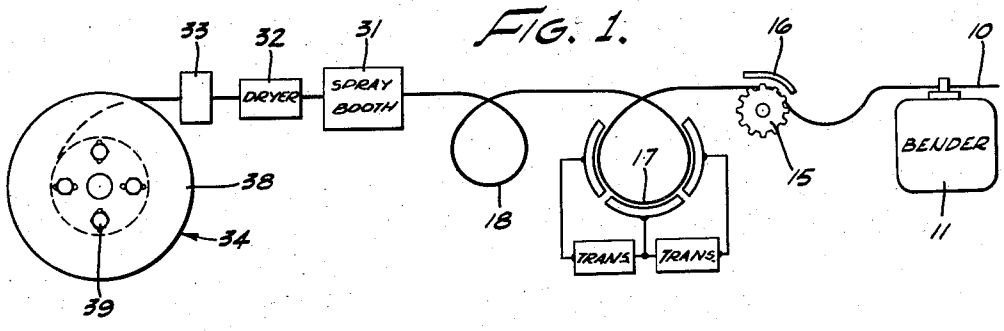
April 7, 1959 H. B. SKLAR ET AL 2,880,861

METHOD AND APPARATUS FOR PRODUCING A ROLL OF WOUND SPRING WIRE AND RESULTING PRODUCT

Filed July 9, 1954

FIG. 1.



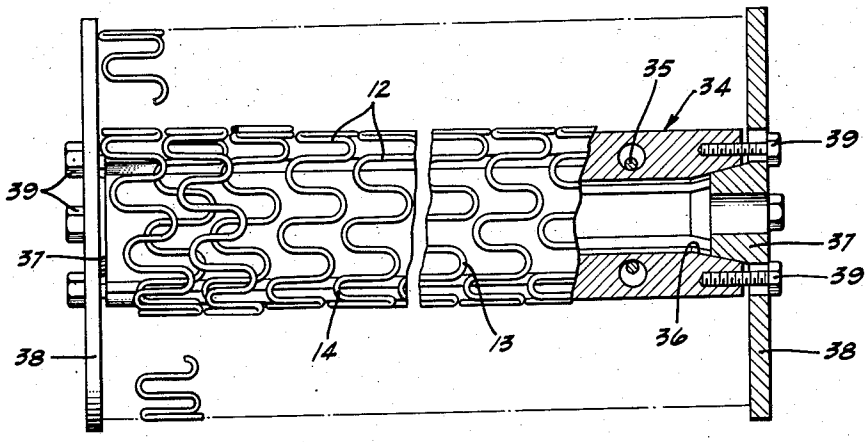


FIG. 2.

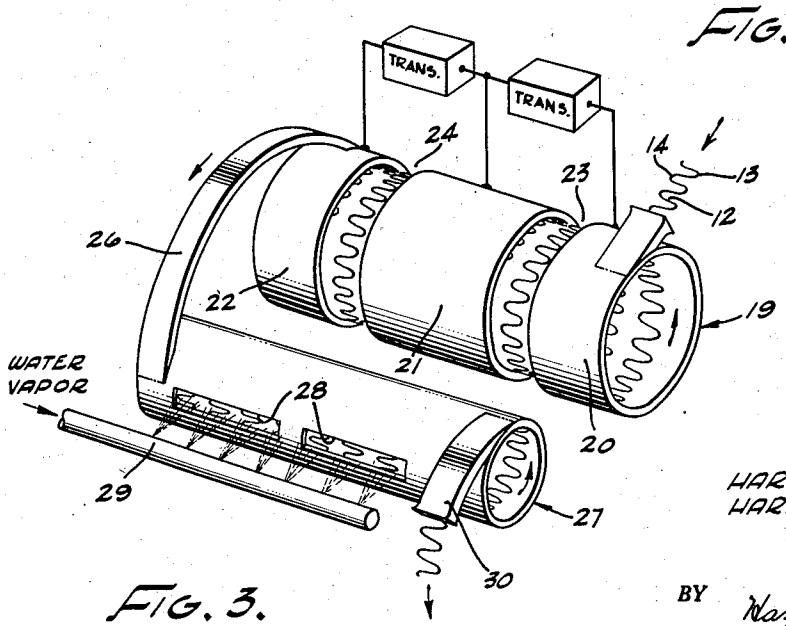


FIG. 3.

