Nov. 15, 1938. A. SIMONS 2,136,714

MECHANISM FOR STRAIGHTENING WIRE

Filed May 16, 1936 3 Sheets-Sheet 1

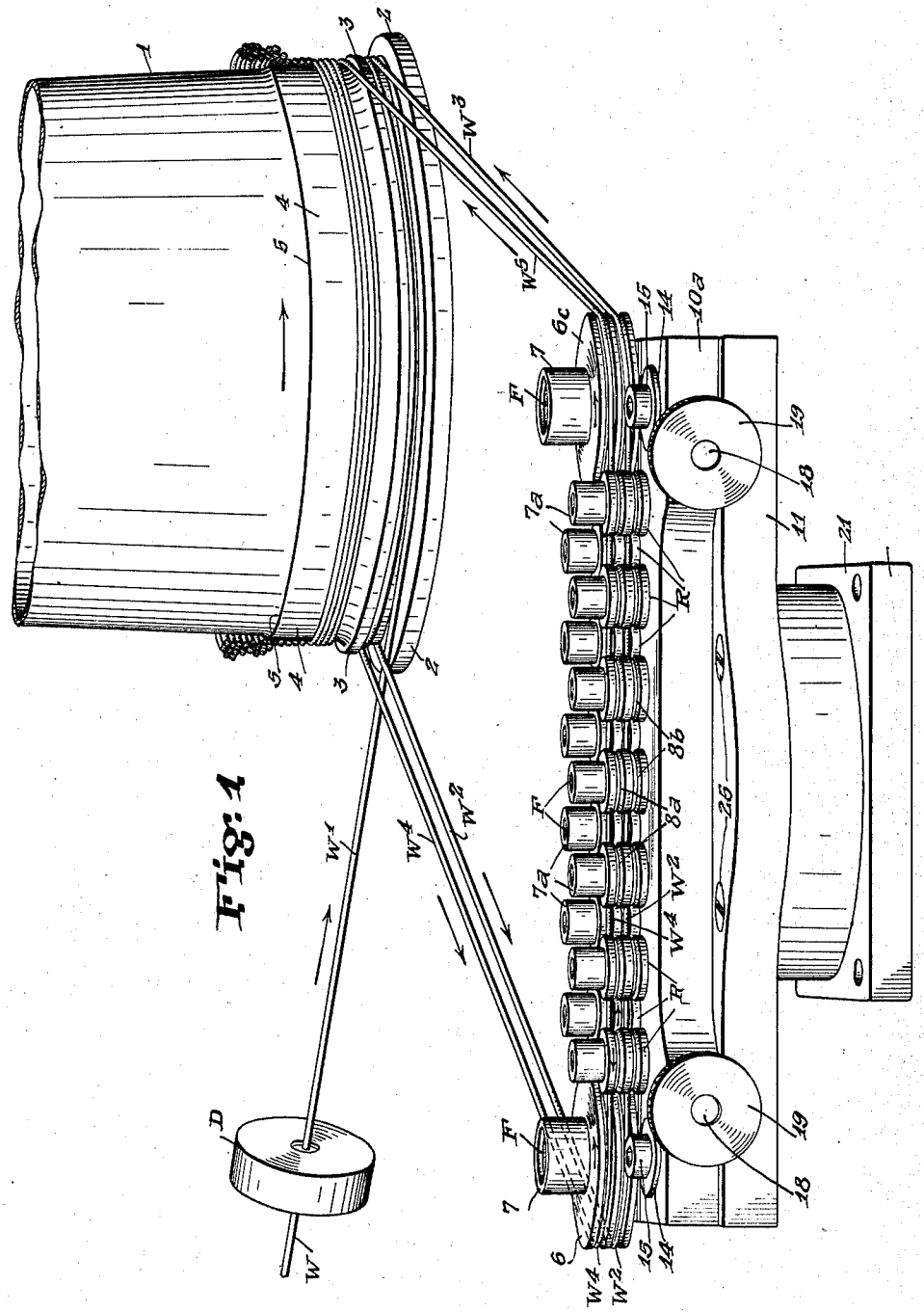


FIG. 1.

