Feb. 15, 1966 P. MARTIN 3,235,241

APPARATUS FOR TREATING WIRE

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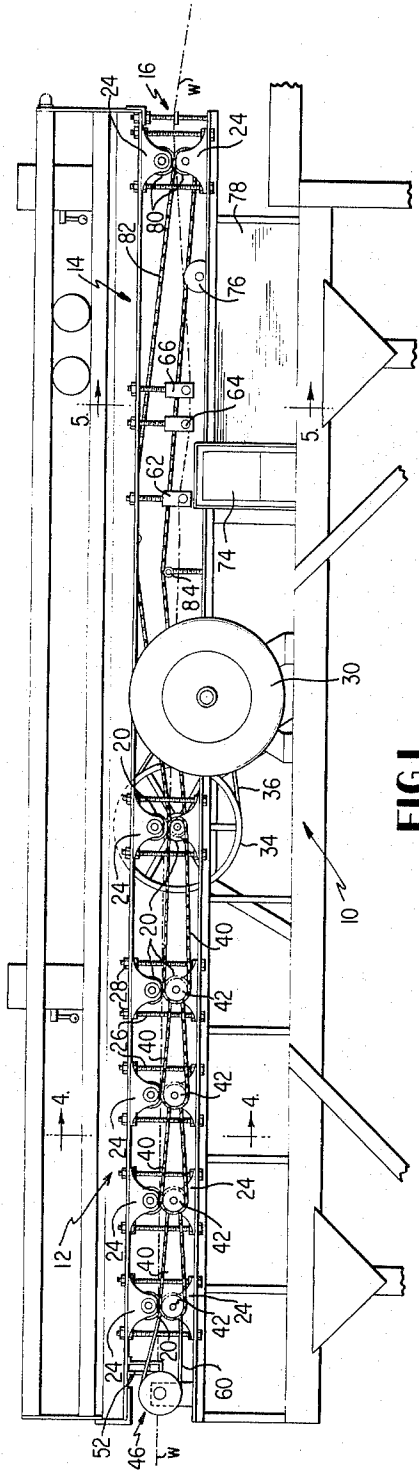