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METHOD AND APPARATUS FOR PRODUCING A ROLL OF WOUND SPRING WIRE AND RESULTING PRODUCT

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Application July 9, 1954, Serial No. 442,232

9 Claims. (Cl. 206—59)

This invention relates to a method and apparatus for producing a wound roll of sinuous spring wire and the resulting product. The application is a continuation-in-part of our prior application Serial No. 376,132, filed August 24, 1953, now abandoned.

Explanatory of the present invention, it has been proposed to produce and deliver to consumers desiring sinuously formed springs as a staple article of manufacture, a roll of sinuous spring wire which is longitudinally arched. Such a roll can be advantageously used by consumers, such as seat and furniture manufacturers in appropriate lengths of wire which may be withdrawn from the roll and cut to size. These lengths may then be mounted in spanning relationship on a seat frame to provide the spring construction therefor.

Machines have heretofore been developed for converting straight spring wire stock into zigzag or sinuous wire. After the wire has been so converted it has frequently been caused to pass over an arching roll beneath an arching shoe so that the sinuous wire is longitudinally arched. After the straight wire stock has been bent into sinuous form and has been longitudinally arched it has generally heretofore been cut to length and thereafter it has been heat treated to stress-relieve the wire or to "normalize" it. The word "normalize" as herein used refers to that treatment given this name in the spring industry, and consists of heating the formed spring wire stock to a temperature of usually from 400° to 800° F. Frequently the temperature selected is 600° F. The term is not to be confused with "normalizing" as used in the steel industry wherein the steel is heated to or above its critical point to produce a change in grain structure.

It has been proposed to produce a bulk supply of "normalized" or stress-relieved sinuous wire that is longitudinally arched. In so doing, the sinuous wire has heretofore been spirally wound on a drum to produce a coil of single width, that is a width equal to the width of the sinuous wire. After having been so wound on a drum, the drum and the wire wound thereon have been placed in an oven or equivalent heating means and brought to the "normalizing" temperature, that is usually a temperature between 400° and 800° F. In such a procedure the inner convolutions of the spiral roll would have a radius of curvature equal to that of the spindle of the drum, but outer convolutions of the spiral roll which were wound thereover would have a greater radius of curvature so that the outermost convolution of the roll would have an arch whose radius of curvature would be the greatest and materially greater than the radius of curvature of the arch of the innermost convolution. Consequently, when the "normalizing" or stress-relieving procedure was completed the spring wire forming the spiral roll would have a non-uniform curvature or arch. Those portions of the wire which formed the exterior of the roll would be "normalized" or stress-relieved in a condition having a long radius of curvature of the arch. Those portions of the spring wire which were adjacent the spindle of the drum

would be "normalized" or stress-relieved in a condition wherein the radius of curvature of its arch was substantially the same as the radius of the spindle. Consequently, that wire which was withdrawn from the exterior of the spindle would only be slightly arched while those portions which were withdrawn from the interior of the spiral would be severely arched.

In order to correct for this lack of uniformity the wire has heretofore been withdrawn from the drum and again passed over an arching roll beneath an arching shoe so as to make the arching of the entire length of wire uniform. This was objectionable in at least two respects.

(1) An additional step of re-arching the wire after it had been "normalized" or stress-relieved was required.

(2) In rebending the wire to make the wire possess uniform arch, portions thereof were necessarily stressed beyond the elastic limit and to this extent the effect of the "normalizing" or stress-relief of the wire was destroyed.

The "normalized" or stress-relieved wire that required severe modification or re-arching by the second arching procedure in order to render the arch of the entire length of wire uniform was consequently severely weakened.

Another objection to this procedure is that the length of the wire that could be wound on the drum in spiral fashion and of single width was necessarily limited to a length which, when spirally wound, would produce a roll which could be conveniently handled.