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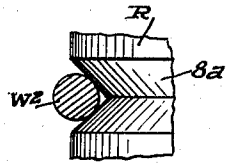


Fig: 8

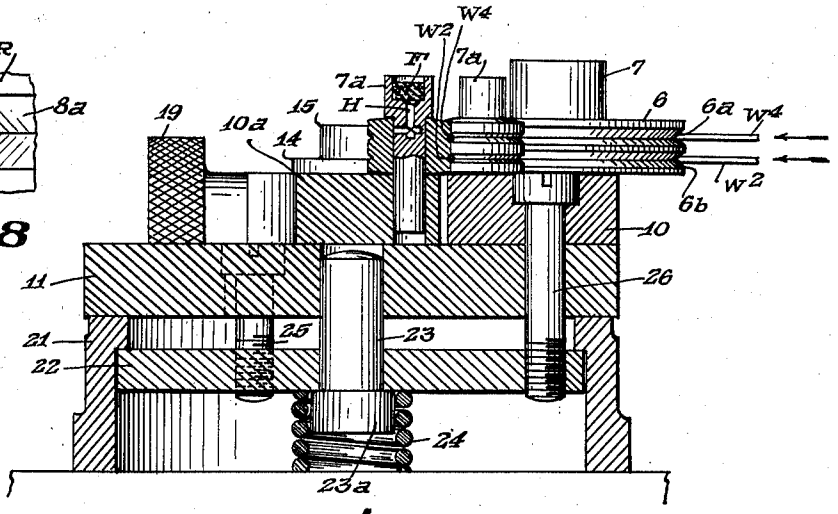


Fig: 3

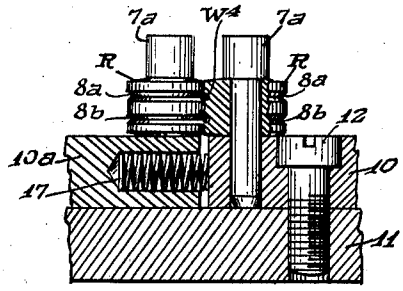


Fig: 5

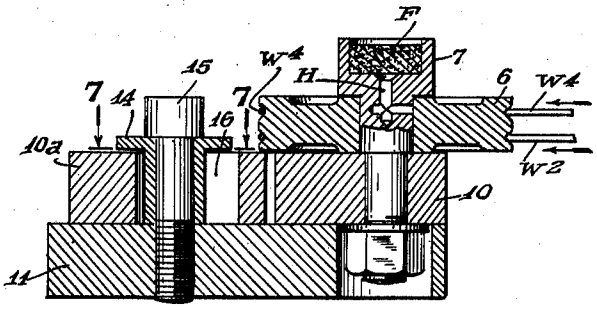


Fig: 4

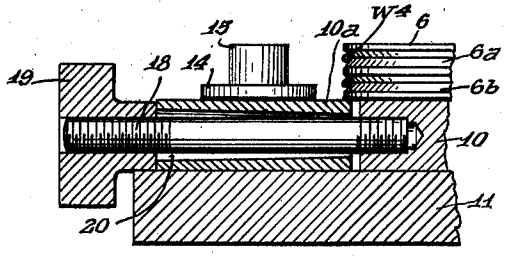


Fig: 6

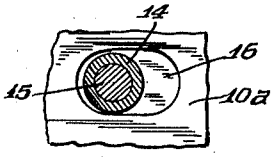


Fig: 7

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MECHANISM FOR STRAIGHTENING WIRE