FIG. 1

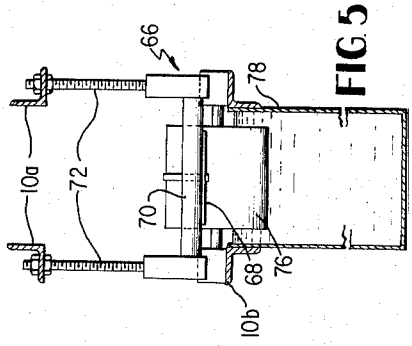


FIG. 5

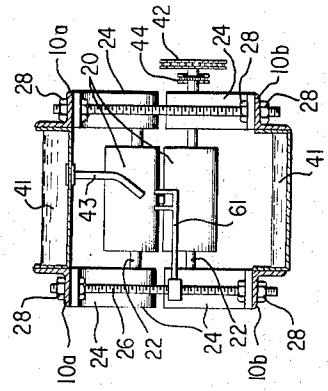


FIG. 4

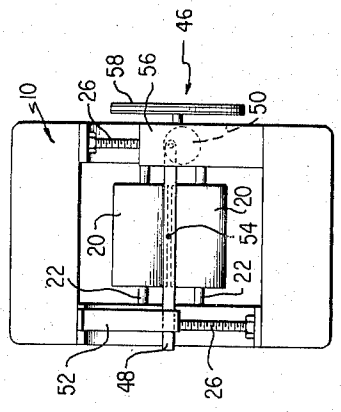


FIG. 3

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APPARATUS FOR TREATING WIRE

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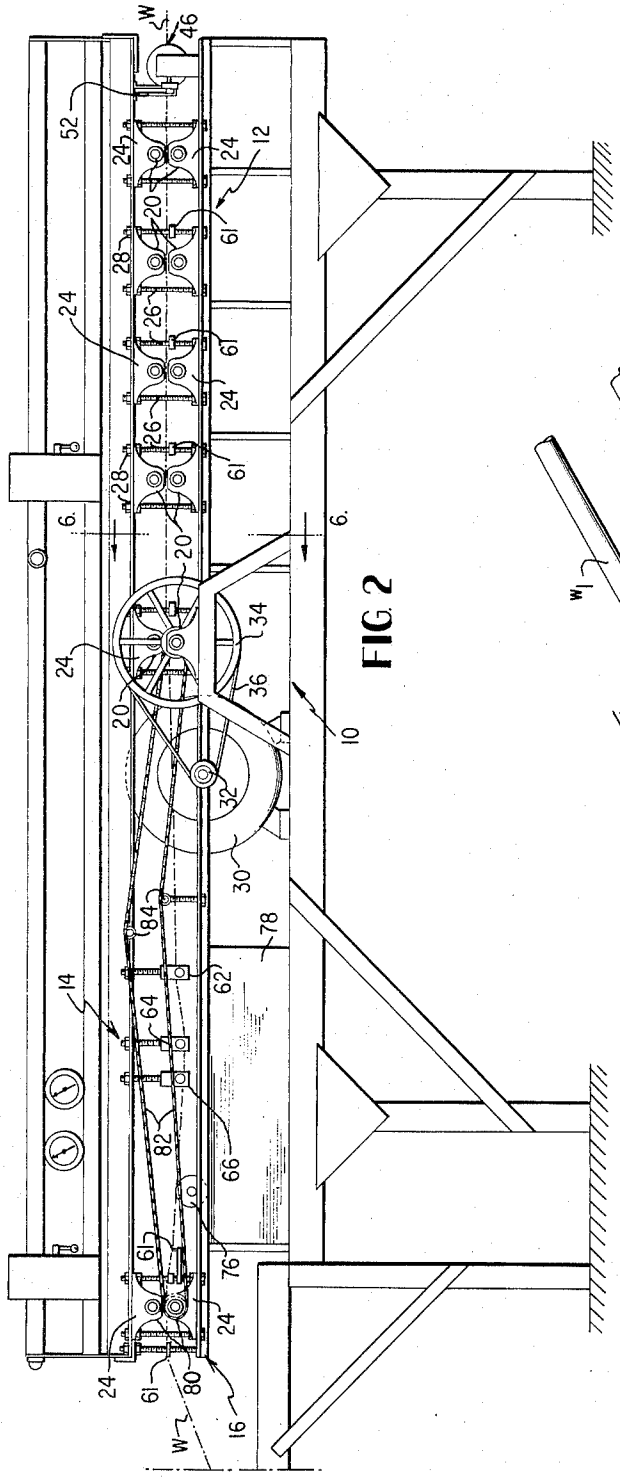