It is an object of the present invention to provide a new method and apparatus for producing a roll of longitudinally arched sinuous wire which has been "normalized" or stress-relieved, and wherein the arch of the wire, after it has been "normalized" will be uniform. This may be accomplished without subjecting the wire to a second arching after the "normalizing" or stress-relieving procedure has been completed. Consequently, the wire will not only possess a uniform arch from end to end but it will be equally strong throughout its length. Furthermore, it is possible to helically wind the wire on a drum so that convolutions may be arranged in side-by-side relationship as well as in superposed relationship. In this manner a roll of uniformly arched sinuous wire may be produced which is of a much longer length and which still can be conveniently handled during transportation. In using wire of this character it is important that the wire when withdrawn from the roll be straight throughout its length when in unstressed condition. That is, it should not have incorporated therein a lateral bend adopted from the shape of the helix. Also, it is important that spacing of the lateral convolutions of the wire be uniform throughout the roll and that this shall be maintained until the wire is withdrawn from the roll and is ready for use.

By forming the wire and longitudinally arching it and then subjecting the wire to a "normalizing" or stress-relieving temperature under conditions wherein the "normalized" wire is straight, uniformly arched, and has a proper spacing of the lateral convolutions before it is spooled or helically wound into the form of a roll, we are able to secure all desirable advantages including uniformity of arch throughout the length of the wire on the roll, uniformity of spacing of the lateral convolutions and wire that is straight from end to end and which does not adopt the set of the helical condition in which it is wound onto the roll.

It is another object of the invention to provide as a new article of manufacture a roll of sinuous wire uniformly arched and which is straight from end to end when withdrawn from the roll and which has been "normalized" or stress-relieved before it was wound onto the roll so that it is of uniform strength from end to end

and wherein outer convolutions of the roll are stressed while in the roll to grip on inner convolutions. In this manner a self-sustaining roll is produced by the gripping action of the outer convolutions on inner convolutions and due to the width of the sinuous wire and the overlapping relationship of outer convolutions with respect to inner convolutions, no ties from end to end of the roll are required.

It is another object of the invention to provide a method and apparatus for producing a roll having the above-mentioned characteristics wherein the wire is wound on a drum, the spindle of which has a radius of curvature no smaller than the radius of curvature of the arch of the wire as "normalized" or stress-relieved. In this manner, inner convolutions of the wire will be effectively gripped by superposed or outer convolutions which are continuously tending to return to the radius of curvature of the arch at which the wire was "normalized" or stress-relieved.

With the foregoing and other objects in view, which will be made manifest in the following detailed description and specifically pointed out in the appended claims, reference is had to the accompanying drawings for an illustrative embodiment of the invention wherein:

Figure 1 is a schematic view in side elevation of the apparatus embodying the present invention;

Fig. 2 is a view in side elevation, parts being broken away and shown in vertical section illustrating the manner in which the "normalized" or stress-relieved longitudinally arched sinuous wire can be wound upon a drum; and

Fig. 3 is a perspective view illustrating parts of the apparatus employed.

Referring to the accompanying drawings wherein similar reference characters designate similar parts throughout, we have illustrated schematically the feeding of straight spring wire stock **10** to a bender **11** which bends the stock laterally into zigzag or sinuous form. Such form is illustrated in Fig. 2 wherein there are a series of laterally extending bars formed of the wire, such bars being indicated at **12**. These bars are continuously connected to each other by semi-circular end loops **13** and **14**. Any suitable bending means may be used for converting the straight wire stock into sinuous or zigzag wire but we prefer to employ the bending apparatus for performing this operation disclosed in United States Letters Patent No. 2,654,252, issued July 14, 1953, to Harry H. Norman.

While the wire stock employed may be any conventional wire stock used for spring forming purposes and which possesses a high tensile strength and is amenable to stress-relieving or "normalizing" that wire which we prefer to employ consists of a carbon steel wire having in the neighborhood of .90% carbon. Wire generally used for this purpose will have a gauge size between 7½ and 13½.

After the wire has been bent or converted into sinuous or zigzag wire it is caused to pass over an arching roll **15** and is pressed thereagainst by a shoe **16** which is effective on the loops **13** and **14** to bend these loops in a longitudinal direction so that after the sinuous wire leaves the arching roll it is longitudinally arched.