Filed May 16, 1936 3 Sheets-Sheet 2

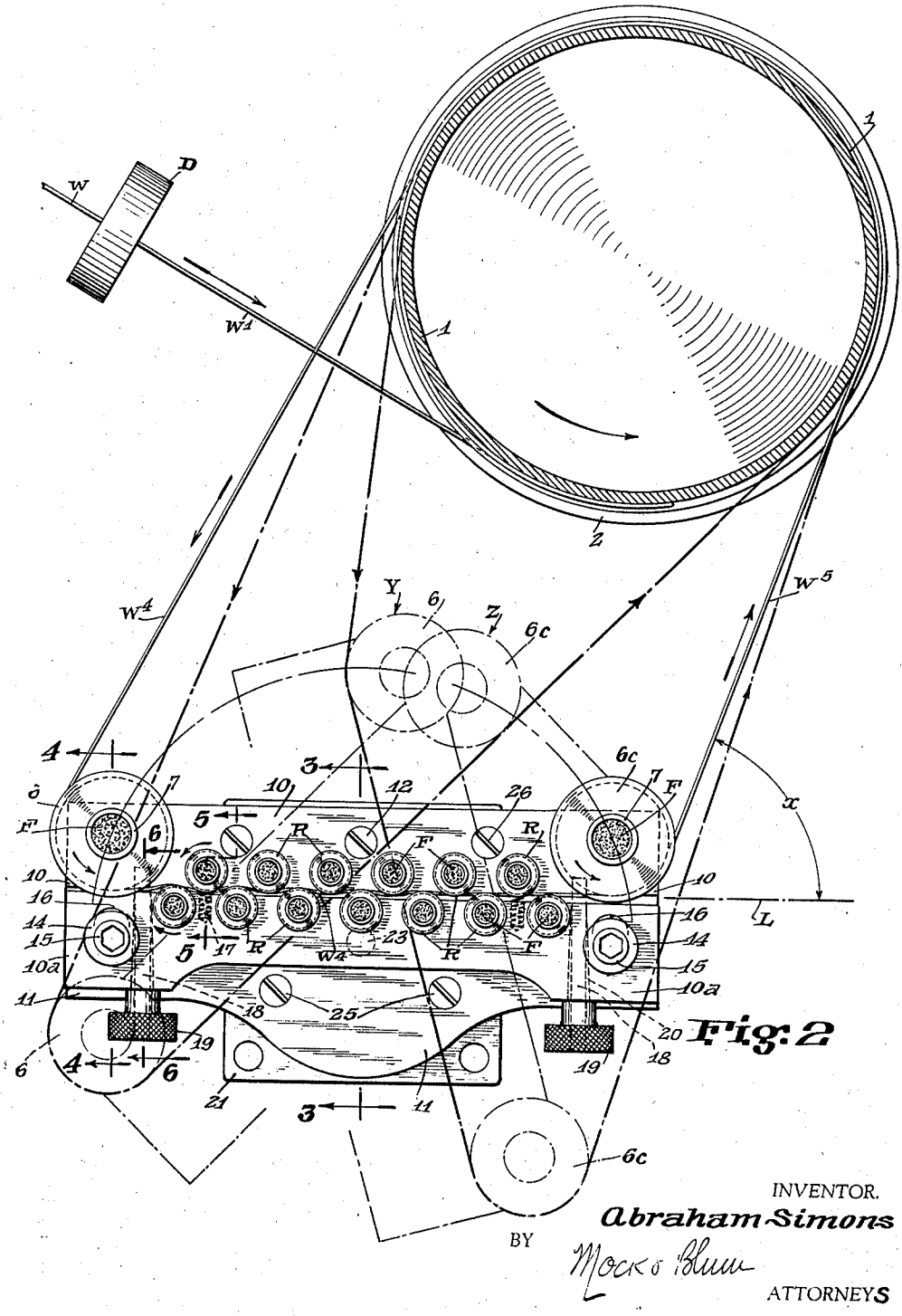


Fig. 2

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UNITED STATES PATENT OFFICE

2,136,714

MECHANISM FOR STRAIGHTENING WIRE

Abraham Simons, New York, N. Y., assignor to Washburn Wire Company, Inc., New York, N. Y., a corporation of New York

Application May 16, 1936, Serial No. 80,026

7 Claims. (Cl. 140—136)

My invention relates to a new and improved mechanism for straightening wire, so as to remove the kinks or ripples therein. The finished wire may be straight or it may have a normal curvature, which is free from said kinks.

