metal is typically initially formed into a U-shaped cross-section prior to the point at which the first position of the roll members of the cluster assembly contacts the outer or under surface thereof. Along the line of travel of the strip S, there is disposed a supporting roller assembly generally indicated by reference numeral **10**. This assembly broadly includes a pair of parallel spaced apart longitudinally extending rails **12** and **14** and a plurality of roller supports **16** suitably journalled to rotate about axles **18**, the opposite ends of which are carried by the rails **12** and **14**, respectively.

The cluster roll assembly is disposed on either side of the supporting roller assembly **10** and comprises pairs of opposed cooperating roll members decreasing in distance apart in a direction normal to the direction of travel of the strip S. The direction of travel of the strip S is indicated by the arrow in FIG. 1. The first pair of opposed cooperating roll members of the assembly is comprised of roll members **30** and **30'**; next pair **32** and **32'**; and the third pair **34** and **34'**. It will be noted that the distance between the opposed pairs decreases; that is, the distance between the opposed cooperating roll members **32** and **32'** is less than the distance between the adjacent pair of opposed cooperating roll members **30** and **30'**; and also the distance between the opposed cooperating roll members **34** and **34'** is less than the distance between the roll members **32** and **32'**.

Since each of the roll members of the cluster assembly is mounted similarly, reference will be made to only the roll member **30**. It will be noted and particularly apparent in FIG. 3 that the roll member **30** is mounted for rotation about a generally vertically disposed spindle within a yoke element **40** having spaced apart horizontally extending upper and lower arms **42** and **44**, respectively. The spaced arms **42** and **44** are joined by a connecting web portion **46**, the upper portion of which is provided with a vertically extending internally threaded hole **48** for receiving an externally threaded shank **50**.

The yoke element **40** has a pair of spaced apart rearwardly extending leg portions **52** and **54**, the inner surfaces of which are adapted to engage, in sliding relation, an upwardly extending leg **56** of an L-shaped platform **58**. The disposition of the yoke assembly **40** may be vertically varied by turning the head **60** of the threaded shank **50**. It will be readily appreciated that by turning the head **60** in one direction, the cooperation between external threads of the shank **50** and the internal threads of the hole **48** will cause the yoke assembly to move upwardly; while the reverse rotation of the head **60** will cause the yoke assembly to move downwardly.

The base **62** of the L-shaped platform **58** is adapted to be supported by and slide on spaced ways **64** and **66** which extend between upright base members **68** and **70**. Movement of the L-shaped platform **58** is effected by a gear-screw arrangement. One end of an externally threaded shank **72** is fixedly screwed to the upwardly extending leg **56** of the platform **58**, and the other end is received within the threaded interior of a gear **74** journalled for rotational movement about its axis within the base member **68**. It will be noted that rotational movement of the gear **74** is achieved through an associated idler gear **76** and a drive gear **78** both being suitably journalled for rotation within the base member **68**. The drive gear **78** is keyed or otherwise affixed to a drive rod

80 which may be turned or rotated in a head 82 integral with or affixed to one end of the drive rod 80. By turning the head 82, rotational movement of the associated gears 78, 76 and 74 will be achieved. Movement of the gear 74 in one direction will cause the threaded shank 72 to be drawn up within the internally threaded interior of the gear 74; while the opposite movement of the gear 74 will effect an opposite movement of the threaded shank 72. Manifestly, since the threaded shank 72 has one of its ends secured to the sliding platform 58, the rotational movement of gear 74 will simultaneously effect a sliding movement of the platform 58, and its associated roll member 30, along the supporting ways 64 and 66.

It will be appreciated from the above description that the forming roll members of the assembly may be adjusted vertically and horizontally by turning the heads 60 and 82, respectively. It is this adjustment feature which enables a single cluster roll assembly to be used for forming tubes or pipes of a substantial range of diameters.

