

March 31, 1936.

D. B. FULMER ET AL

2,036,034

METHOD OF MAKING GROOVED WIRE

Filed Nov. 25, 1933

2 Sheets-Sheet 1

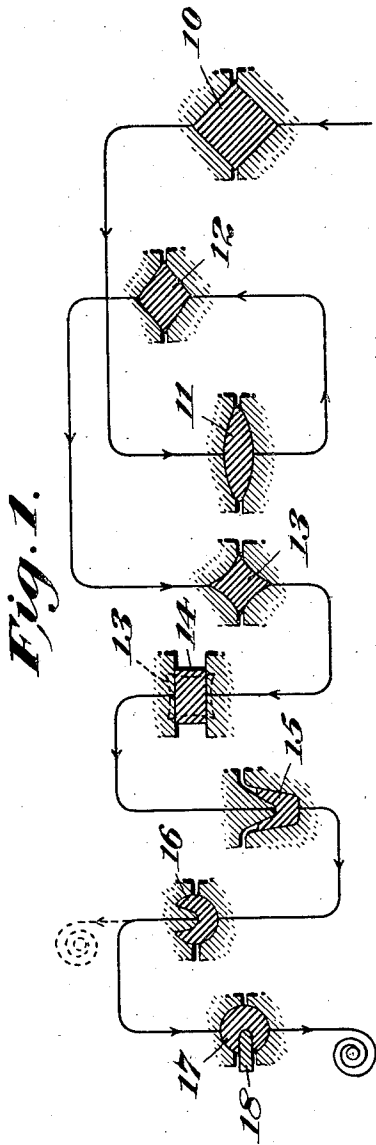


Fig. 1.

Fig. 5.

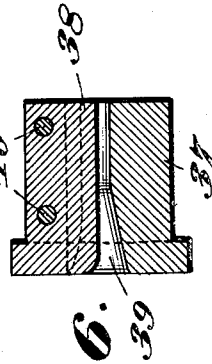
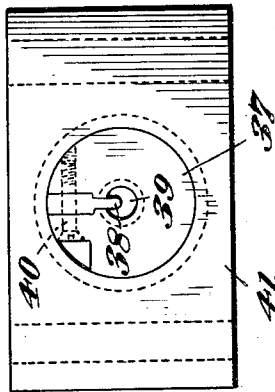


Fig. 6.

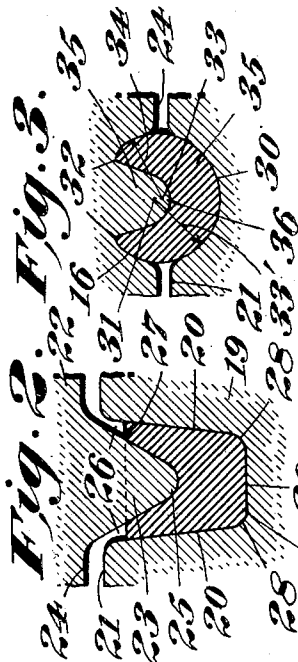
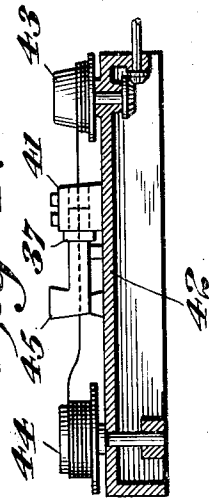


Fig. 2.

Fig. 3.

Fig. 4.

Fig. 4.



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Fig. 7.

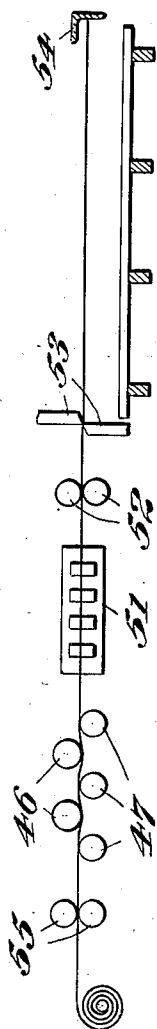


Fig. 9.