One of the objects of my invention is to provide an improved attachment to a wire-drawing machine, whereby the wire will be effectively straightened after the wire has passed through the last wire-drawing die or other finishing device of the wire-drawing machine.

Another object of my invention is to provide improved mechanism whereby the finished or drawn wire will be straightened so as to substantially eliminate all the kinks and ripples in the wire, and to regulate the curvature of the finished wire, before the wire is wound up upon the take-up drum.

Another object of my invention is to provide an attachment having mechanism for straightening the wire, which attachment can be regulated or adjusted, so as to impart different normal curvatures to the wire, after the straightening operation has been completed. The straightened wire may be wound under tension upon a take-up drum in the form of a coil. The diameter of said take-up drum need not be changed but since the natural curvature of the wound-up wire may be greater than the curvature of the drum, said wire will assume its natural curvature if a coil of the wire is cut off the mass of wire which has been wound under tension on the drum.

Another object of my invention is to provide an attachment for this purpose, said attachment being mounted on a swivel or other turnable mount, so that the angle of the attachment to the axis of the take-up drum can be varied.

Another object of my invention is to provide a machine having straightening rollers of special construction, whereby the wire is prevented from turning about its own axis, during the straightening of the wire.

Another object of my invention is to provide a machine for this purpose in which the wire is clamped along spaced and relatively narrow zones, during the straightening of the wire.

Another object of my invention is to straighten the wire by feeding it under tension, while forming successive reverse bights in the wire, and allowing the wire to bend freely at the inner surfaces of said bights.

Other objects of my invention will be set forth in the following description and drawings which illustrate a preferred embodiment thereof, it being understood that the above statements of the objects of my invention are intended generally to explain the same without limiting it in any manner.

Fig. 1 is a perspective view illustrating the finishing die, the mechanism for straightening the wire, and the winding or take-up drum, as well as other parts of a device which can be used for carrying out the invention.

Fig. 2 is a top plan view, partially in section, of Fig. 1. This figure also shows in dot-and-dash lines how the attachment can be adjusted relative to the axis of the take-up drum, in order to vary the natural curvature of the wound-up wire.

Fig. 3 is a sectional view on the line 3—3 of Fig. 2.

Fig. 4 is a sectional view on the line 4—4 of Fig. 2.

Fig. 5 is a sectional view on the line 5—5 of Fig. 2.

Fig. 6 is a sectional view on the line 6—6 of Fig. 2.

Fig. 7 is a sectional view on the line 7—7 of Fig. 4.

Fig. 8 is a detail sectional view showing the grooved or recessed configuration of the straightening roller.

Referring to Fig. 1, the wire W is led through any suitable wire-drawing machine, and through the last drawing die D. This last die may be a finishing die of any suitable design. Said die frictionally resists the feeding of the wire, so that the wire is under tension while it is pulled or fed through the straightening attachment.

The invention is not limited to any particular method of reducing the wire.

In addition to operating on freshly drawn wire, the device can also operate upon a coil of wire which may have bad kinks or ripples therein. Such a coil of wire can be led through the machine, by substituting a suitable friction device for the member D, and pulling the wire through said friction device, so that the wire is under tension while it is being fed and straightened.

Fig. 1 shows a drum 1, which is turned about its own axis. This drum 1 may be the magazine or take-up drum which is used in the usual wire-drawing machine.

For convenience, the various runs of the wire after the member D are designated by different reference letters. The run W' is passed around the base of the drum 1 in one or more turns, said turns being in a single layer.