It has been found that satisfactory forming operations are achieved by contouring the forming surfaces of each of the individual roll members on the same radius and varying the center point from which this radius is swung. The center points for the radii of the forming surfaces are illustrated in FIGURE 2; wherein P_1 designates the center point for the forming surface of the roll member 30, P_2 designates the center point for the forming surface of the roll member 32, and P_3 designates the center point for the forming surface of the roll member 34.

In operation, the cluster roll assembly is set up by initially adjusting the heads 60 and 82 which, in turn, determine the vertical position of the yoke assembly 40 and the horizontal position of the L-shaped platform 58 respectively. The adjustments to be made are determined by the size of the tube to be manufactured. Typically, the adjustment of the apparatus is made in accordance with the distance between the top of the yoke assembly 40 and the upper portion of the upstanding leg 56 (indicated in FIG. 3 as "A"); and the distance between the inner face of the base member 68 and the outer vertical face of the yoke assembly 40 (indicated in FIG. 3 as "B"). As alternate adjustment for "B," dimensions "C" or "D" may be used. "C" is the distance between the inner free end of the base 62 of the L-shaped platform 58 and the outer surface of the rail 14. "D" is the distance between the inner free end of the base 62 and the center line of the pipe to be formed which is also the center line of the entire mill.

Various typical settings for the roll members in positions 1, 2, and 3 (FIG. 1) are shown on the following tables:

Cluster Roll Settings for 8⅝" Pipe

Position No.	Setting A, inches	Setting B, inches	Alternate Settings For Setting B—Use "C" or "D"	
			Setting C, inches	Setting D, inches
1	8¾	9	2⅜	7¼
2	8¾	6¾	1⅝	6½
3	8¾	7⅜	1	5⅞

Cluster Roll Settings for 12¾" O.D. Pipe

Position No.	Setting A, inches	Setting B, inches	Alternate Settings For Setting B—Use "C" or "D"	
			Setting C, inches	Setting D, inches
1	4⅜	5⅝	5¾	10⅜
2	4⅜	4	4⅜	8¼
3	4⅜	5¼	3⅛	8

Cluster Roll Settings for 16" O.D. Pipe

Position No.	Setting A, inches	Setting B, inches	Alternate Settings for Setting B—Use "C" or "D"	
			Setting C, inches	Setting D, nches
1	1⅛	3⅛	8¼	13⅛
2	1⅛	2	6⅛	11¼
3	1⅛	3¾	4⅝	9½

With the above discussion, the distance between the outer vertical face of the yoke assembly 40 and the inner free end of the base 62 of the L-shaped platform 58 is in the order of 26¾".

With the cluster roll assembly adjusted in accordance with one of the above tables, the strip S enters the first position (opposing roll members 30 and 30') substantially in a U-shaped cross-section. These rolls then act further to form the strip S causing the same to approach a cylindrical shape. Next, the second position (opposing roll members 32 and 32') acts on the strip S and finally the third position (opposing roll members 34 and 34') acts to further form the strip S.

Typically, after the third position rolls act on the strip S, the strip is fed to a fin roll which trues the abutting edges before the edges are suitably welded together to form an integral tube or pipe.

It will be noted that the contoured surfaces of the individual roll members of the cluster roll assembly, in forming the material of the strip S, contact only a relatively small portion of the under surface thereof. Since the roll members are relatively small in size, less material is used in their fabrication and less power is required to drive the strip through the assembly.

In the light of the above description, it will be appreciated that the apparatus of the invention has produced a method and apparatus for manufacturing tubing or pipe wherein by relatively simple adjustments, the apparatus can be readily changed from manufacturing pipe of one diameter to pipe of another diameter. In addition minor adjustments can easily be made to compensate for changes in both thickness and physical properties of material for the same pipe diameter.

I claim:

1. Method of manufacturing tubular metal stock from a relatively flat strip of metal comprising feeding said flat strip of metal along a path; forming said strip into a substantially U-shaped cross-section; sequentially passing said U-shaped strip between pairs of opposed forming roll members; each of said forming roll members having a forming surface of the same radius and decreasing in distance apart in a direction normal to the direction of travel of said strip; and contacting substantially only a small portion of the under surface of said strip adjacent to and including the marginal edges and along the center longitudinal axis thereof thereby causing the free edges of said strip to approach one another to form a tube having an annular cross sectional configuration.

