Dec. 27, 1966 F. L. HOLTER 3,293,897

MECHANICAL BENDING APPARATUS FOR MAKING COILED TUBING

Filed March 18, 1964 2 Sheets-Sheet 1

FIG. 1

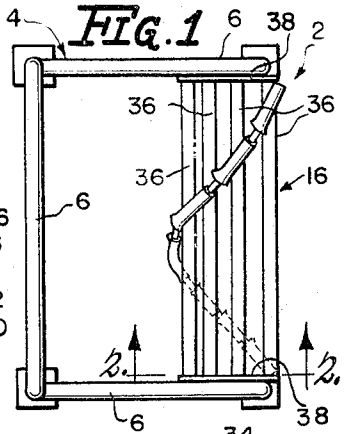
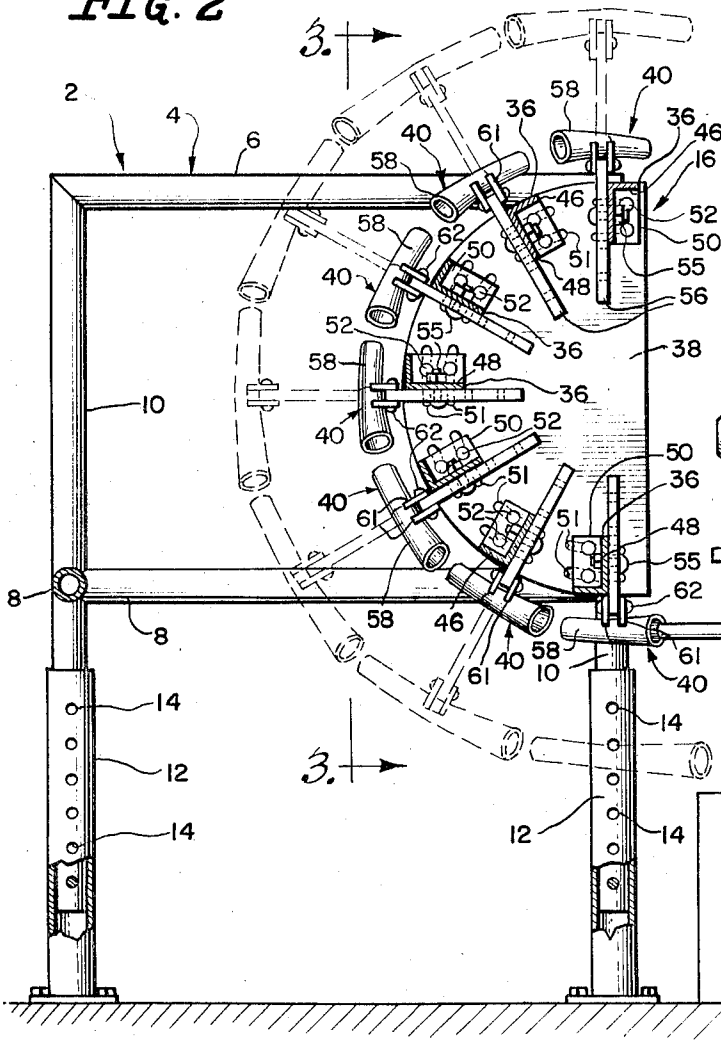


FIG. 2



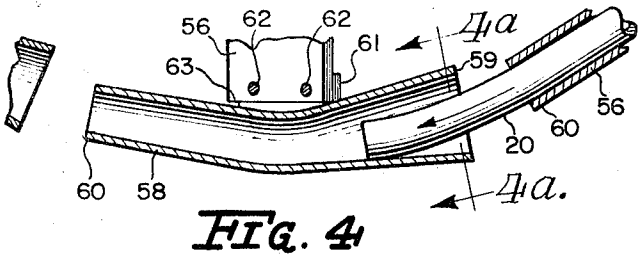
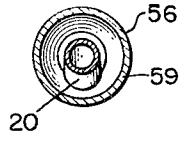