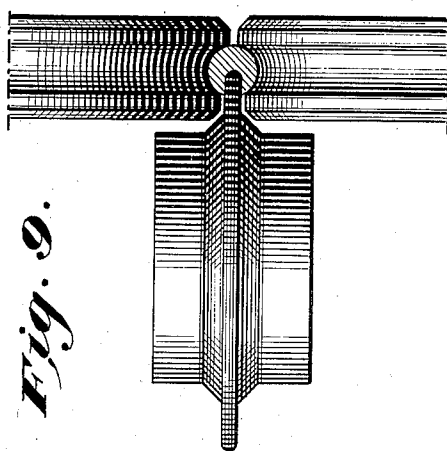
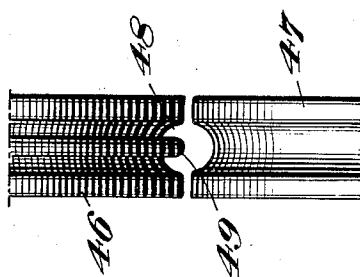


Fig. 8.



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UNITED STATES PATENT OFFICE

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METHOD OF MAKING GROOVED WIRE

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17 Claims. (Cl. 29—148)

This invention relates to an improved method of making wire having a continuous longitudinal groove or flute formed in its surface, and the article produced thereby.

Wire of this character is extensively used in the manufacture of bed springs, to form the outer edges of the assembled spring and at the same time to provide a means for securing the outer coils of the spring to the edge or binding wire by crimping the wire over a portion of the coils.

Heretofore wire of this character was produced by taking a plain, cold drawn steel wire and machining a continuous groove in its surface, or machining a series of spaced grooves along its length. These methods, however, proved to be a slow and expensive way of producing wire of this nature.

We have devised a method of forming wire of this character in a rolling mill, which may be used directly as a commercial article, or if a higher grade wire is desired we take the finished rolled product of the mill, or a rolled shape partly of the final section and subject it to a cold working operation of its entire surface, including the groove, which produces a stiffer and more finely finished wire of greater accuracy than the hot rolled product, or that produced by former methods.

The novel features of our invention will be more fully understood from the following description and claims taken with the drawings, in which:

Fig. 1 shows a series of rolling mill passes for producing a grooved round.

Fig. 2 is an enlarged sectional view of a roll pass and the leader section formed by the pass.

Fig. 3 is an enlarged sectional view of a roll pass for entering the leader to form a round having a V shaped groove in its surface.

Fig. 4 shows the arrangement of a draw bench for cold drawing wire.

Fig. 5 is an end view of the drawing die used on the draw bench.

Fig. 6 shows a longitudinal section of the die.

Fig. 7 diagrammatically represents a bending, straightening and shearing machine.

Fig. 8 shows a partial section of two rolls used in the machine illustrated in Fig. 7, and;

Fig. 9 shows an arrangement of rolls for cold working and shaping the wire to finished size.

Referring to Fig. 1, to roll a grooved wire we start with a heated steel square 10 which is reduced to an oval 11; then to a diamond 12; then to a fluted square 13 which is passed between plain faced rolls to form a rectangular section 14. The rectangular section is then turned on end and entered into a leader pass of section 15. The

top roll of this pass has an annular V shaped portion which projects into the channeled portion of the bottom roll so as to form a substantially trapeziform section with a V shaped groove in its broader parallel face. The leader is then entered into pass 16 to form what we term a fluted round, and from that pass the piece may be coiled for subsequent cold working operations or else it may be entered while hot into a final closing pass 17 to transform the V shaped groove to U shape. This last pass 17 may be provided with a horn or a rotatable mandrel 18 upon which the fluted round is closed, so as to provide a gauge for limiting the closing in of the portions of the round forming the U shaped groove. This pass also trues up the shape generally.

Fig. 2 shows more in detail the shape of the coacting rolls for forming the leader. The bottom roll 19 is machined to form an annular channel having side walls 20 converging from its face 21 toward the axis of the roll, while the top roll 22 has a V shaped annular portion 23 projecting outwardly from its face 24, the apex 25 of the projection being rounded. It will be noted that when the two rolls are operatively aligned that there are open spaces 26 between the rolls to allow the metal of the section forming the leader to flow upwardly after the lower cavity of the pass has been filled. The section thus formed is substantially trapeziform with a V shaped groove in its broader parallel face 27. The corners 28 at the narrow parallel face 29 are rounded. It will also be noted that the leader section is partly of the shape of the fluted round, inasmuch that the groove of the finished section is partially formed before entering the finishing pass 16. When the leader properly proportioned and shaped such as we have shown, is entered into the round finishing pass of Fig. 3, a grooved round can be rolled without finning at the parting of the rolls.