The drum 1 is provided with an enlarged base 2, and said drum is also provided with a divisional

rib 3, so that said drum has a recess below said rib 3.

Above the rib 3, the periphery of the drum has a slightly tapered portion 4, which is of greater diameter than the main periphery of the drum, which is above the line 5. The drum may be tapered above the line 5. The periphery of the wall of the recess which is below the divisional rib 3, is of slightly greater diameter than the diameter of the portion 4. This difference in diameter may be from ten thousandths of an inch to thirty thousandths of an inch.

The wire does not have a firm frictional grip upon the periphery of the drum, below the divisional rib 3, so that the turns of the wire can slip under suitable tension, relative to the periphery of the drum. This slipping may be a circumferential slip and also a slip in the direction of the axis of the drum. This part of the drum is of well known and standard construction.

After having been led around the drum 1 in one or more turns, the wire leaves the drum in the form of a run W^2. The wire then passes around the lower recessed portion or lower groove of a roller 6, which is mounted upon a stud shaft having a head 7. This stud shaft is held stationary, and the roller 6 turns around the same. As shown in Fig. 4, a felt pad F is located in head 7, and said pad may be saturated with lubricant, and said stud shaft may be provided with the usual lubricating bore or bores H.

Fig. 3 shows the roller 6 having an upper groove 6*a* and a lower groove 6*b*.

As shown in Fig. 1 and in Fig. 2, the run W^2 is now led partially around the lower grooved portions or lower recesses of a plurality of straightening rollers R. Said rollers R are of identical construction. The wire is thus bent, while it is being fed under tension, so as to produce succesive bights of opposite curvatures. Said rollers R are mounted on stud-shafts having heads 7*a*. The rollers turn around said stud shafts. Said heads 7*a* also having lubricating felt pads F, and said stud-shafts are also provided with a lubricating bore or bores.

As shown in Fig. 5, each said roller has a lower groove 8*b*, and an upper groove 8*a*. As shown in Fig. 5, the rollers R are arranged with their corresponding grooves at the same respective levels, so that the wire run W^2 is led in contact with the walls of the lower series of grooves, during the first run of the wire through the attachment.

As shown in Fig. 2, the rollers R are arranged in two longitudinal rows, and in staggered relation. The rollers of the respective rows are mounted upon separate base plates 10 and 10*a*, and said base plates are laterally or angularly adjustable relative to each other. One of said base plates, such as the base plate 10, can be connected to a suitable support or plate 11, by means of a series of screws or other connecting members 12. The other base plate 10*a* rests slidably upon the plate 11.

As shown in Fig. 2 and Fig. 7, the plate 10*a* is provided at its ends with lateral slots 16.

Screws 15 pass through bushings 14, and said screws 15 are connected to the plate 11, as shown in Fig. 4. The bushings 14 are thus clamped to the plate 11. There is a slight clearance between the bushings 14 and the walls of the slots 16, and there is also a clearance between the underside of the head of each bushing 14 and the adjacent top surface of the plate 10*a*.

Hence the bushings 14 serve as guides for the lateral or angular movement of the plate 10*a* towards and away from the plate 10.

Compression springs 17 normally space the plate 10*a* from the plate 10. The spacing or angle between said plates 10 and 10*a* is regulated by means of screws 18, and nuts 19. The screws 18 extend through bores in the plate 10*a*, and the inner threaded ends of said screws 18 are connected to the plate 10.

As shown in Fig. 6, said bores 20 are tapered, so that the plate 10*a* can be adjusted at an angle relative to the plate 10. The nuts 19 can be turned on the outer threaded ends of the screws 18, and said nuts 19 abut the plate 10*a* so that the turning movement of said nuts 19 can move the plate 10*a* towards the plate 10, against the force of the springs 17.

By suitably spacing and regulating the angle between the plates 10 and 10*a*, the wire run W^2 can be led between the two series of rollers so that the wire is bent in a series of bights or waves, as the run W^2 passes partially around the respective circular peripheries of the walls of the grooves 8*b*.

