

April 21, 1931.

O. M. SUMMERS

1,802,161

METHOD OF AND APPARATUS FOR FORMING COILS

Filed Nov. 6, 1926

4 Sheets-Sheet 1

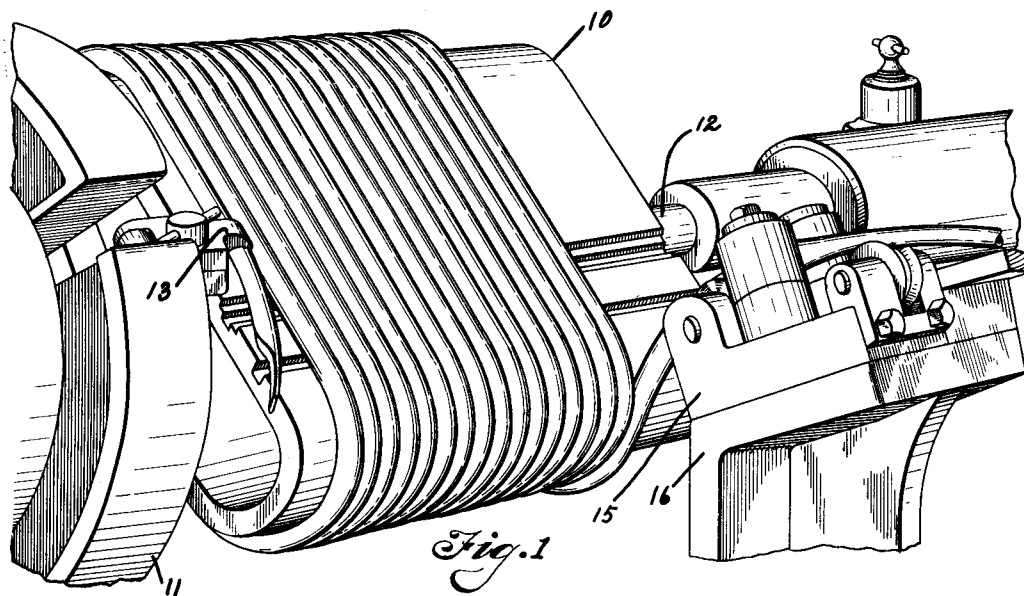
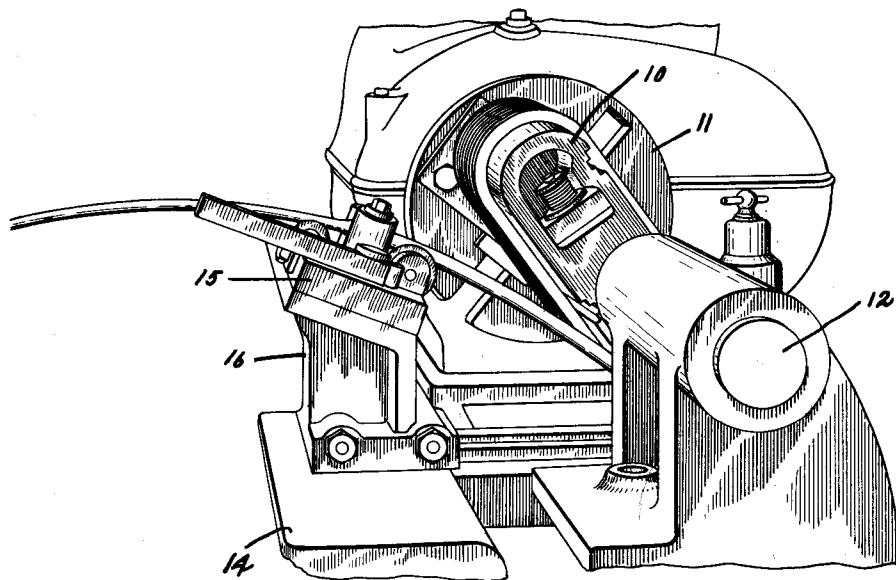