FIG. 2

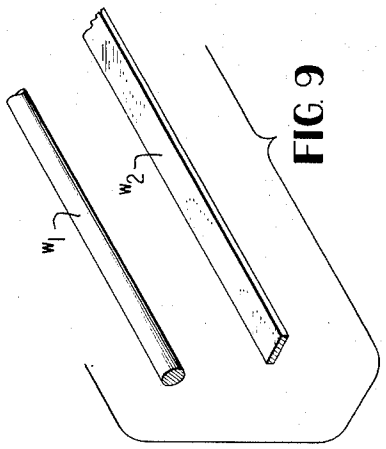


FIG. 9

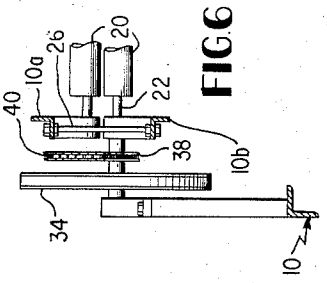


FIG. 6

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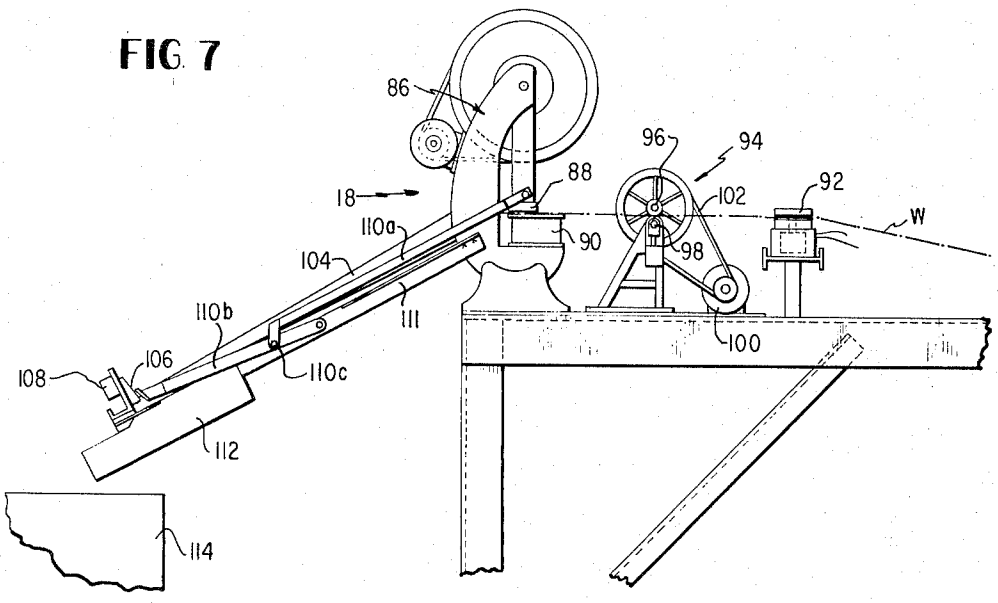
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FIG. 7



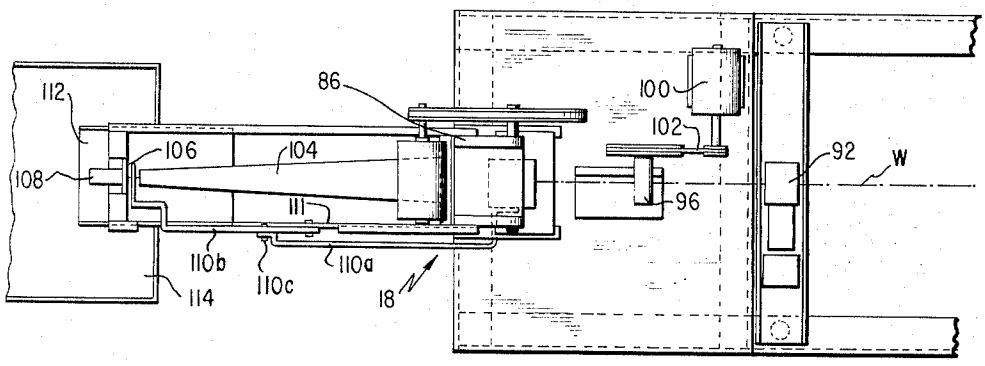


FIG. 8

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3,235,241

APPARATUS FOR TREATING WIRE

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Filed July 6, 1961, Ser. No. 122,296
1 Claim. (Cl. 266—2.5)

This invention relates to apparatus for treating wire, and more particularly to apparatus for forming wire bristles which may be used in street cleaning brushes and the like.

Street cleaning brushes which employ wire bristles are well known. For example, it is common to employ a vehicle-mounted rotary brush which comprises a circular backing plate from which many stiff wire bristles depend. In the use of the brush, the bristles are subjected to considerable working stress, and the resultant bristle wear is a well recognized probem. After a period of brush use it is necessary to replace the bristles or to replace the brush as a whole. Various attempts have been made to prolong bristle life, but in general, the added expense involved in the production of bristles in accordance with such prior proposals has not significantly alleviated the problem from an economic standpoint.

The present invention is directed to the production of improved wire bristles more efficiently and economically than has heretofore been possible. While it is a principal object of the invention to provide a machine for the production of such bristles, the invention has broader applicability.

Another object of the invention is to provide improved apparatus for continuously producing flattened, hardened, coated wire bristles and the like.

A further object of the invention is to provide improved wire flattening apparatus.

Another object of the invention is to provide improved heat treating apparatus for wire.

Still another object of the invention is to provide improved apparatus for manipulating wire before, during, and after cutting.

A still further object of the invention is to provide apparatus of the foregoing type which permits continuous feeding of wire for flattening and heat treating, with intermittent cutting of the wire into predetermined lengths and removal of the cut wire.