FIG. 4

FIG. 4a



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FIG. 3

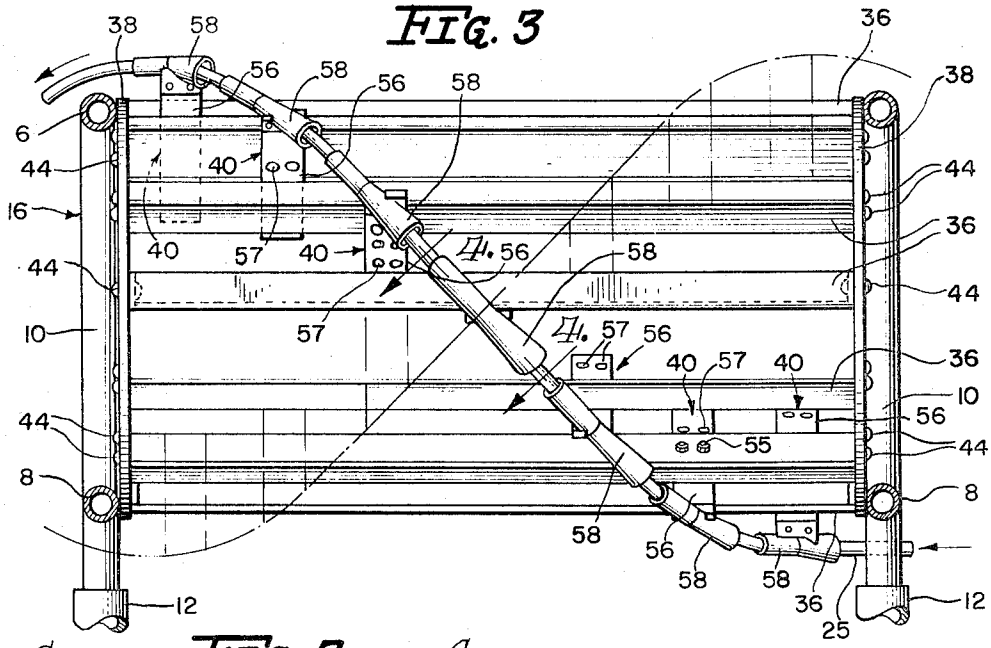


FIG. 5

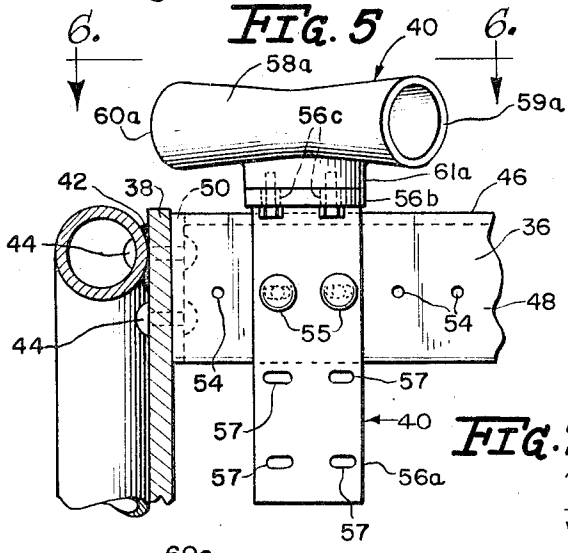


FIG. 7

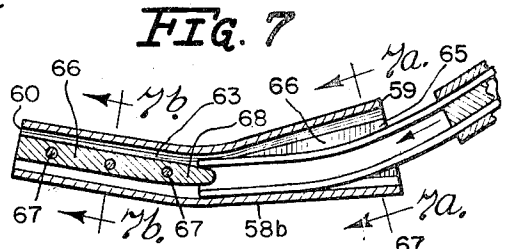


FIG. 7a

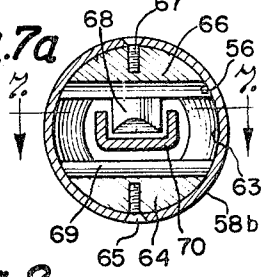


FIG. 7b

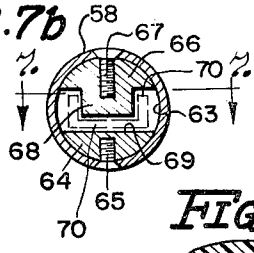


FIG. 6

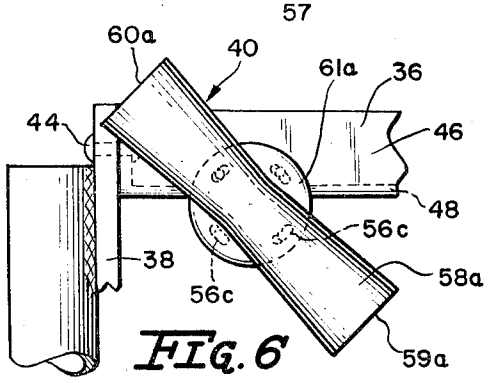
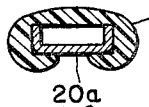