After the wire has been thus shaped into zigzag or sinuous condition and longitudinally arched, it is necessary to heat treat it in order to stress-relieve it or "normalize" it, it being understood that in the course of bending the wire from its straight wire condition into the sinuous wire form and in arching it that certain portions of the wire have had their elastic limits exceeded. In "normalizing" the wire we cause the wire to pass through two loops or helices, one of which is smaller than the other and one of which may be regarded as progressing in a left-hand direction while the other progresses toward the right. The first of these loops is indicated at **17** on Fig. 1 and the second is indicated at **18**. In the actual construction of the device used to heat treat the wire to stress-relieve it or "normalize" it. The wire, after leaving the arching roll **15** is caused to enter in a tangential manner a cylinder **19**. This cylinder may be regarded as being divided into three parts **20**, **21**, and **22**. These parts are spaced from each other by spaces **23** and **24**. These spaces are somewhat greater in width than the width of the sinuous wire strip so that a helical convolute of sinuous wire within the cylinder **19** while opposite the space **23** will have one end thereof in contact with the part **20** and the other end thereof in contact with the part **21**. In a similar manner, a convolute of the sinuous wire within the cylinder **19** while opposite the space **24** will have one end thereof in contact with the part **21** and the other in contact with the part **22**. The internal radius of the cylinder **19** is slightly smaller than the radius of curvature imparted to the wire by the arching roll **15**. Thus, if the roll **15** and shoe **16** impart to the sinuous wire strip a radius of curvature of 5" the radius of the cylinder **19** may be only 4" so that the sinuous wire while in the cylinder **19** is slightly flexed to a smaller diameter than its normal diameter that it possesses on leaving the arching roll **15** and the shoe **16**.

The wire is caused to move in a helical path through the cylinder **19** and to pass in a helical manner across the spaces **23** and **24**. During its passage through the cylinder **19** the wire is heated. For this purpose a high amperage, low voltage current is employed and as illustrated in Fig. 3, terminals from a source of supply of electric current are connected to the three parts **20**, **21**, and **22**. Thus, as the wire helically passes across the space **23** current will be caused to flow from the part **21** through a substantial portion of the length of the helical convolute that is opposite the space **23**. The flow of this high amperage current through the sinuous wire while opposite the space **23** quickly raises the temperature of the wire to approximately 300° F. As the wire progresses and traverses the space **24** current is also caused to pass through it from the part **21** through the wire to the part **22**. This raises the temperature of the wire to approximately 600° F. We find that it does not make a great deal of difference in the course of stress-relieving or "normalizing" as to how long the wire is maintained at this temperature as long as it is brought to this temperature.

From the end of the cylinder **19** the wire is then conducted through a chute **26** to a second cylinder **27**. This cylinder may have one or more openings or windows therein indicated at **28**. The second cylinder **27** is of smaller diameter than the diameter of the cylinder **19**. Thus, if the internal radius of the cylinder **19** is 4" as above mentioned, the radius of the cylinder **27** is only 2½". The wire is caused to pass through the cylinder **27** in a helical manner in the opposite direction from that in which it progresses through the cylinder **19**. In other words, if the wire is regarded as screwing through the cylinder **19** toward the left, then the wire will be caused to screw through the cylinder **27** toward the right. As the wire passes through the cylinder **27** it is still in a heated condition, but it may be cooled in this cylinder by the discharge of a cooling medium such as water vapor through a perforated pipe **29**. A dry cold air blast may be used if desired.

The effect of the cylinder **27** is to remove from the sinuous wire the lateral bend impart to it by reason of the fact that it was in a helical condition while passing through the cylinder **19** and heated. Being in a helical condition in the cylinder **19** and being heated therein, the wire would tend to adopt the helical condition or lateral bend toward the left. However, as the wire is still heated while passing through the cylinder **27** toward the right and is cooled therein, and this cylinder is of smaller radius, its effect is to overcome or counteract the lateral bend that the wire would otherwise acquire in the cylinder **19**. The resulting product which is discharged through the outlet **30** is consequently straight from end to end. That is, it is neither bent to the left from the effects of the

cylinder 19 nor to the right from the effects of the cylinder 27. Furthermore, the wire will be in a completely "normalized" or stress-relieved condition and will have an arch that is uniform from end to end. The radius of curvature of the finished product if the sizes above suggested are adhered to will normally be about 2¾" to 2⅞".