As shown in Fig. 2, when the machine is adjusted for a run, the plates 10 and 10*a* are preferably inclined to each other.

Since the rollers are of identical construction throughout, their grooves have walls of the same curvature. However, the curvature or bend of the wire between the rollers can be regulated by adjusting the axes of the rollers towards or away from each other. Likewise, by having the axes of the two rows of rollers R located along lines which are inclined to each other, the lengths of the successive bights can be regulated.

Hence in the construction shown in Fig. 2, the curvatures of the bights of the wire between the rollers, and the lengths of the successive bights, are successively diminished from the entering or left-hand end of the attachment to the exit or right-hand end of the attachment.

While this can be varied, it will be noted that the wire is almost straight as it passes between the last two rollers, at the exit end of the machine.

The wire is now led partially around the lower groove of a roller 6*c*, which is identical with the roller 6. The wire now passes in the form of a run W^3, back to the recess of the drum 1.

Assuming for illustration, that the run W' has passed around the drum in the form of a single turn, the run W^3 can be passed around said drum in the groove previously mentioned, and above the run W'. If the run W' is passed around the wall of said groove in two or more turns, the turn or turns of the run W^3 can be above the turn or turns of the run W'. The run W^3 can also slip relative to the drum.

The wire is now led away from the drum in the form of a run W^4, and said run W^4 passes partially around the wall of the upper groove 6*a*, of the roller 6.

The run W^4 is now led between the two series of rollers R, passing partially around the walls of the upper grooves 8*a* of said rollers.

The second straightening operation is therefore a duplicate of the first straightening operation.

I can utilize two or more series of straightening operations, and by forming the rollers with superposed grooves, the length of the attachment can be diminished.

In making certain types of wires, the passage of the run W^3 around the drum 1, can be elimi-

nated, and the run W^3 can be passed immediately from the member 6c to the upper groove 6a of the member 6. This is preferably done with fine wire having great tensile strength, such as the so-called "music" wire, which is used for making springs, and which requires a very high tensile strength, as for example about four hundred thousand pounds per square inch.

The straightened or finished run W^5 is now led back to the drum 1, above the divisional rib 3, and it then slips upwardly on the drum 1 and it forms a coil in the usual manner.

Referring to Fig. 3, the underside of the plate 11 is smooth, and it rests turnably upon a hollow base 21. A plate 22 is located in said base, and the upper surface of said plate 22 slidably contacts with the under surface of an interior shoulder which is formed in said base 21.

A pivot pin 23 has a drive fit in the plate 22 and said pivot pin 23 has an enlarged head 23a. A compression spring 24 forces the plate 22 against the internal shoulder of the base 21.

The plate 11 is connected to the inner turnable plate 22, by means of bolts 25 and 26. The bolts 25 extend only through the plate 11 and the plate 22. The bolt 26 also extends through the plate 10.

There are two of the bolts 25, and one bolt 26.

The entire attachment can therefore be turned about the axis of the pivot pin 23, through any desired angle, even 360°. After the attachment has been adjusted around the axis of the pivot pin 23, the bolts 25 and 26 can be tightened so as to clamp the member 11 against the base 21 and hold the attachment in its adjusted position. One position of said attachment relative to the winding drum 1 is shown in full lines in Fig. 2, and two different positions are shown in said figure in dot-and-dash lines.

As shown in Fig. 2, the finished wire can be supplied to the drum, at a series of different angles to the median or reference line L of the attachment. Fig. 2 shows the finished wire making an angle X with said reference line L, when the attachment is in the full line position. This angle is greater than the angle between the wire and said reference line, when the attachment is in the position indicated by the reference letter Y. When the attachment is in the position indicated by the reference letter Z, there is practically zero angle between the finished wire, as it leaves the attachment, and said reference line L of the attachment. The normal curvature which is imparted to the wire as it is wound upon the drum, should never be less than the curvature of the periphery of the drum 1. However, by controlling the angle between the finished wire and the median line of the attachment, as the wire leaves the attachment, the normal curvature of the springy wire can be controlled. For example, when the attachment is in the position Z, the springy wire is wound so as to give it its greatest normal curvature. If the wire is wound upon the drum 1, when the attachment is in the position Z, and a portion of the bundle of wire is cut off, said cut off wire will immediately expand so as to have a much smaller curvature than the periphery of the drum.