FIG. 8



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United States Patent Office 3,293,897 Patented Dec. 27, 1966

3,293,897

MECHANICAL BENDING APPARATUS FOR MAKING COILED TUBING

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Filed Mar. 18, 1964, Ser. No. 352,821
18 Claims. (Cl. 72—135)

This invention relates to a mechanical bending apparatus and in particular to a bending apparatus for developing the length of an elongated body such as a tube or pipe into a spiral path of the helical type wherein the tube length or coil extends concurrently axially along and peripherally or circumferentially from a central axis. The apparatus finds particular use in fabricating a hand rail for a spiral staircase.

It is therefore a general object of this invention to provide a mechanical bending apparatus for developing elongated members into a curving peripherally or circumferentially and axially extending coil like unit.

It is a further object of this invention to provide a mechanical bending apparatus for bending a member such as a tube into axially and circumferentially extending spiral coil means whereby the diameter and the axial distance between each coil or winding may be varied.

It is another object of this invention to provide a mechanical bending apparatus for forming tubular hand rail for a spiral staircase whereby the circumferential and axial dimensions of the rail coils may be varied in conforming with variation in the size of the risers and treads of the spiral staircase.

It is another object of this invention to provide a mechanical bending apparatus in fabricating a hand rail for a spiral staircase wherein the apparatus is adjustable to accommodate varying diameters of spiral stairs; varying degrees of treads, and to the varying height of risers.

Another object is to provide a method for making coiled tubing.

It is a still further object of this invention to provide a mechanical bending apparatus being provided with guide means in the form of a plurality of adjustable tubes or sleeve members for receiving the elongated body or member to be coiled.

Another object of this invention is to provide sleeve elements for the mechanical bending apparatus that receive the elongated body to be coiled wherein the sleeve elements may have flared tube entrance portions and may be provided with guide track means to guide the material and prevent it from crimping or otherwise deforming as the body or material is coiled.

These and other objects will become apparent from reference to the following detailed description of a preferred construction taken in conjunction with the accompanying drawings in which:

FIGURE 1 is a plan view of my invention;

FIGURE 2 is a sectional view of my invention taken along line 2—2 of FIGURE 1;

FIGURE 3 is a sectional view of my invention taken along line 3—3 of FIGURE 2;

FIGURE 4 is a sectional view of my invention taken along line 4—4 of FIGURE 3;

FIGURE 4*a* is a sectional view taken along line 4*a*—4*a* of FIGURE 4;

FIGURE 5 is an enlarged sectional view of a modified form of sleeve means; and

FIGURE 6 is a sectional view taken along lines 6—6 of FIGURE 5;

FIGURE 7 is an enlarged sectional view of a modified form of the sleeve means shown in FIGURE 4 and as taken generally along section line 7—7 of FIGURES 7*a* and 7*b*;

FIGURE 7*a* is a sectional view taken along lines 7*a*—7a of FIGURE 7;

FIGURE 7*b* is a sectional view taken along lines 7*b*—7*b* of FIGURE 7;

FIGURE 8 is a sectional view of a type of covered rail to be formed by the sleeve means of FIGURE 7.

With reference now to the drawings and in particular to FIGURES 1 through 4*a*, there is shown a mechanical bending apparatus 2 comprising a support or tubular framework 4 having upper horizontal arms 6 and lower horizontal arms 8 and vertical standard 10 adjustably mounted in base members 12 by bolts 14. A material bending unit 16 is carried by the arms 6, 8 and 10 at the right side of the framework 4 as viewed in FIGURES 1 and 2. A material feed mechanism 18 feeds the material such as round tube or pipe 20 to the bending or coil forming unit 16 and comprises a base 22 and a gear box 24 for driving feed rolls 26 which feed tube 20 to unit 16, the gear box 24 being operated through pulleys 28 and 30 and belt 32 driven by motor 34.