Briefly stated, and without limitation, the wire treating machine of the present invention includes a plurality of pairs of wire flattening rollers having a common drive means, a plurality of electrodes for heating the wire, a coating roller for applying oil to the heated wire, straightening rollers, and wire cutting and associated elements for severing the wire into predetermined lengths as the succeeding wire is continuously advanced through the flattening, heating, coating, and straighening means of the invention.

The foregoing and other objects, advantages, and features of the invention, and the manner in which the same are accomplished will become more readily apparent upon consideration of the following detailed description of the invention taken in conjunction with the accompanying drawings, which illustrate preferred and exemplary embodiments and wherein:

FIGURE 1 is a side elevation view of flattening, heat treating, and straighening apparatus in acordance with the invention;

FIGURE 2 is a reverse side elevation view of the apparatus of FIGURE 1;

FIGURE 3 is an end view of the left extremity in FIGURE 1;

FIGURE 4 is a sectional view taken along line 4—4 of FIGURE 1;

FIGURE 5 is a sectional view taken along line 5—5 of FIGURE 1;

FIGURE 6 is a sectional view taken along line 6—6 of FIGURE 2;

FIGURE 7 is a side elevation view of another portion of the apparatus of the invention;

FIGURE 8 is a plan view of the apparatus of FIGURE 7; and

FIGURE 9 is a fragmentary perspective view illustrating wire before and after treatment in accordance with the invention.

Referring to the drawings, and initially to FIG. 1, reference numeral 10 designates a machine frame which supports the apparatus of the invention. This apparatus may be divided generally into rolling and flattening apparatus 12, heat treating apparatus 14, straightening apparatus 16, and cutting apparatus 18 (FIGS. 7 and 8). The path of the wire through the machine of the invention is designated by the dash-dot line *w*. The raw wire is preferably round high carbon steel wire which may have an initial diameter of from about .0475 inch to about .0915 inch, for example. Such wire is desgnated in FIGURE 9 as *w1*, the finished bristle *w2* being from about .020 to about .040 inch thick and from about .080 to about .140 inch wide, and being produced in a manner to be described.

Referring now to FIGURES 1 and 2, the wire rolling and flattening apparatus comprises pairs of horizontal rollers 20, there being an upper roller and a lower roller in each pair, between which the wire passes. In the form shown there are five pairs of rollers spaced along the length of the frame 10. As shown in FIG. 4, each roller may have a supporting shaft 22 mounted on pillow blocks 24 or the like. The pillow blocks are attached to the frame 10 by means of bolts 26 which extend between pairs of frame members 10*a* and 10*b* as shown. The bolts have nuts 28 threaded thereon, and the nuts may be adjusted to permit a small range of variation in the spacing between the rollers of each pair.

The drive power for the rollers is obtained from an electric motor 30 mounted on the frame as shown in FIGURES 1 and 2. The motor has a drive pulley 32 which turns a larger driven pulley 34 by means of a belt 36. A suitable chain drive could be employed instead of the belt drive. Pulley 34 is rotatably mounted on the frame 10 and turns the shaft 22 of an adjacent lower roller 20 as shown in FIGURE 6. Pulley 34 also drives a small sprocket wheel 38, which in turn drives a chain 40. As shown in FIGURE 1, chain 40 drives a larger sprocket wheel 42 fixed to the shaft of the next lower roller, which also carries a smaller sprocket wheel 44 as indicated in FIGURE 4. Sprocket wheel 44 drives another chain 40, which drives another small sprocket wheel 42 fixed to the shaft of the next lower roller. Each lower roller thus has a sprocket wheel driven from a chain which is driven by a smaller sprocket wheel on the next lower roller, except the first-mentioned lower roller which is driven from the main sprocket wheel 34. The upper rollers are driven by contact with the wire, which engages the upper and lower rollers and is advanced thereby as it is flattened. By virtue of the common drive train for the flattening rollers and by virtue of the gradation in sprocket size, the rollers in sequence from left to right in FIGURE 1 are driven at progressively higher speeds. The rollers of each pair are set progressively closer together in the sequence from left to right in FIGURE 1, so that the round wire which enters the machine at the left in FIGURE 1 (from a suitable wire supply, such as a large supply roll) becomes progressively flattened in passing through the pairs of rollers in sequence. The progressive increase of roller speed accommodates the elongation of the wire due to flattening and maintains the desired tension in the wire. The

size of the various sprockets in the roller drive train is chosen to obtain the desired speed of each of the rollers.