Fig. 2

Inventor

Otto M. Summers

By Spencer Hardman & Lehr

Attorneys

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4 Sheets-Sheet 2

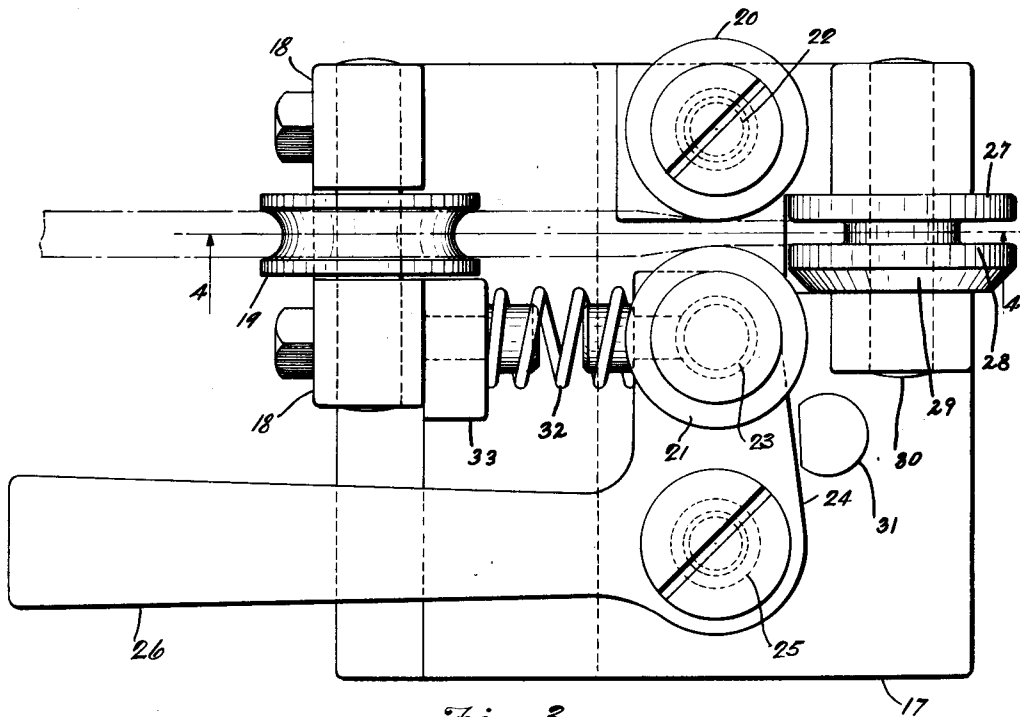


Fig. 3.

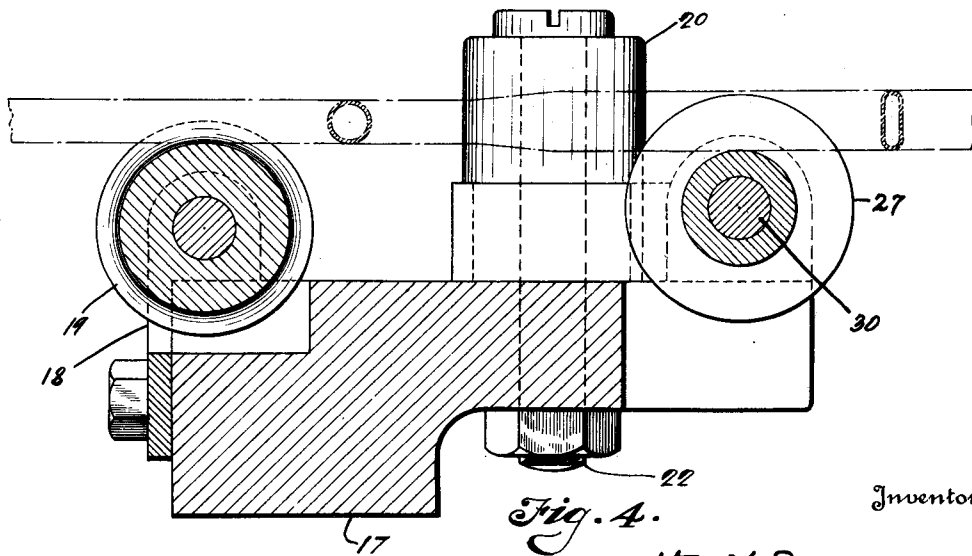


Fig. 4.

Inventor

Otto M. Summers.

By Spencer Hardman & Fehr
Attorneys

Attorneys

April 21, 1931.