In the finishing pass as shown in Fig. 3 the bottom roll is made with a rounded annular groove 30 struck from a point 31 outside the face 21 of the roll. The top roll is likewise grooved from its outer face 24 to points 32. These grooves being struck from the point 33 which is below the point 31 of the radius for the bottom roll. With these radii points offset, and the radius 33' being slightly larger than radius 34, an eccentric pass is produced. From points 32 a V-shaped annular section 35 is formed on the top roll with the point truncated and rounded as at 36. Thus by proper alignment of the rolls a rounded pass is formed which will produce a rolled section having a V shaped groove extend-

ing longitudinally its length. It will be noted that the annular section 35 of the finishing pass is of less angularity than the groove of the leader and that the round point 36 is of larger radius than the groove in the leader so that when the leader enters the finishing pass it is pressed and deformed by the rolls so as to fill out the upstanding openings of the pass in the top roll and fill up the rounded portion of the bottom roll. The side walls 20 of the leader will be bulged outwardly only sufficiently to fill the pass without finning at the parting of the rolls. A leader of this shape is easily entered into the finishing pass because it has a preformed groove which is engaged by the top roll of the finishing pass and at the same time it is properly centered in the pass, whereby an equal distribution or filling out of the pass is effected without finning.

After the rolling operation the coiled material is pickled or otherwise suitably treated to remove the scale and then lime dipped in a usual manner preparatory to the cold working operation.

For cold drawing we prefer to take the rolled rod as it comes from pass 16 and draw it through a die as shown in Figs. 5 and 6 so as to slightly reduce its sectional area and at the same time transform the V shaped groove of the rod to U shape. This operation not only produces a bright and accurately finished wire but at the same time adds greatly to its stiffness which is much desired when used as binding or frame members of bed springs.

The drawing die is made in two parts, the die body 37, and the groove forming tongue 38. The tongue is replaceable and may be made from material different from the die body 37. The opening 39 at the entering end of the die is flared so as to receive the rod which is slightly larger in section than the reducing orifice 39 in the body of the die. Screws 46 are provided for holding the tongue 38 in place. The die is mounted in a die block 41 which is attached to the draw table 42. The drawing drum 43, reel 44 and lubricating box 45 are of the usual construction.

As the section formed in pass 16 is drawn through the die, the upstanding side portions or fingers of the rod are bent toward each other into contact with the tongue 38 of the die which changes the V shaped groove of the rod to U shape and at the same time reduces the cross section of the rod to a substantially round wire section, which previously to drawing was only partly of the finished section or an approximate round, the tongue serving as a gauge for limiting the closing in of finger portions of the rolled section and for drawing a clean cut and accurate groove. We may, however, take the rod as shaped in pass 17 of the hot mill and give it a skin drawing pass to slightly reduce its section so as to obtain a brightly finished and stiffer wire by drawing it through a die similar to the one we have illustrated. Again, we may take the fluted round 16 having a V shaped groove and deform the rod when cold to provide a groove of U shape by means of rolls as shown in Fig. 9. This in a measure would be equivalent to a cold drawing operation.

From experience it has been found that when a wire of this particular section has been drawn through a die so as to reduce its section and effect a general deformation of the physical structure of the material, that certain stresses are set up in the wire which tend to twist it about its axis after the drawing tension has been released. These stresses also impart to the drawn wire a

bowed or wavy effect. These conditions may be due to the fact that the wire is unsymmetrical in section, unlike a solid round. As a result of the drawing operation the wire is unfit for immediate use because the groove in the wire does not run in a straight line, which is essential for its intended purpose. To correct this misalignment of the groove in the wire and to effect a general straightening of the wire, we run it through a straightening machine of the character shown in Patent 1,751,094, generally called a "Shuster" straightener, the principal features being shown diagrammatically in Fig. 7.

While a straightener of this type will effectively straighten a piece, it does not provide any means for correcting for axial twist so as to position the groove in the wire in a straight line. To accomplish this we substitute special rolls 46 and 47 as shown in Fig. 8 for the ordinary, adjustable straightening rolls commonly known in the art as "breakers". The feed rolls 52 and 55 may also be shaped after this manner if desired. The upper rolls 46 are each provided with a rounded peripheral groove 48 and an annular tongue portion 49 extending outwardly from the base of the groove which is adapted to engage the groove of the wire. These upper rolls are provided with suitable means for positioning them relatively to the bottom rolls 47 so as to flex the wire passing therebetween. The lower rolls are positively driven, the upper rolls rotating freely to respond to conditions as they may be imposed.