For example, the drum 1 may have a transverse diameter of eight inches. By moving the attachment to the position Z, I can produce a coil of wire which will assume a normal diameter of from 32 inches to 40 inches after the tension on said wire is removed, depending upon the diameter of the wire.

A thicker wire will assume a greater curvature or a smaller transverse diameter, after said wire has been removed from the drum, and after the winding-up tension on said wire is released.

Another important feature of my invention is illustrated in Fig. 8. This shows the groove of the roller R shaped so as to have contact along two spaced lines with the wire. The angle of the groove 8a is 90° and this angle is preferred although I do not wish to be limited thereto.

In constructions of this type which have been heretofore used, each roller was provided only with a single groove, and said groove contacted with the wire, only along a single line of the wire. Said line was the innermost line of the bight or curve which was formed in the wire. Said grooves had a general curved section taken on a plane which passed through the axis of the roller, instead of having the angular cross section which is shown in Fig. 8.

Since the wire is led through the attachment under considerable tension, according to my invention the wire is effectively held by friction along spaced lines thereof by the respective rollers, and on opposite sides of the central axis of the wire.

For example Fig. 8 shows how one of the rollers grips the wire along two spaced lines, and the corresponding rollers of the opposite series grip the wire along two additional spaced lines so that as the wire is being straightened, it is gripped along four spaced lines thereof, which may be separated by transverse arcs of 90°.

The wire is thus prevented from turning or twisting about its own axis while it is being straightened.

Likewise in grooved rollers of the type previously used, if wire of a definite size was being straightened, this tended to wear the wall of the groove so that when wire of a larger size was led through the machine, the rollers would not work properly. By using the angular form of groove shown in Fig. 8, the different sizes of wire touch different portions of the wall of the groove so that the wear on the wall of each groove is uniform throughout.

In order to straighten the kinks out of wire, it is necessary to bend the wire first in one direction, and then in the opposite direction, while the wire is being maintained under suitable tension. It is highly important to prevent the wire from twisting around its own axis, and the machine and method specified herein are the first that have been effective for this purpose.

I have discovered that in order to straighten the wire effectively, it is desirable to exceed the tensile limit of the wire and also to exceed the compression limit of the wire, while it is being passed through the attachment. While this is not absolutely necessary, it constitutes an important feature of the invention.

By suitably regulating the resistance to the feed of the wire by means of the die D, or other suitable means, including auxiliary means if necessary, the tension on the wire as it passes between the freely turning rollers R, can be regulated.

Likewise I can effectively regulate the tension on the wire by passing it two or more times through the attachment.

Likewise by regulating the distance between the plates 10 and 10a, I can regulate the curvatures of the bights in the wire between the rollers, and the lengths of the bights, thus further increasing

the resistance to the passage of the wire through the attachment, and thus increasing the tension to which the wire is subjected.

When a bight or wave is formed in wire which is under tension, the formation of the bight tends to increase the tension on the outer side of the bight and to decrease the tension on the inner side of the bight.

As shown in Fig. 8, when a bight is formed in the wire by leading it around the improved roller, the wire is supported in the groove of said roller along two spaced lines thereof, and the wire is unsupported and free along the innermost line of said bight. Hence the wire is free at the point of maximum compression of the wire. The tension may be regulated so that the wire is under no compression, or even under tension or compressed to any desired degree at the inner or concave wall of the bight.