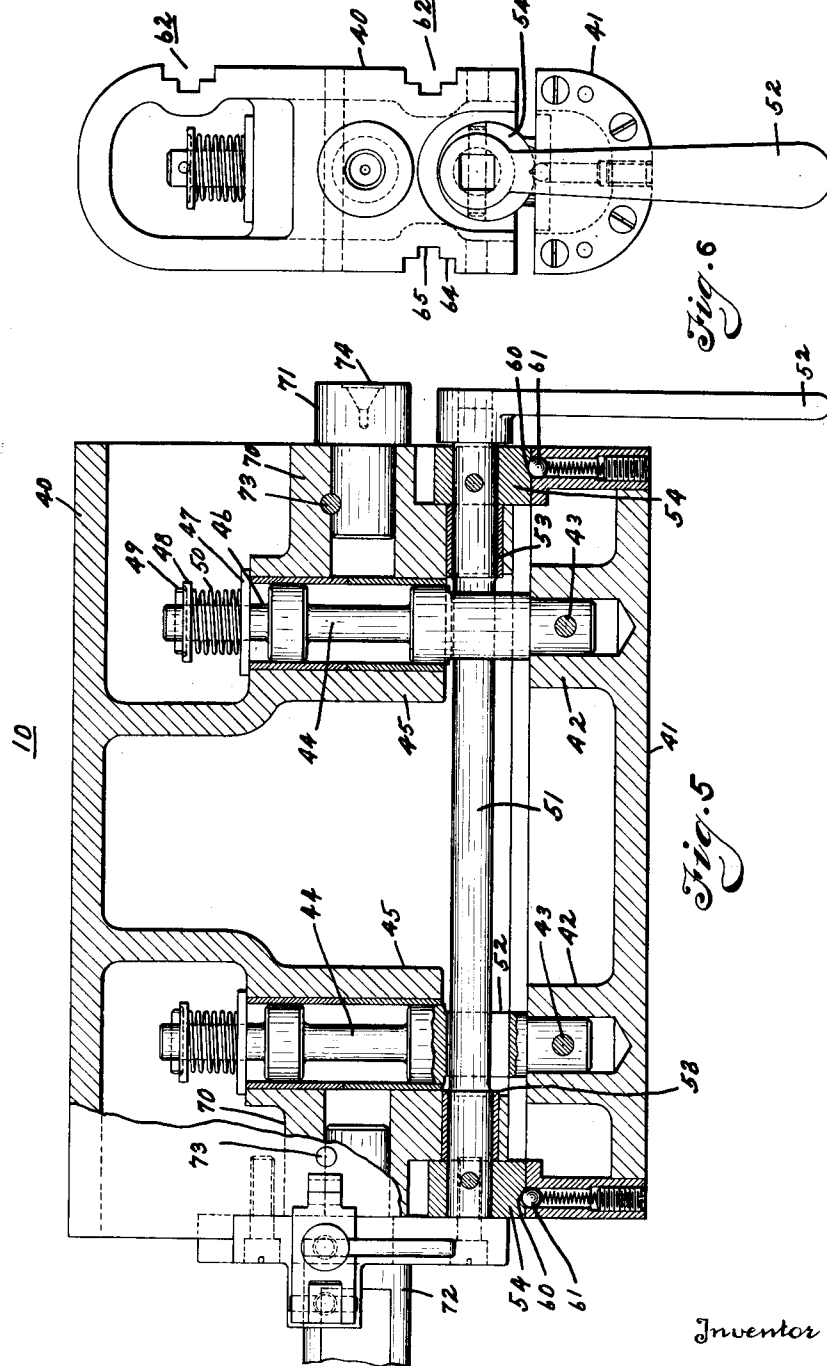
O. M. SUMMERS

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4 Sheets-Sheet 3



Inventor

Otto M. Summers

By Spencer Hardman & Fehs

Attorneys

April 21, 1931.