From the cylinder 27 the wire is conducted to a spray booth 31 where it may be painted or lacquered and from this spray booth it passes to a drier 32. 33 indicates a laterally reciprocating shuttle or guide means through which the wire is caused to pass as it is wound upon a drum. This drum illustrated in Fig. 2, consists essentially of a spindle 34 made up of individual segments urged into mutually contracted position by means of a split spring 35 that is threaded therethrough. The ends of the spindle are coned out as indicated at 36 to receive conical hubs 37 on end plates 38 which can be tightened inwardly by means of bolts 39. As these bolts are tightened they are effective to expand the spindle of the drum. The tightening of the bolts is continued until the external diameter of the spindle is substantially equal to the radius of curvature of the longitudinal arch of the wire after it has been "normalized" or stress-relieved.

The wire is first wound on the spindle by means of the shuttle or guide means 33 helically in one direction with the convolutions or wraps in side-by-side relationship. The next superposed layer of wire is helically wound on the drum in the opposite direction. Alternate layers of wire will consequently be helically wound in one direction and intermediate layers in the opposite direction. After the drum has been filled the end plates can be removed which permits the spindle to contract and to be removed from the interior of the roll. As the innermost wraps of wire around the spindle are disposed on a core formed by the spindle having the same radius of curvature as the arch of the wire these wraps will neither tend to contract nor expand. Superposed wraps, however, are wound on larger surfaces so that these convolutions are flexed from their normal positions. These convolutions consequently tend to contract on subjacent or inner convolutions. The outermost convolutions of the roll are of course flexed to the greatest extent and correspondingly grip on the convolutions or wraps therebeneath. As the successive convolutions or wraps laterally overlap subjacent convolutions and are relatively wide individually the completed roll is in the nature of a self-sustaining structure after the drum has been removed. Consequently, it can be readily handled without danger of the roll opening up endwise or otherwise loosening. The roll therefore is capable of withstanding rough handling during shipment.

Due to the fact that the wire has been stress-relieved or "normalized" prior to its being wound on the drum it will not adopt a set. Therefore, even though the wire may remain in roll form for an indefinite period of time when the wire is unwound or withdrawn from the roll it will be found that the radius of curvature of the arch of the wire is uniform from the exterior of the roll to its center. Furthermore, although the wire is flexed into a helical condition in the successive layers these helices automatically straighten out so that the withdrawn wire is perfectly straight. At the time of use the wire may be withdrawn from the roll and cut into the desired length. When so withdrawn it will be found that the spacing of the lateral bars 12 will also continue to be uniform which is quite important in seat constructions.

It will, of course, be appreciated that while the wire is preferably spooled or helically wound back and forth across the drum to produce a roll whose length is many times the width of the sinuous wire, in order that a long length of wire can be included in a bulk supply roll that can be readily handled, that it is possible to wind the wire that is produced onto a drum so as to make a spiral coil of single width. Such coils ordinarily are disadvantageous in that the length of the wire capable of being contained therein in the size of coil that can be conveniently handled is limited. However, such coils may be advantageously used in some instances in conjunction with wire bending machines or profile spring forming machines.

Various changes may be made in the details of construction without departing from the spirit and scope of the invention as defined by the appended claims.

We claim:

1. The method of making a bulk supply roll of sinuous spring wire which consists of shaping spring wire stock into the form of sinuous wire, longitudinally arching the sinuous wire, subjecting the arched sinuous wire to normalizing or stress relieving treatment, and finally winding the normalized arched sinuous wire into a roll of superposed layers of helical convolutions the innermost of which has a radius of curvature at least as great as the radius of curvature of the arched condition under which the wire was normalized whereby while in roll form the outer convolutions will grip on subjacent convolutions and when the wire is unwound from the roll at the time of use the radius of curvature of all portions thereof will be uniform.

2. The method of making a bulk supply roll of sinuous spring wire which consists of shaping spring wire stock into the form of sinuous wire, longitudinally arching the sinuous wire, subjecting the arched sinuous wire to normalizing or stress relieving treatment, and finally winding the normalized arched sinuous wire into a roll of superposed layers the innermost of which has a radius of curvature at least as great as the radius of curvature of the arched condition under which the wire was normalized whereby while in roll form outer convolutions will grip on subjacent convolutions and when the wire is unwound from the roll at the time of use the radius of curvature of all portions thereof will be uniform.