When starting a coil of wire through the straightener, the advancing end of the wire is threaded through the rolls so that the groove in the wire registers with the tongues of the top rolls. To do this it may be necessary to twist the end of the wire so as to effect this alignment, due to its inherent twist. With the groove thus properly aligned and held in position, the flexing action of the "breakers" simultaneously relieves the stresses in wire which originally caused it to twist, thereby correcting for this misalignment. In other words the rolls 46 actually twist the wire about its axis at the same time the stresses which caused the initial twist are being relieved, so as to effectively correct for the initial twist. After the wire has been corrected for twist, it passes on to the flier straightening unit 51, then to the feed rolls 52, after which it is automatically cut into fixed lengths by means of shears 53. The gauge 54 at the end of the machine determines the length of the piece to be cut and automatically controls the action of the shears. The straightened rods with properly aligned grooves are then bundled for shipment.

It will be apparent that a grooved wire produced after this manner will have superior qualities to a drawn wire having a machined groove, because by this new method the entire surface of the wire, including the groove, is cold worked so as to produce a uniform grain structure around its entire enveloping surface, thus increasing its stiffness which is an important feature when used as a binding or frame member. Where a groove is machined in a cold drawn wire, the continuity of the drawn skin of the wire is broken and the material defining the groove is not of the same grain structure as the outside surface of the wire, thereby impairing its stiffness.

Having thus described our invention, what we claim as new and desire to secure by Letters Patent is:

1. The method of producing wire having a continuous longitudinal groove in its surface, comprising rolling a grooved rod of larger section than the finished size, cold drawing said rod so as to reduce its section, and then axially twisting the wire thus formed and straightening the same so as to position the groove in the wire in a straight line.

2. The method of producing wire having a continuous longitudinal groove in its surface, comprising rolling a grooved rod of larger section than the finished size, cold drawing said rod so as to reduce its section, and then axially twisting and flexing the wire thus formed and simultaneously straightening the same so as to position the groove in the wire in a straight line.

3. The method of producing wire having a continuous longitudinal groove in its surface, comprising rolling a grooved rod of larger section than the finished size, cold drawing said rod so as to reduce and stiffen its section, then relieving the twisting stresses in the wire produced by the drawing operation by flexing the wire while correcting for twist, and further straightening the wire so as to position the groove in the wire in a straight line.

4. The method of producing wire having a continuous longitudinal groove in its surface, comprising rolling a rod of larger section than the finished size with a V shaped groove therein, cold drawing said rod so as to reduce its section and simultaneously deforming the material defining the V shaped groove so as to form a groove of U shape, then relieving the drawing stresses tending to twist the wire by a flexing operation while correcting for twist, and further straightening the wire so as to position the groove in the wire in a straight line.

5. The method of producing wire having a continuous longitudinal groove in its surface, comprising rolling a rod partly of the finished section with a continuous longitudinal V shaped groove therein, reducing said rod by a cold working operation to the finished wire size and at the same time shaping said V shaped groove to U shape, and then by another cold working operation correcting for any existing axial twist in the wire and simultaneously straightening same longitudinally its axis.

6. The method of producing wire having a continuous longitudinal groove in its surface, comprising producing an approximately round hot rolled rod having a longitudinal V shaped groove with a rounded bottom in its surface, closing in on the portions of the rod defining said V groove so as to form a U shaped groove, and then correcting for transverse angular misalignment of said groove and straightening the piece in a single operation.

7. The method of producing wire having a straight longitudinal groove in its surface, comprising forming in a rolling mill pass, an elongated leader of trapeziform cross section with a V shaped recess in its broader parallel face, reducing said leader in another roll pass to a fluted round, deforming said fluted round to a round of the finished size having a U shaped groove in its surface by a cold working operation, and by another cold working operation relieving the stresses in the wire produced by a previous operation so as to straighten the wire and to align said groove in a substantially straight line.

8. The method of producing wire having a straight longitudinal groove in its surface, the steps comprising forming in a rolling mill pass,

an elongated leader of trapeziform cross section with a V shaped recess in its broader parallel face, reducing said leader in another roll pass to a fluted round section, coiling said rod as it emerges from the last roll pass, suitably preparing the coiled rod for a cold drawing operation, then drawing the rod through a die to further reduce its section to a round wire and to transform said V shaped groove to one of U shape and again coiling the wire, then feeding the coiled wire into a straightening device adapted to engage the groove and the surface opposite the groove at a plurality of points in staggered relation along the wire so as to flex the same, whereby the torsional drawing stresses are relieved and said groove is positioned in a common plane, and cutting the straightened wire to desired lengths.