O. M. SUMMERS

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4 Sheets-Sheet 4

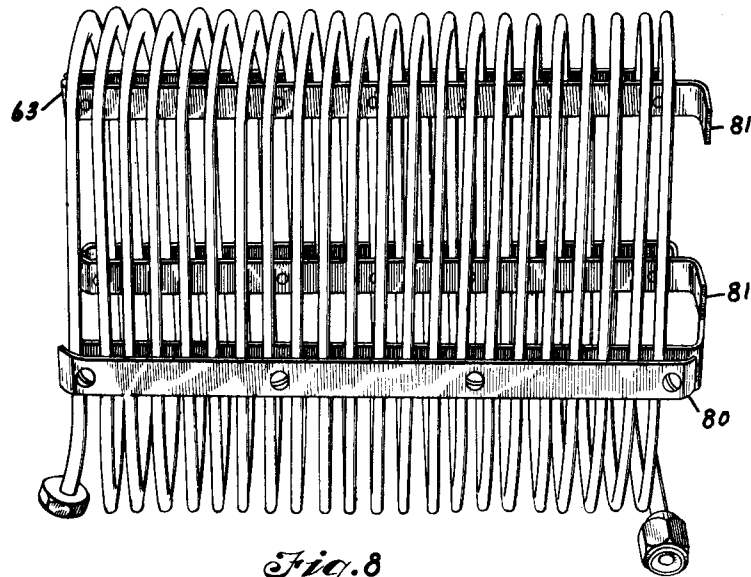


Fig. 8

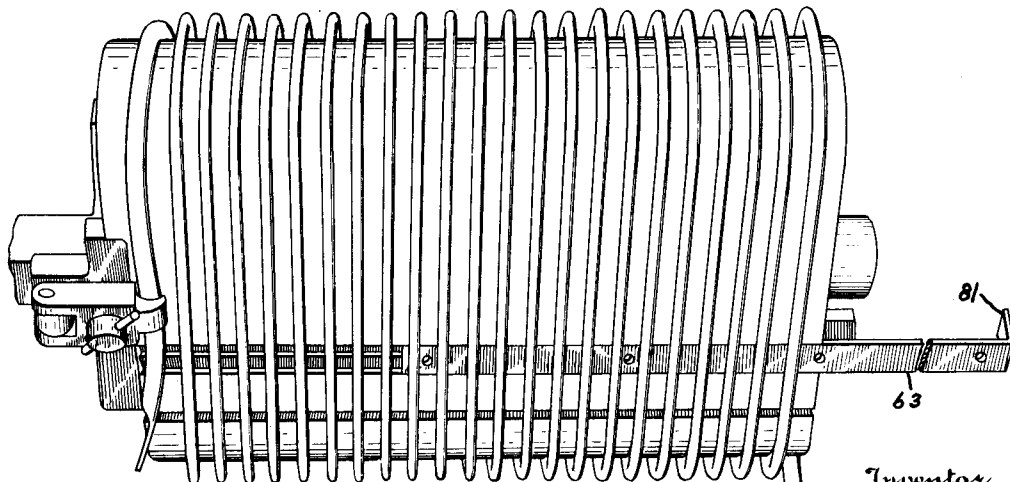


Fig. 7

Inventor
Otto M. Summers
By Spencer Nordman & Fehr
Attorneys

UNITED STATES PATENT OFFICE

OTTO M. SUMMERS, OF DAYTON, OHIO, ASSIGNOR, BY MESNE ASSIGNMENTS, TO FRIGIDAIRE CORPORATION, A CORPORATION OF DELAWARE

METHOD OF AND APPARATUS FOR FORMING COILS

Application filed November 6, 1926. Serial No. 146,780.

The present invention relates to methods and apparatus for winding coils, particularly coils of tubing used for condensers in refrigerating apparatus.

5 One of the objects of the invention is to improve on the present methods and apparatus of winding flat stock, specifically tubing, edgewise.

Another object is to effect cheap and rapid 10 production of condenser coils having a relatively large amount of surface but occupying a relatively small amount of space.

Another object is to effect the cheap and rapid production of condenser coils having 15 flat convolutions, particularly convolutions wound edgewise.

Other objects will be apparent from the accompanying specification and the annexed drawings.

20 In the drawings:

Fig. 1 is a perspective view from the left of a machine for winding coils, showing a coil nearly completed.

Fig. 2 is a perspective view from the right 25 of the same machine.

Fig. 3 is a detail plan view of the portion of the machine which flattens and guides the stock.

Fig. 4 is a section on the line 4—4 of Fig. 3 30 looking in the direction of the arrows.

Fig. 5 is a longitudinal section of a collapsible mandrel used on the machine.

Fig. 6 is an end view of the mandrel.

Fig. 7 shows a completely wound coil on 35 the mandrel, and

Fig. 8 shows a completed coil removed from the mandrel.