It is therefore possible to subject the wire to a tension which is slightly above the elastic limit of the wire during the straightening operation, so that the wire is elongated slightly during the straightening operation.

By permitting the inner side of the bights of the wire to remain free as the wire is bent alternately in one direction and in the opposite direction, a much superior straightening effect can be secured.

The turning of the drum provides the necessary pull on the wire. The tapered portion 4 has enough turns of the wire thereon, so as to provide the necessary frictional grip on the wire, in order to pull it through the attachment. The wire is accumulated above said tapered portion 4, in the form of a coil having a plurality of layers. Since the wall of the groove, below rib 3, is of greater diameter than said winding portion 4, there is some circumferential slip between the drum, and the runs W^1 and W^3. This slip between the drum and the run or runs which pass through the straightening means, may be very small, and said slip may be eliminated by suitably designing the apparatus.

I have shown a preferred embodiment of my invention but it is clear that numerous changes and omissions can be made without departing from its spirit.

I claim:

1. Mechanism for straightening wire, said mechanism including two longitudinal series of rollers, said rollers being arranged in staggered relation, each of said rollers having a plurality of spaced grooves, said grooves being arranged in a plurality of corresponding series each of which is adapted and operative to straighten a run of the wire, mechanism adapted to feed and guide a continuous length of wire under tension in a plurality of consecutive runs, each said run passing partially around the peripheries of one of said series of grooves.

2. Mechanism for straightening wire comprising a pair of guide rollers, each of which has a plurality of superposed grooves, straightening rollers intermediate said guide rollers, each of said straightening rollers having a plurality of spaced grooves so as to form a plurality of series of straightening grooves, means adapted to feed and guide the wire under tension in a plurality of runs, each said run passing partially around the peripheries of one of said series of grooves and partially around a pair of the grooves of said guide rollers.

3. Mechanism for straightening and winding up wire, said mechanism comprising a take-up drum and a straightening device having an axis and a bending device for bending the wire, said bending device being located intermediate the straightening device and said drum, said straightening device being adjustable so as to regulate the angle between the run of the wire which passes through the straightening device, and the run of the wire between said bending device and the periphery of the take-up drum.

4. Mechanism for straightening wire comprising a base, a first supporting plate which is turnable on said base, two longitudinal rows of straightening rollers, said straightening rollers having shafts which are connected to said first supporting plate, turnable guide means adapted to guide wire between said rows of straightening rollers and in partial contact with the peripheries of said straightening rollers, said turnable guide means having shafts which are also mounted on said first supporting plate, and a take-up drum having a shaft and which is spaced from said first-supporting plate, so that said straightening mechanism can be turned as a unit relative to said take-up drum.

5. Mechanism for straightening wire, said mechanism comprising a take-up drum, a straightening device spaced from said drum, said straightening device comprising a plurality of rows of rollers, said rollers being arranged in consecutive staggered relation, said rows of rollers being connected to supporting means, said supporting means being mounted to be adjustable to vary the angle between the run of the wire which is located between said rows of rollers and the run of the wire which is intermediate said rollers and said drum.

6. Mechanism for straightening wire, said mechanism comprising a take-up drum, a straightening device spaced from said drum, said straightening device comprising a plurality of rows of rollers, said rollers being arranged in consecutive staggered relation, said rows of rollers being connected to supporting means, said supporting means being mounted to be adjustable to vary the angle between the run of the wire which is located between said rows of rollers and the run of the wire which is intermediate said rollers and said drum, said rows of rollers being also mounted to be adjustable relative to each other.

7. Mechanism for straightening wire, said mechanism comprising a take-up drum, a straightening device spaced from said drum, said straightening device comprising a plurality of rows of rollers, said rollers being arranged in consecutive staggered relation, supporting means, holding means adapted to hold said rollers fixed relative to said supporting means, said supporting means and said rows of rollers being adjustable in unison so as to change the angle between said rows of rollers and the periphery of the drum while said rows of rollers remain in fixed position relative to each other.

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