The bending unit or coil forming structure 16 comprises the longitudinal beams or plates 36, the two flat semi-circular disc-like plates 38, 38 and the adjustable material guide means or sleeve structure 40. The two vertical end plates 38, 38 are welded and bolted to the support structure 16 at arms 6, 8, 10 as by welds 42 and bolts 44 as seen in FIGURES 1 and 2. Each longitudinal beam or plate 36 is L-shaped having axially extending sides 46 and 48 and is provided with end sides 50. The end plates 38, 38 have arcuate slots 51 for receiving bolts 52 that fasten sides 50 of beams 36 to the plates 38. The arcuate slots 51 allow for circumferential adjustment of the beams 36 on the plates 38. The side 48 of each beam 36 is with a plurality of horizontal aligned apertures 54 for receiving bolts 55 for holding flat plate or arm 56 of the guide structure 40 in two of such apertures 54 to provide for a plurality of axial or horizontal positions for the guide structure 40. The guide arm 56 is provided with a plurality of radially extending pairs of apertures 57 for receiving bolts 55 to provide for a plurality of positions of the arm 56 radially displaced from the center or axis of the bending unit 16. Thus it is seen that the beam 36 may be arcuately moved to several positions along the disc plates 38, 38 and the guide means 40 may be moved to a number of positions horizontally along the beams 36 as to a number of positions radially of the beams.

The outer end of the guide arm 56 is provided with a guide element or sleeve 58 for receiving the end of the material or hollow tube 20 as it moves in its spiraling or helical path circumferentially and axially along the bending unit 16.

Each hollow sleeve or tube 58 is outwardly flared into a cone shape at its entrance end 59 and is cylindrically shaped and unflared at its exit end 60 (see FIGURE 4) and is held by welding to clamp arms 61 held by fastening means 62 to outer end 63 of plate 56 (see FIGURE 2). An alternate form of the sleeve 58 is shown in FIGURES 5 and 6 where the tubular sleeve 58*a* is flared at entrance and exit ends 59*a* and 60*a* and has an integral cylindrical base 61*a* held by bolts 62 extending through base 61*a* and arcuate slots 56*c* of integral round bracket portion 56*b* of plate 56*a*, shown in FIGURES 7, 7*a* and 7*b*, permitting arcuate or angular adjustment of the sleeve 58*a* on the bracket portion 56*b*. A further alternate form of sleeve 58*b* has its inner peripheral surface 63 provided with lower crescent shaped axially tapering guide block or track 64 wider at entrance end 59 and narrower at exit end 61 and held to sleeve 58*b* by screw means 65 and upper axially tapering guide block 66 wider at entrance end 59 and narrower at exit end 61 and held to sleeve 58*b* by screw means 67. The guide

block or track **66** has an internal rectangular projection **68** that cooperates with flat surface **69** of guide block **64** for channeling and guiding U-shaped rail **20***a* through opening or channel **70** of sleeve **58***b*. Thus the U-shaped rail **20***a* is prevented from bending or buckling as it passes through sleeve **58***b* and may thereafter be capped by hand rail cover **71** as shown by FIGURE 8 for a spiral staircase.

Thus it is seen that there is provided a bending apparatus for developing elongated members into a spiral form of the helical type finding use in the production of the hand rails **20** or **20***a* for a spiral stair case where the member or rail **20** may be of varying diameter and of varying axial extent, the degrees of tread for a spiral staircase rail **36** being determined by the angular position of one beam or guide carrier relative to another by the end plates or spacer means **38** and wherein the number of beams or carriers **36** may be varied. Further, the guide means **40** are radially extended outwardly or withdrawn inwardly for varying the diameter of the helical coil of the tube-like rail **20**, **20***a* to accommodate the diametrical size of the spiral staircase. Also, the rail **20**, **20***a* may be made to conform to the height of the riser of the stair by varying the axial proximity of one guide means **40** relative to another. Also, the entrance end of each guide or sleeve means **58** may be angularly adjusted to insure proper alignment with a preceding sleeve means **58** and the sleeve means may be flared to insure reception of the member **20** or **20***a* therein. Too, the guide means may be provided with internal track or tube guides **64**, **66** for maintaining the diametric or perimeter shape of tube or rail member in its travel through the sleeve or guide means.

Further there is provided a method of making spiral coil tubing generally helical in form from an elongated tubular body by feeding the same through the apparatus as aforedescribed.

The guide means **40** may be so positioned on the framework or fixture **4** in a reverse pattern as shown by the dotted lines in FIGURE 3 allowing the fabrication of hand rails for the opposite side of the staircase such as making right-handed as well as left-handed rails. Whereas, FIGURE 2 has dotted lines illustrating a second radial position of the guide means **40** for the fabrication of hand rails of greater diameter.

It will be appreciated that variations and modifications of the embodiment disclosed may occur within the scope of the invention described herein without departing from the spirit of the invention and that the embodiment disclosed herein is not to be considered as a limitation on the scope or breadth of the appended claims.