Coils of tubing are extensively used for air cooled condensers in household electric refrigerators. Because the surface required is 40 relatively large and the space available for the condenser is limited, the problem of how to get the greatest surface in a given space is of great importance. It has been proposed 45 to make a coil of flat tubing wound on edge because more convolutions could be placed in a given space and because the flat edgewise tube has more surface exposed to the air stream. Thus the heat exchange area would 50 be materially increased. Although such coils

have been made they were so kinked, rough, and crude, or the process of manufacture was so expensive that their general use was prohibited.

My invention enables me to make perfectly 55 smooth and kinkless coils, having flat edgewise convolutions, both rapidly and cheaply.

Referring to the drawings, a mandrel or form 10 on which a coil is to be wound, is supported and rotated by any suitable means, 60 conveniently a headstock or chuck 11 and point 12 of a lathe. Near one end of the mandrel is a clamp 13 for holding tubing. A tool carriage 14 may travel along the lathe bed in the usual manner. The device for flattening and guiding the tubing, shown in Figs. 3 and 4, is generally denoted by 15 and is 65 mounted on a tool post 16 supported by the carriage 14.

Referring more particularly to Figs. 3 and 70 4, a base plate 17 forms the main body of the device, and upon this is mounted a pair of bearing members 18 which support a guide roller 19 grooved as shown to receive round tubing. Behind the guide roller 19 is a pair 75 of flattening rollers, 20 and 21, mounted on parallel spindles 22 and 23. These rollers are spaced as shown, closer together than the diameter of round tubing intended to be passed through them. In order to permit 80 ready insertion of round tubing, the spindle 23 is supported on a link 24, pivoted at 25 so that it can be swung to move roller 21 away from roller 20. A handle 26 is secured to the link for convenience in swinging the roller 85 aside.

Behind rollers 20 and 21 is a pair of guide 90 members 27 and 28 whose faces are parallel to the faces of the flattening rollers at the lines where they touch the tubing. The distance 90 apart of these guide members should be no greater than the minimum distance apart of the rollers, and is preferably slightly less, so as to draw the tubing down slightly as it passes between them. 95

These guide members may be of various forms, but I prefer to make them integral and rotatable, by simply cutting a peripheral groove, substantially as deep as the width of the flattened tubing, in a roller 29 and mount- 100

ing the roller on a spindle 30 so that the median plane of the groove is parallel to the faces of the flattening rollers at their lines of contact with the tubing.

5 In operation tubing is drawn from left to right as seen in Figs. 3 and 4. The dragging of the tubing on the flattening rollers draws the one roller 21 along in the direction of travel of the tubing and so rotates the link 24. In order to hold the roller in the proper position, a stop 31 is placed behind the link. Its position is such that when the link lies against the stop the centers of the rollers are substantially on a line perpendicular to the axis of the tubing. In this position the two roller centers and the center of the link pivot 25 should be substantially, (that is almost), in line, but it is preferable that the center of the pivoted roller 23 be slightly off the line connecting the centers of the other roller and the link in the direction of travel of the tubing. This gives the roller 21 a stable position, making it impossible for the roller 21 to fly backwards as could possibly happen if the three centers were absolutely on a line.

If desired, a spring 32 may be placed between an abutment 33 and the link 24 in order to return the link to operative position and urge the roller 21 against the tubing when the latter is placed in the machine at the beginning of the operation.

The height of the tool post 16 and/or slope of base plate 17 are so adjusted with relation to the distance from the lathe center 12 and the size of the mandrel 10 that the tubing is given a curve which is convex to the face of the mandrel, between the guide roller 29 and instantaneous point of contact of the tubing with the mandrel. The purpose and operation of this feature are explained below.

The mandrel used may be of any suitable form. One form which I find satisfactory is shown in Figs. 5 and 6.

Two complementary core members 40 and 41 together constitute the core or form which determines the size and shape of the coil. These may conveniently be castings. In the member 41 are formed two bosses 42 in each of which is rigidly secured by a pin 43 a rod 44. In the other mandrel part 40 are two bosses 45 having holes in alignment with and adapted to receive rods 44 which are slidable in the holes and fit them snugly. The end of each rod is reduced in diameter as at 46 to pass through a collar 47 resting on the face of the boss 45. A collar 48 is held on the end of each rod by a pin 49 to retain a spring 50 which urges the rod upwardly as seen in Figs. 5 and 6, and thus pulls the two parts of the mandrel together.

