Oct. 8, 1968 J. O. WHITCOMB 3,404,711

COIL FORMING MECHANISM

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FIG. 1.

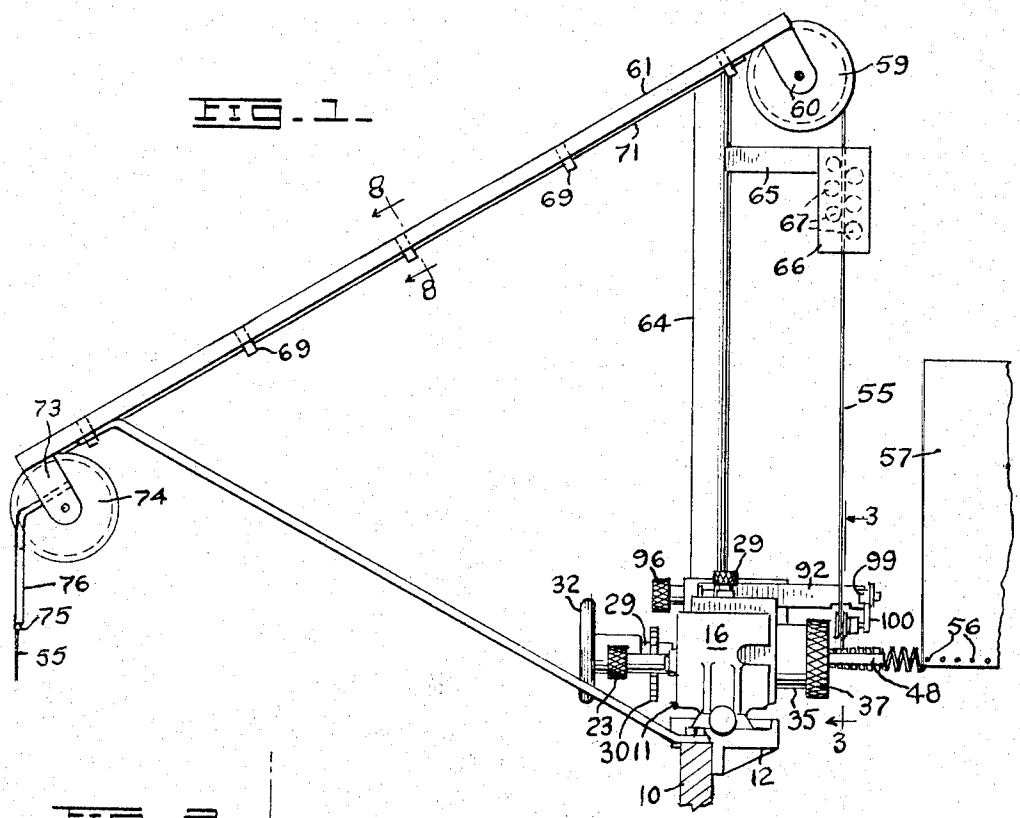


FIG. 2.

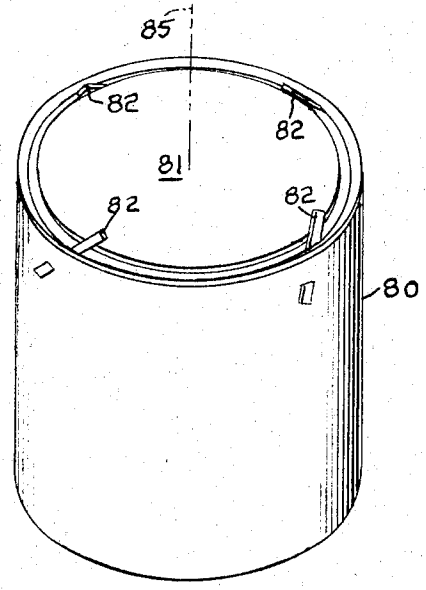
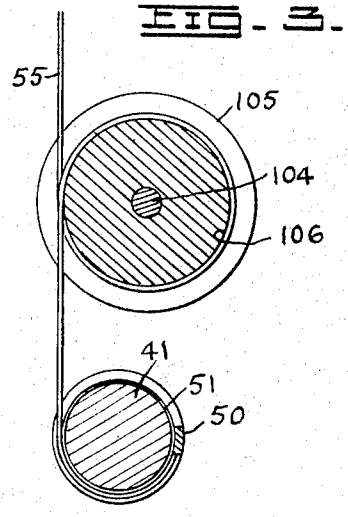


FIG. 3.