What is claimed is:

1. A bending apparatus for coiling an elongated tube-like member into a spiral coil pattern of the general helical type for use as a spiral staircase rail and the like comprising a pair of diametrically opposed radially extending spacers, axially extending guide carrying members disposed between the spacers and extending radially outward from the central axis of the apparatus, and means coupling the guide carrying members and the spacers in angular positioning of one guide carrying member relative to the other, said guide carrying members each having an outer portion collectively presenting with another a general circumferential zone adapted to determine the general diametric extent of the spiral coil pattern, and guide means disposed on the outer portion of each guide carrying means in the circumferential zone and adapted for the reception of the tube-like member in coiled circumscribing and axial travel above the apparatus from one guide means to another.

2. The invention according to claim **1** and said apparatus being provided with means for axially adjustable positioning of the guide means along the guide carrying members.

3. The invention according to claim **1** and said apparatus being provided with means for radially adjustable positioning of the guide means along the guide carrying member.

4. The invention according to claim **1** and said guide means comprising a sleeve adapted for reception of the tube-like member from a preceding sleeve.

5. The invention according to claim **1** and said spacers each having means connecting with the guide carrying members and adjusting the angularity of one guide member relative to another.

6. A mechanical bending apparatus for coiling an elongated tube-like member into a spiral coil pattern of the general helical type comprising a pair of diametrically opposed radially extending spacers, a plurality of axially elongated beam means radiating out from the central axis of the apparatus and connecting with each spacer in determinative angular spaced relation of one beam means relative to the other, each beam means presenting an outer peripheral surface to define collectively with another surface a circumferential sleeve zone, a plurality of sleeves for reception of the tube-like member in circumferential array in the sleeve zone, each sleeve being mounted on a complemental beam means surface defining an axial and radial coiled path for the tube-like members.

7. The invention according to claim **6** and each spacer defining a generally semi-circular plate provided with means associated with a respective beam means in predetermining the angularity of the respective beam means to an adjacent beam means.

8. The invention according to claim **6** and said sleeve being provided with means connecting with a respective beam means for extending the sleeve radially of the respective beam means.

9. The invention according to claim **6** and said sleeve being provided with means connecting with a respective beam means for extending the sleeve axially of the respective beam means.

10. A mechanical bending apparatus for coiling an elongated part in a general helical type pattern comprising a plurality of axially extending members, each member spaced in angular relation to one another and having an inner portion extending radially inward toward a central axis of the bending apparatus and having an outer peripheral portion extending radially outwardly to define with one another a generally circumferentially arrayed guide carriage structure, and guide means provided for the reception of the elongated part and disposed on the outer peripheral portion of the member, and cooperative with the guide means of another member for coiling the elongated part about the carriage structure, and means operatively associated with the guide means and the outer peripheral portion of the member and operative to position the guide means along the members in varying the dimension of the elongated part in the coiling thereof.

11. The invention according to claim **10** and said guide means comprising a sleeve element mounted on the outer peripheral portion and adapted to receive the elongated part from a preceding sleeve element.

12. The invention according to claim **10** and said guide means comprising a sleeve element mounted on the outer peripheral portion and having an outwardly flared inlet end adapted to receive the elongated part from a preceding sleeve element.

13. The invention according to claim **10** and said guide means comprising a sleeve element mounted on the outer peripheral portion and having outwardly flared inlet and exit portions adapted to receive the elongated part from a preceding sleeve element.

14. The invention according to claim **10** and spacer means connecting with each member and provided with angle adjusting means adapted to adjust the angularity of one member relative to another.

15. The invention according to claim 10 and said guide means comprising a hollow sleeve element mounted on the outer peripheral portion and track means disposed wtihin the sleeve element adapted to guide the path of the elongated member through the sleeve element.

16. The invention according to claim 10 and said apparatus being provided wtih part feeding means and with adjustable support means for the member, said adjustable support means being provided with means adapted for registering the feed means with the guide means in the travel of the elongated part from the feed means to the guide means.

17. The invention according to claim 10 and said last mentioned means comprising means operatively connecting the radial portions of the guide means and the members and adapted to provide radial adjustment of the sleeve means relative to the members in varying the diametric extent of the elongated part.

18. The invention according to claim 10 and said last mentioned means comprising means operatively connecting the axial portions of the guide means and the members and adapted to provide axial adjustment of the sleeve means relative to the members in varying the axial extent of the coiled portions of the elongated part.

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