To equalize the wear along the length of the first pair of rollers, a traverse or shuttle mechanism **46** may be provided. As shown in FIGURE 3, this mechanism may comprise a shuttle bar **48** attached to an eccentric or cam **50** at one end and supported in a guide **52** at the other end. The bar has an opening **54** through which the wire passes, and the eccentric or cam may be driven from a transfer case **56** motivated by a pulley or sprocket wheel **58** driven (as shown in FIG. 1) by a belt or chain **60** from another pulley or sprocket wheel fixed to the shaft of the adjacent lower roller. The repetitive movement of the shuttle bar **48** along the length of the rollers causes concurrent adjustment of the wire position along the length of the rollers and tends to equalize roller wear.

Suitable wire guides **61** may be spaced along the path of the wire, being mounted on the bolts **26** as shown in FIGURE 4. The rollers **20** are kept cool by spraying them with a mixture of water and water-soluble oil shown at **41** in FIGURE 4. The mixture may be placed in a reservoir above the rollers and sprayed by means of nozzles **43**, being collected in a reservoir below the rollers for recirculation by means of a pump (not shown).

After the wire is rolled and flattened, it passes through the heat treating apparatus **14**. In the preferred form of the invention, this apparatus comprises a plurality of electrodes **62**, **64**, and **66**. As shown in FIGURE 5, each electrode may comprise a metal plate **68** mounted on an insulating support **70** suspended by bolts **72** from the frame of the machine. Three electrodes are utilized in the preferred embodiment, the wire passing over the first electrode plate (which is mounted over its insulating support) and under the second and third electrode plates as shown in FIGURE 1. The electrodes are energized from an electrical supply which may include a transformer **74**. The electrodes are preferably connected to the electrical supply so that two of the electrodes, say electrodes **62** and **66**, are of one polarity, and one of the electrodes, say electrode **64**, is of the opposite polarity. Because of the inherent resistance of the wire, the current, which passes through the wire between the electrodes of opposite polarity, heats the wire. The transformer **74** may be a welding transformer, for example, which may be energized from the standard 110-volt A.C. supply lines to produce a low voltage high current output. For example, the open circuit output voltage may be from 2 to 5 volts, and the output current through the wire may be from 10 to 400 amperes. The temperature to which the wire is heated is a function of the current and the speed at which the wire travels, a temperature range of from about 600° F. to about 1200° F. being suitable. After the wire is heated, it passes against a coating roller **76** which dips into oil in a reservoir **78** as shown in FIGURE 5.

The cold rolling of the wire by the rollers **20** greatly increases the hardness of the wire. The internal stresses created during rolling are relieved and the wire is tempered by the heating of the wire and the contact with the film of oil on the roller **76**, the oil serving to "quench" the wire. The resultant wire is very tough, has a somewhat harder casing and a softer core, and has a black surface coating which resists corrosion. Wire produced in this manner has given excellent service in street sweeping brushes and strongly resists the fatigue, stress, and work-hardening to which such brushes are subjected in use.

After the wire passes the coating roller **76**, it moves between a pair of strengthening rollers **80**, which are similar to and mounted like the rollers **20** previously described. As shown in FIGURE 2, the lower roller **80** has a sprocket wheel driven from a chain **82**, which is driven by another sprocket wheel on the shaft of the main pulley **34**. Chain **82** passes over tensioning and idler rollers **84**.

From the straightening rollers **80**, the wire passes to the cutting apparatus **18** of FIGURES 7 and 8. This apparatus preferably comprises a conventional punch **86** which may have the usual clutch operated by compressed air. Such a punch has a vertically reciprocating upper die member **88** and a cooperating stationary lower die member **90**. Before reaching the punch **86**, the wire passes through a wire grip **92**, which is arranged to grip the wire intermittently and halt its advance to the punch **86**. Such wire grips are well known and may comprise a solenoid operated vertically reciprocating plunger which clamps the wire against a stationary anvil. As indicated at the right side of FIGURE 7 and the left side of FIGURE 2, the wire sags between the straightening rollers **80** and the wire grip **92** when the wire grip is energized, because the wire is continuously fed through the apparatus of FIGURE 2.