9. The method of producing wire having a straight longitudinal groove in its surface, the steps comprising forming in a rolling mill pass, an elongated leader of trapeziform cross section with a V shaped recess in its broader parallel face, reducing said leader in another roll pass to a fluted round section, coiling said rod as it emerges from the last roll pass, preparing the coiled rod for a cold drawing operation, then drawing the rod through a die to further reduce its section to a round wire and to transform said V shaped groove to one of U shape and again coiling the wire, then engaging the grooved portion of the wire so as to effect its axial rotation and simultaneously flexing the material, whereby to remove the bend due to its coiled condition and to correct for axial twist in the wire, and cutting the wire to desired lengths.

10. The method of rolling round wire having a longitudinal groove in its surface, comprising forming in a roll pass an elongated heated leader of trapeziform cross section having a V shaped groove in its wide parallel face, passing said leader through another roll pass formed to reduce its section to an approximate round having a V shaped groove in its surface, and in another pass partly closing said V shaped groove to U shape and rounding up the section.

11. The method of rolling round wire having a longitudinal groove in its surface, comprising forming in a roll pass an elongated heated leader of trapeziform cross section having a V shaped groove in its wide parallel face, passing said leader through another roll pass formed to reduce its section to an approximate round having a V shaped groove with a rounded bottom in its surface, and in a cold rolling operation partly closing said V shaped groove to U shape and sizing up the section.

12. The method of rolling round wire having a longitudinal groove in its surface, comprising forming in a roll pass a leader of trapeziform section having a groove extending longitudinally its length in its wide parallel face passing said leader through another roll pass formed to an approximate round with a V shaped portion on one of the rolls extending into the pass so as to produce a fluted round, and in another suitable pass partly closing the fluted portion of said round to form a round having U shaped groove in its surface.

13. The method of producing round wire having a longitudinal groove in its surface, comprising forming in a roll pass a heated leader of trapeziform section having a groove extending longitudinally its wide parallel face, passing said leader through another roll pass formed to reduce its section to an approximate round having a groove converging inwardly toward its axis, and

continuously passing said round through another roll pass formed to convert said converging groove to U shape and round up the section, then in another operation giving the finished rolled wire a light cold drawing pass to accurately size and reduce its sectional area.

14. The method of producing wire having a continuous U shaped groove in its surface, comprising producing an approximately round bar having a curved bottom and curved side portions struck from different points on a vertical line passing through its axis and a depressed V shaped groove in its top portion extending approximately to its axis, and in another operation deforming said side portions so as to transform said V shaped groove to U shape.

15. The method of rolling a round section having a longitudinal groove in its surface, comprising forming in a roll pass an elongated leader of greater section than the finished round and having a flat bottom portion, upwardly and outwardly extending side faces and a downwardly extending angular groove in its upper face, then entering said leader into a finishing roll pass of rounded section having an inwardly extending angularly shaped portion of less angularity than the groove of said leader for compressing said leader in the direction of its depth to laterally spread the middle portion of said side faces while closing in on their upper portions to round same and narrow said groove, and simultaneously deform

said flat bottom portion whereby to fill out the rounded pass without finning.

16. The method of rolling a round section having a longitudinal groove in its surface, comprising deforming a bar having a major and a minor axis in an open roll pass to form a leader having a narrow bottom portion and a wider top portion with a groove therein without restricting the flow of material in the direction of its top portion, then entering said leader into a finishing pass of rounded section having an inwardly extending angularly shaped portion to compress the leader in the direction of its major axis whereby to narrow said wide top portion while spreading that portion intermediate its top and bottom portions so as to fill out the pass without finning.

17. The method of rolling a round section having a longitudinal groove in its surface, comprising compressing in an open roll pass a heated bar of rectangular section in the direction of its major axis to form a leader having a narrow bottom portion and a top portion wider than said bar with a groove therein without restricting the flow of material in the direction of the groove, then compressing said leader in a rounded roll pass having an inwardly extending angularly shaped portion so as to reduce the leader in the direction of the groove whereby to spread the leader and fill out the rounded pass without finning.

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