A rod 51 passes axially through the core member 40 and through the two aligned holes 52 in the rods 44. This rod is rotatable in bearings 53 and carries near each end an eccentric cam 54 which bears against the core

member 41. Rotation of the rod 41, by a wrench 52, turns the cams to force the core members apart against the action of the springs 50. A depression 60 in each cam, and spring pressed plunger 61 holds the cam with the core members at their maximum distance apart.

A plurality of axial slots 62 are provided in the face of the mandrel to receive coil stays 63 (see Fig. 7). Each slot has shoulders 64 for holding the stays flush with the face of the mandrel, and a deeper central portion 65 for permitting screws to be inserted in the stays while the latter are in place.

The mandrel is used with the core members forced apart as shown in Fig. 6. Located on the axis of symmetry of this structure is a pair of hollow bosses 70 which receive bearing members 71 and 72, keyed therein by keys 73. Member 71 has a depression 74 to receive the point of the lathe, while the member 72 is adapted to fit in a chuck or head stock.

Method of operation

The mandrel is placed in the lathe with the core members 40 and 41 forced apart. One end of a piece of tubing is secured to the mandrel by the clamp 13. At the appropriate point the tube is flattened by any suitable hand tool so as to permit its insertion in the groove of the roller 29. The link 24 is swung out to permit the round tubing to be inserted between the rollers 20 and 21. The lathe is now started, the operator feeding the tubing onto the roller 19. As the mandrel rotates the tubing is drawn between the rollers 20 and 21 and between the guide members 27 and 28 which first flatten the tubing to the section shown in Fig. 4 and then hold it edgewise upon the mandrel. In practice, the operator may hold a coil of commercial round tubing in his hands and let it unwind over the roller 19, holding the tubing down against the roller. As stated above, the tubing is given a curve convex to the sides of the mandrel as it leaves the roller 29 by reason of the location of the roller with relation to the mandrel. Then as the tubing is coiled about the mandrel it will be straightened against the flat sides of the mandrel, and due to the tension set up in the tubing by the drawing rollers 20, 21 and 29, the tubing will be straightened and stretched across the flat faces of the mandrel. Thus the tubing will be caused to lie flat against the mandrel. It is found that soft copper tubing can be wound very rapidly and will give a coil having a fairly sharp edgewise bend without any kinks or other irregularities.

It will be understood that the tool carriage travels along the lathe at a speed propor-

tional to the speed of rotation of the mandrel, thus giving a uniform pitch to the coil.

When a length of tubing has been wound upon the mandrel, the lathe is stopped, and the mandrel with its coil is removed. The mandrel can then be collapsed and the coil slid off, but it is found that due to the tension in the coil, the latter will unwind to a certain extent and produce a screw-like coil. To prevent this, each coil is held together by stays which are bolted to the coil before it is removed from the mandrel.

Referring to Figs. 7 and 8, it will be seen that a stay 63 may be slid into each groove 64 under the convolutions of the coil. A stay 80 is then bolted or screwed to each of the stays 63, clamping the convolutions firmly in place. The clamp 13 is then released and the mandrel collapsed, after which the coil may be slid off the mandrel and will retain the form shown in Fig. 8. The stays 63 may be bent at one end to provide feet 81 which form a supporting base for the coil.

It will be appreciated that the invention may be used for other purposes than winding coils, for instance, for bending flat tubing edgewise to form a single loop or bend.

It is to be understood that the invention is not limited to the particular details which have been described for the sake of illustration but that it covers modifications which fall within the scope of the appended claims.

What is claimed is as follows:

1. The method of causing a tube to lie straight against a plane surface which comprises giving the tube a curve convex to the plane and then straightening the tube against the plane while stretching the tube lengthwise.

2. The method of causing a flat tube to lie edgewise against a plane surface which comprises both giving the tube a curve convex to the plane and then straightening the tube against the plane while maintaining the section of the tube perpendicular to the plane.

3. The method of forming a coil having flat sides which comprises during the winding of tubing about a form having flat sides, giving the tubing a curve convex to the sides of the form and then straightening the convex bends by stretching the tubing lengthwise on said form.

4. The method of forming a coil having edgewise convolutions and flat sides which comprises during the winding of tubing about a form having flat sides, bending the tubing convex to the sides of the form and then straightening the convex bends by stretching the tubing lengthwise on the flat sides of the form, all the while guiding the tubing to maintain its section perpendicular to the face of the form.

5. Apparatus for winding coils comprising in combination, means for flattening

stock, a forming device and a guide between said means and device for holding flat stock coming from the flattening means edgewise on the forming device.