3. The method of making a bulk supply roll of sinuous spring wire which consists of shaping spring wire stock into the form of sinuous wire, longitudinally arching the sinuous wire, helically looping the arched sinuous wire first in one direction and then in another, subjecting the arched sinuous wire to normalizing or stress relieving treatment while helically looped, and finally winding the normalized arched sinuous wire into a roll of superposed layers the innermost of which has a radius of curvature at least as great as the radius of curvature of the arched condition under which the wire was normalized whereby while in roll form outer convolutions will grip on subjacent convolutions and when the wire is unwound from the roll at the time of use the radius of curvature of all portions thereof will be uniform and the wire will be straight.

4. The method of making a bulk supply roll of sinuous spring wire which consists of shaping spring wire stock into the form of sinuous wire, longitudinally arching the sinuous wire, helically looping the arched sinuous wire first in one direction and then in another, the latter loop being of smaller radius of curvature than the first, subjecting the arched sinuous wire to normalizing or stress relieving treatment while helically looped, and finally winding the normalized arched sinuous wire into a roll of superposed layers the innermost of which has a radius of curvature at least as great as the radius of curvature of the arched condition under which the wire was normalized whereby while in roll form outer convolutions will grip on subjacent convolutions and when the wire is unwound from the roll at the time of use the radius of curvature of all portions thereof will be uniform and the wire will be straight.

5. The method of making a bulk supply roll of sinuous spring wire which consists of shaping spring wire stock into the form of sinuous wire, longitudinally arching the sinuous wire, looping the arched sinuous wire into the form of a helical loop, subjecting the arched sinuous

wire to heat to normalizing or stress relieving it, forming the wire into a second helical loop reversely directed with respect to the first and of smaller radius while the wire is still in heated condition, cooling the wire while in the second loop and finally winding the normalized arched sinuous wire into a roll of superposed layers of helical convolutions the innermost of which has a radius of curvature at least as great as the radius of curvature of the arched condition under which the wire was normalized whereby while in roll form outer convolutions will grip on subjacent convolutions and when the wire is unwound from the roll at the time of use the radius of curvature of all portions thereof will be uniform and the wire will be straight.

6. As a new article of manufacture a bulk supply roll of sinuous spring wire longitudinally arched with a uniform radius of curvature and normalized or stress relieved while uniformly and longitudinally arched, said wire being in the form of a roll of superposed layers of helical convolutions the innermost of which has a radius of curvature at least as great as the radius of curvature of the arched condition under which the wire was normalized whereby while in roll form outer convolutions grip on subjacent convolutions and when the wire is unwound from the roll at the time of use the radius of curvature of all portions thereof will be uniform.

7. As a new article of manufacture, a bulk supply roll of sinuous spring wire longitudinally arched with a uniform radius of curvature and normalized or stress relieved while uniformly and longitudinally arched, said wire being in the form of a roll of superposed layers of helical convolutions the innermost of which has a radius of curvature at least as great as the radius of curvature of the arched condition under which the wire was normalized whereby while in roll form outer convolutions grip on subjacent convolutions and when the wire is unwound from the roll at the time of use the radius of curvature of all portions thereof will be uniform and the sinuous wire will be straight.

8. The method of making a bulk supply roll of sinuous spring wire which consists of shaping spring wire stock into the form of sinuous wire, helically looping the sinuous wire first in one direction and then in another, subjecting the sinuous wire to normalizing or stress-relieving treatment while helically looped, and finally winding the normalized arched sinuous wire into a roll of superposed layers, the innermost of which has a radius of curvature at least as great as the radius of curvature of the arched condition under which the wire was normalized whereby when in roll form outer convolutions will grip on subjacent convolutions and when the wire is unwound from the roll at the time of use the radius of curvature of all portions thereof will be uniform and the wire will be straight.

9. The method of making a bulk supply roll of sinuous spring wire which consists of shaping spring wire stock into the form of sinuous wire, helically looping the sinuous wire first in one direction and then in another, the latter loop being of smaller radius of curvature than the first, subjecting the sinuous wire to normalizing or stress-relieving treatment while helically looped and finally winding the normalized arched sinuous wire into a roll of superposed layers, the innermost of which has a radius of curvature at least as great as the radius of curvature of the arched condition under which the wire was normalized whereby while in roll form outer convolutions will grip on subjacent convolutions, and when the wire is unwound from the roll at the time of use the radius of curvature of all portions thereof will be uniform and the wire will be straight.

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