2. In a universal apparatus for forming from a continuous flat strip of metal a tube of a predetermined selected diameter, wherein the flat strip is caused to be moved along a predetermined path and initially formed into a generally U-shaped cross section; roll means rotatable on a horizontal axis for supporting said strip along the longitudinal axis thereof; a plurality of pairs of opposed laterally spaced forming rolls disposed above and in spaced relation to said supporting roll means, said forming rolls having a tube forming surface, each of the forming surfaces being contoured to contact substantially only a small portion of the under surface of said strip adjacent to and including the marginal edges thereof, said pairs of forming rolls being respectively spaced horizontally from each other and the rolls of advancing pairs being progressively disposed closer to each other thereby

gradually to cause the marginal edges of the strip to approach each other to effect an annular cross section; and mounting means for said forming rolls to enable same to rotate about axes normal to the path of travel of said strip and disposed on opposite sides of said supporting roll means, said mounting means being adjustable for selective horizontal and vertical movement within a plane normal to the path of travel of said strip wherein said forming rolls may be selectively adjusted relative to said supporting roll means to accommodate strips of metal of various widths and thicknesses for use in the forming of tubes of different diameters.

3. In a universal apparatus for forming from a continuous flat strip of metal a tube of a predetermined selected diameter, wherein the flat strip is caused to be moved along a predetermined path and initially formed into a generally U-shaped cross section; roll means rotatable on a horizontal axis for supporting said strip along the longitudinal axis thereof; a plurality of pairs of opposed laterally spaced forming rolls disposed above and in spaced relation to said supporting roll means, said forming rolls having a curved forming surface, each of the forming surfaces having substantially the same radius of curvature and being contoured to contact substantially only a small portion of the under surface of said strip adjacent to and including the marginal edges thereof, said pairs of forming rolls being respectively spaced horizontally from each other and the rolls of advancing pairs being progressively disposed closer to each other thereby gradually to cause the marginal edges of the strip to approach each other to effect an annular cross section; and mounting means for said forming rolls to enable same to rotate about axes normal to the path of travel of said strip and disposed on opposite sides of said supporting roll means, said mounting means being adjustable for selective horizontal and vertical movement within a plane normal to the path of travel of said strip wherein said forming rolls may be selectively adjusted relative to said supporting roll means to accommodate strips of metal of various widths and thicknesses for use in the forming of tubes of different diameters.

4. The invention defined in claim 3 wherein the center points of the radii of the curvature of the forming surfaces for each of said pairs are progressively lower for the progressively closer together rolls thereof.

5. In a universal apparatus for forming from a continuous flat strip of metal a tube of a predetermined selected diameter, wherein the flat strip is caused to be moved along a predetermined path and initially formed into a generally U-shaped cross section; roll means rotatable on a horizontal axis for supporting said strip along the longitudinal axis thereof; a plurality of pairs of opposed laterally spaced forming rolls disposed above and in spaced relation to said supporting roll means, said forming rolls having a curved forming surface, each of the forming surfaces being contoured to contact substantially only a small portion of the under surface of said strip adjacent to and including the marginal edges thereof, said pairs of forming rolls being respectively spaced horizontally from each other and the rolls of advancing pairs being progressively disposed closer to each other thereby gradually to cause the marginal edges of the strip to approach each other to effect an annular cross section; and mounting means for said forming rolls to enable same to rotate about axes normal to the path of travel of said strip and disposed on opposite sides of said supporting roll means, said mounting means and said roll means being relatively adjustable for selective relative horizontal and vertical movement within a plane normal to the path of travel of said strip wherein said forming rolls and said supporting rolls may be selectively adjusted relative to one another to accommodate strips of metal of various widths and thicknesses for use in the forming of tubes of different diameters.

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