6. Apparatus for winding coils comprising in combination, a pair of parallel flattening members spaced apart to permit passage of stock between them, a forming device receiving the stock from said members and a guide for such stock having a groove for holding the stock edgewise on a forming device.

7. Apparatus for winding coils comprising in combination, a pair of rollers whose axes are parallel, the rollers being spaced apart to permit the passage of stock between them, and a guide roller movable laterally with said rollers having a peripheral groove, the median plane of which is parallel to the axes of the other rollers.

8. Apparatus for winding coils comprising in combination, a pair of rollers whose axes are parallel, the rollers being spaced apart, one of the rollers being movable away from the other to permit the insertion of stock between them, and a pair of spaced guide members movable laterally with said rollers whose faces are parallel to the axes of the rollers.

9. Apparatus for winding coils comprising in combination, a pair of rollers having parallel axes and being spaced apart, a pivoted member, substantially perpendicular to the line of travel of stock, carrying one of the rollers and adapted to be rotated by stock passing between the rollers, and a stop adapted to hold the pivoted member against such rotation in such position that the pivot and axes of the rollers are substantially in line.

10. Apparatus for winding coils comprising in combination, a rotatable form, means for flattening round stock, and means for guiding such flattened stock edgewise onto the form in alignment with said means for flattening.

11. Apparatus for winding coils comprising in combination, a rotatable form having a flat side, and means for guiding stock onto the form, said means being adapted to give the stock a curve convex to the form and to subsequently straighten the stock by stretching across the flat side of said form.

12. The method of forming a coil which comprises forming a tube of flat cross-section, winding said tube edgewise with spaced convolutions on a form, securing stays on said coil while on said form and removing said coil from said form.

13. The method of forming a coil which comprises forming a tube of flat cross-section, winding said tube edgewise with spaced convolutions on a collapsible form, securing stays on said coil while on said form and removing said coil from said form by collapsing said form.

14. The method of forming a coil which

- comprises forming a tube of flat cross-section, winding said tube edgewise with spaced convolutions on a collapsible form having flat sides, securing stays on said coil while on said form and removing said coil from said form by collapsing said form. 70
15. The method of forming a coil which comprises forming a tube of flat cross-section by flattening a round tube, winding said tube edgewise with spaced convolutions on a form, securing stays on said coil while on said form and removing said coil from said form. 75
16. The method of forming a coil which comprises forming a tube of flat cross-section by flattening a round tube, winding said tube edgewise with spaced convolutions on a collapsible form, securing stays on said coil while on said form and removing said coil from said form by collapsing said form. 80
17. The method of forming a coil which comprises forming a tube of flat cross-section by flattening a round tube, winding said tube edgewise with spaced convolutions on a collapsible form having flat sides, securing stays on said coil while on said form and removing said coil from said form by collapsing said form. 85
18. Apparatus for winding coils comprising in combination a pair of rollers having parallel axes and being spaced apart, a pivoted member carrying one of the rollers and adapted to swing said carried roller between the pivot of said member and the other roller on either side of the plane passing through the pivot and the center of said other roller, said pivot member being adapted to be rotated by stock passing between the rollers, and a stop adapted to hold the pivoted member against such rotation in such position that the axis of said carried roller is slightly outside of but adjacent to said plane in the direction of travel of the stock. 90
19. The method of making a bent tube having a flattened cross-section whose major axis is parallel to the plane of the bent tube which comprises bending the tube over a form while maintaining the major axis of the section of the tube perpendicular to the form. 95
20. The method of making a bent tube having a flattened cross-section whose major axis is parallel to the plane of the bent tube which comprises bending the tube over a form while maintaining the major axis of the section of the tube parallel to the plane of the bend being made. 100
21. The method of coiling flat tubing edgewise which comprises winding a flat tube about a form while maintaining the section of the tube flat, and the major axis of said section perpendicular to the form. 105
22. The method of coiling flat tubing edgewise which comprises winding a flat tube about a form while maintaining the section of the tube flat, and the major axis of said section substantially parallel to the plane of the convolutions of the coil. 110
23. The method of forming a coil having edgewise convolutions which comprises flattening round tubing and winding the tubing about a form while maintaining the section flat, and the major axis of said section perpendicular to the face of the form. 115
- In testimony whereof I hereto affix my signature. 120
- OTTO M. SUMMERS. 125
- 130