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FIG - 4 -

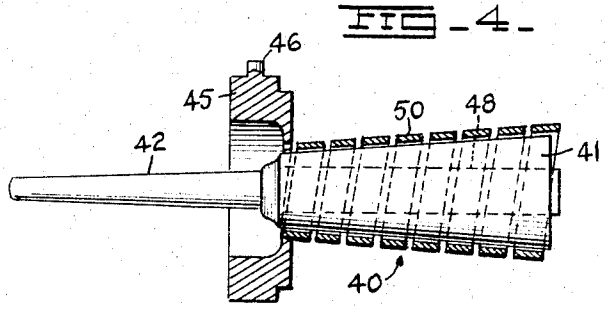


FIG - 5 -

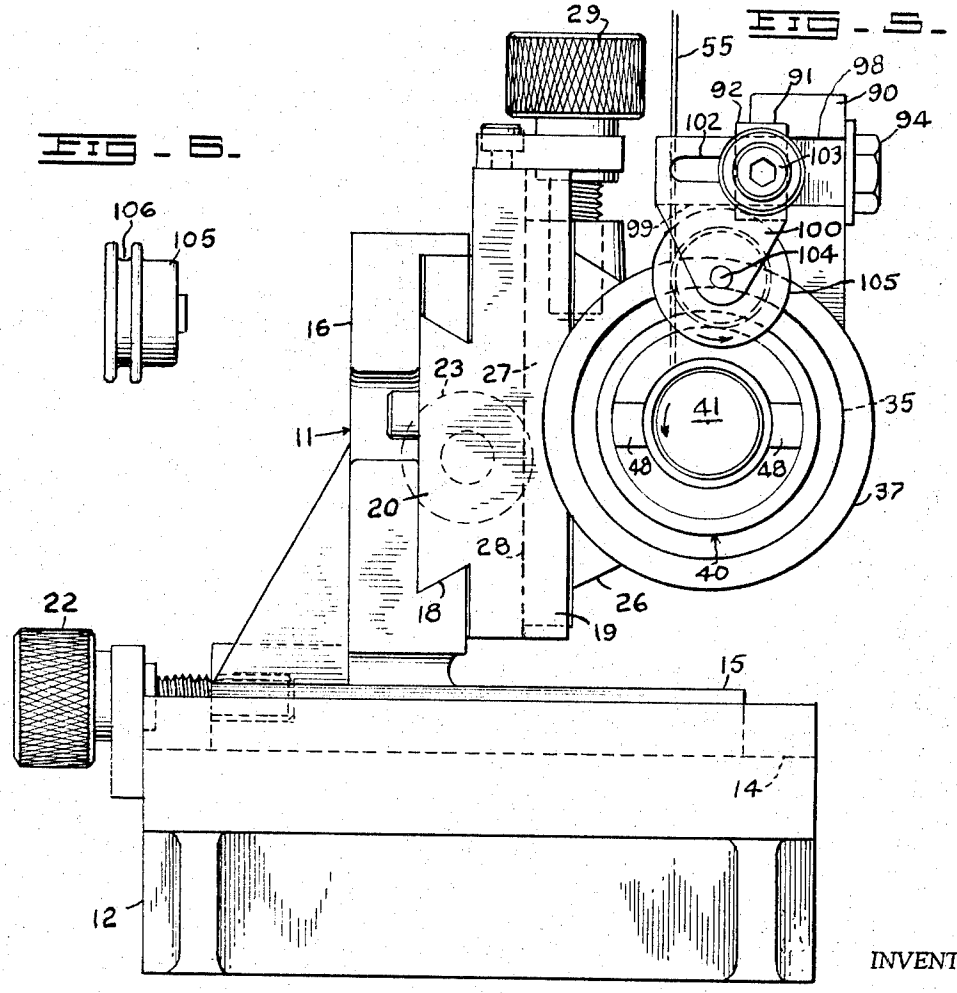


FIG - 6 -

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COIL FORMING MECHANISM

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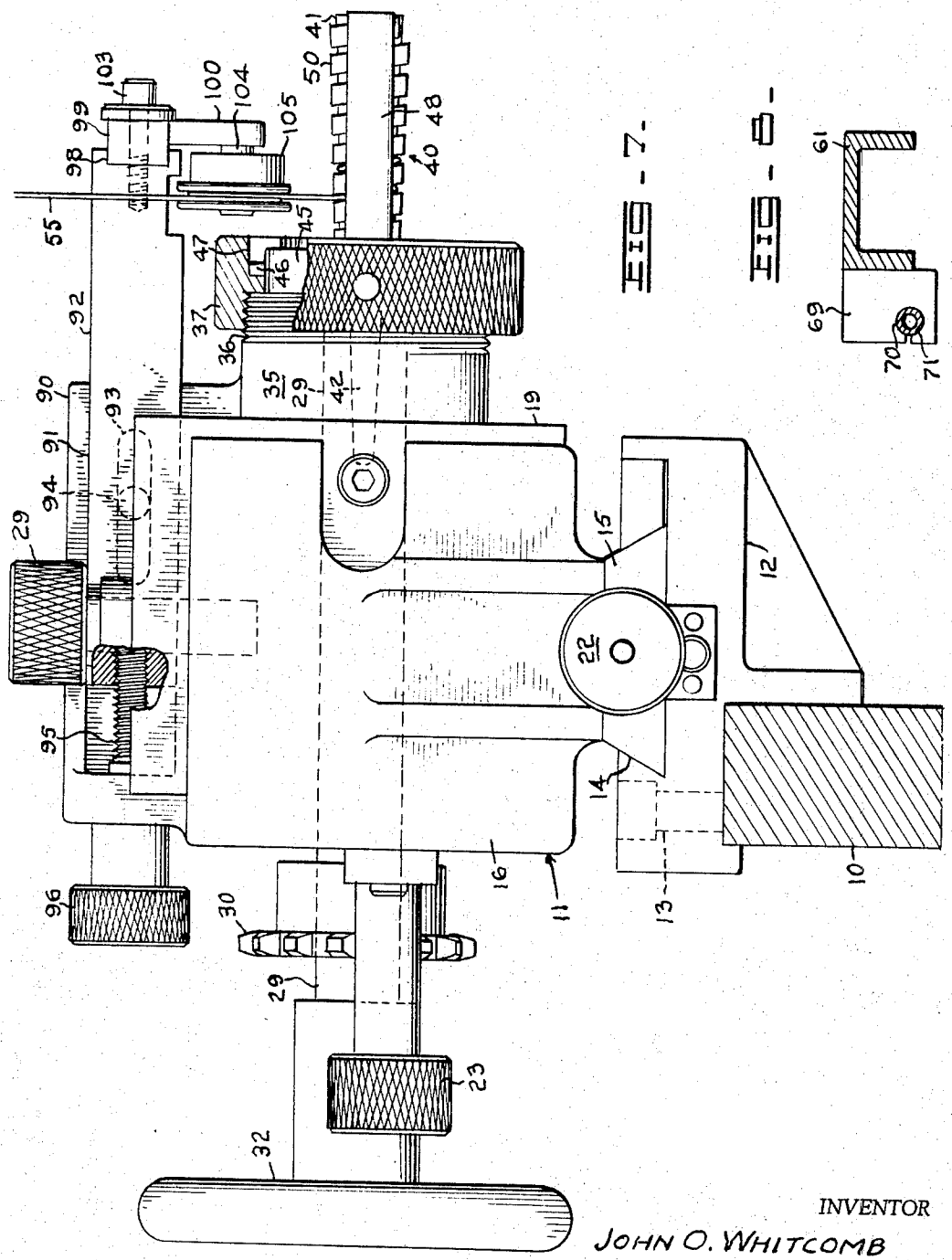


FIG - 7 -

FIG - 8 -

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COIL FORMING MECHANISM

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6 Claims. (Cl. 140—92.3)

ABSTRACT OF THE DISCLOSURE

A rotary mandrel forms wire coils for binding books such as stenographers' notebooks. Just ahead of the mandrel, a stress removing wheel is employed and around which the wire is wound in the same direction as on the mandrel to remove previously introduced stresses from the wire and then introduce into the wire stresses which correspond to the curvature imparted to the wire by the mandrel, thus providing wire coils of perfectly uniform pitch to prevent the coils from binding while being spun through the openings in the notebook.

This invention relates to a coil forming mechanism for book binding machines.

In the manufacture of certain types of books, for example, stenographers' notebooks, it is the common practice to wind wire coils, rotate them to spin the coils through the book openings provided for the reception of the coils. The wire from which the coils are made is pulled upwardly from a so-called "wire barrel."

In manufacturing the wire and coiling it around a vertical axis in the barrel, uneven stresses are placed in the wire. As a result, when the wire is pulled from the barrel and wound to form coils threaded through stenographers' notebooks, for example, the inherent stresses in the wire result in the formation of coils of non-uniform pitch. In threading the wire through the book openings, therefore, there is a serious tendency for the wire to bind in the openings.

An important object of the present invention is to provide a novel mechanism for removing or overcoming the "barrel stress" prior to the formation of the coil so that the resultant book binding coil is of uniform pitch, thus eliminating any binding of the turns of the coils in the book openings.

A further object is to provide ahead of the coil forming device a member having a curved surface around which the wire is flexed to remove the undesirable stresses from the wire to facilitate the formation of coils of uniform pitch.

A further object is to provide such a mechanism wherein the wire is caused to take a complete turn around an axis parallel to the axis of the coiling device, thus overcoming "barrel stress" with the result stated above.

A further object is to provide such a mechanism which not only overcomes the "barrel stress" but also bends the wire around a turn corresponding to the direction in which the wire will be wound to form the coil, thus facilitating the formation of the coil.