Between the wire grip and the punch **86** is a wire feed mechanism **94** comprising a pair of rollers **96**, **98**, the upper roller, **96**, being driven from a small electric motor **100** by a belt drive **102**, and the lower roller, **98**, being spring biased against the upper roller. The feed mechanism **94** operates continuously and tends to advance the wire at a somewhat greater speed than it is fed from the straightening rollers, so as to take up any slack. The drive roller **96** slips with respect to the wire when the grip **92** is engaged.

From the punch **86** the wire passes through a guide chute **104**, and the leading edge of the wire ultimately engages an abutment **106** associated with a microswitch **108**. Guide chute **104** is an open-bottom channel, the wire engaging the top of the channel, by virtue of the stiffness of the wire, and being deflected downwardly to the abutment. The abutment **106** may be spring biased toward the leading edge of the wire and when depressed by the wire actuates the switch **108**, which closes an energization circuit for the clutch of the punch **86**, so as to cause the upper die member **88** to move down and cut the wire. The length of the wire is predetermined by the distance between the punch and the abutment **106**. As will be described hereinafter, actuation of switch **108** also closes an energization circuit for the solenoid of the wire grip **92**, causing the wire grip to grasp the wire and halt its advance to the punch **86**.

After the wire is cut, it tends to fall from the open bottom of the guide chute **104**. Removal of the cut wire may be assisted by a knock-off arm **110**, which has two parts **110***a* and **110***b* pivotally interconnected at **110***c*. Part **110***a* is pivotally connected to the upper die member **88**. Part **110***b* is pivotally connected to a stationary frame **111** at one end and has its other end free and shaped to overlie the end portion of the wire at the abutment **106**. The configuration of the knock-off arm is such that when the upper die **88** of the punch moves down to sever a piece of wire, the free end of the knock-off arm engages the severed wire immediately after cutting and deflects the cut wire downwardly, so that the wire falls into a chute **112**, an open trough, and slides down the latter chute to a collection box **114**. The timing is such that when the free end of the advancing wire engages the abutment **106**, the grip **92** is actuated first to halt the advancement of the wire, the feed mechanism **94** "free wheels," the punch **86** cuts the wire, and the knock-off arm **110** moves the cut wire off of the chute **104**. This opens the microswitch, releases the wire grip, and permits the feed mechanism to take up the slack in the wire and advance the wire to the abutment **106** again.

From the foregoing description of the invention it will be apparent to those skilled in the art that wire bristles and the like having highly desirable properties may be produced continuously and rapidly. While preferred embodiments of the invention have been shown and described, it will be apparent to those skilled in the art that changes can be made in these embodiments without departing from the principles and spirit of the invention, the scope of which is defined in the appended claim. Ac-

cordingly, the foregoing embodiments are to be considered illustrative, rather than restrictive of the invention, and those modifications which come within the meaning and range of equivalency of the claim are to be included therein.

The invention claimed is:

Apparatus for converting continuous wire stock of substantially round cross section into a plurality of lengths of wire of generally rectangular cross section having a relatively soft core and a relatively hard shell, said lengths of wire being suitable for use as the bristles of street cleaning brushes, said apparatus comprising in sequence, roller means for flattening and elongating said wire, said roller means comprising a plurality of longitudinally spaced roller means, said roller means each comprising a pair of rollers, the rollers of successive roller means being set progressively closer together, whereby said wire is progressively flattened as it passes through said pairs of rollers in sequence, drive means for driving one roller of each pair with successive driven rollers being driven faster than preceding rollers to maintain a desired tension in the wire as the wire elongates due to flattening, said drive means comprising a wheel fixed to each of said driven rollers and an endless elongated member arranged to drive each wheel from a wheel fixed to an adjacent preceding driven roller, heater means for heating said wire, liquid contact means for surface quenching said heated wire by bringing it in contact with a film of oil, means for continuously advancing said wire past said roller means, heater means and liquid contact means, and means for cutting the quenched wire into predetermined lengths, and traverse means for causing said wire to move back and forth along the length of the first pair of said rollers to equalize roller wear.

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