Other objects and advantages of the invention will become apparent during the course of the following description.

In the drawings I have shown one embodiment of the invention. In this showing:

FIGURE 1 is a face view of the mechanism showing a portion of the main supporting frame associated with the machine,

FIGURE 2 is a perspective view of a coil barrel from which a wire is being withdrawn as indicated in dotted lines thereon,

FIGURE 3 is an enlarged detailed sectional view on line 3—3 of FIGURE 1,

FIGURE 4 is an enlarged axial sectional view through the coiling device, the coil mandrel being shown in elevation,

FIGURE 5 is an enlarged end elevation of the coiling mechanism and associated parts, looking from the right in FIGURE 1,

FIGURE 6 is an edge elevation of the stress removing wheel,

FIGURE 7 is an enlarged face view of the bearing and associated structure in FIGURE 1, and

FIGURE 8 is an enlarged detailed section on line 8—8 of FIGURE 1.

The present mechanism is intended for use in the machine of the type shown in my prior Patent No. 3,133,562, granted May 19, 1964. In this mechanism, books are fed from the portion of the machine indicated by the numeral **112** in the prior patent and the preformed openings in the book are engaged with hooks **85** (FIG. 3 of the patent) carried by a turret **18** to be carried around the axis of the shaft **11** (FIG. 1 of the patent) for the performance of various operations, one of which is the threading of the book binding coil through the openings in the book. In FIGS. 1 and 7 of the present application, the numeral **10** designates a portion of the main frame of the book binding machine, corresponding to the frame members **10** in FIG. 2 of my prior patent. A bearing structure indicated as a whole by the numeral **11** is mounted on one of the side frame members **10** and comprises a lower base structure **12** (FIG. 7) mounted on the top of the frame **10** and secured thereto in any suitable manner, for example, by screws **13**. The base **12** is provided with guide means **14** receiving a dovetail member **15** carried by a body member **16** for adjustment of the latter transversely of the coil winding axis to be described. The body member **16** is provided with guide means **18** receiving a bearing support **19** having a dovetail **20** slidable in the guide means **18**. Adjustment of the body **16** is through a screw **22** (FIGS. 5 and 7) for movement of the body **16** transversely to the winding axis, while adjustment of the body **16** parallel to the winding axis is accomplished through a screw **23**. A bearing proper **26** (FIG. 5) is provided with a vertical dovetail **27** slidable in a vertical guide **28** in the member **20** and a screw **29** is provided for vertical adjustment of the bearing **26**. The adjusting means thus far described need not be shown in detail and form no part of the present invention.

The bearing **26** supports a shaft **29** (FIG. 7) on which is mounted a sprocket **30** to be engaged with a drive chain (not shown) driven from any suitable source of power. A hand wheel **32** is mounted on the left-hand end of the shaft **29** in FIG. 7 for the hand-turning of the shaft **29** for the initial winding or starting of a coil, as will become apparent below.

A cylindrical extension **35** (FIG. 7) on the bearing **16** is threaded as at **36** for engagement within a locking cap **37** turned up tightly on the threads **36** to be held stationary.

Referring to FIGS. 4 and 7, a coil winding device is indicated as a whole by the numeral **40**. Any suitable type of coil winding device may be used. In the present instance, such device comprises a tapered mandrel **41** of circular cross-section having a projecting driving stem **42** tapered as shown in FIG. 4. This stem (FIG. 7) has a driving fit in the adjacent end of the shaft **29** to be driven thereby, and is removable to be replaced by the stem of a mandrel **41** of different size, when desired.

Within the cap **37** is mounted a disk **45** carrying a radial pin **46** engageable in a slot **47** in the cylindrical extension **35** to prevent rotation of the disk **45**. This disk carries parallel arms **48** (FIGS. 4, 5 and 7) and within these arms

is mounted a heavy rigid coil **50** brazed or otherwise secured to the arms **48** and preferably pinned thereto (not shown). The coil is wound on the mandrel **41** as described below between the turns of the spiral member **50**. The mandrel **41** is freely rotatable within the member **50** and has a clearance therewith of the order of about .010" (shown exaggerated at **51**, FIG. 3). This clearance allows free rotation of the mandrel **41** but prevents the wire coil being formed from becoming jammed between the mandrel and the spiral member **50**.

In FIGS. 1 and 7 a wire **55** is shown being fed downwardly to the coil forming device from the end of which the coil is threaded through openings **56** near the edge of a book **57** held in position by any suitable means (not shown), such as the means disclosed in my prior patent referred to above.

The wire **55** feeds over a pulley **59** (FIG. 1) journaled in a bearing arm **60** carried by a structural member **61** preferably of inverted channel-shape as shown in FIG. 8. The structural member is carried by a vertical post **64** to which it is welded. The post is mounted in any suitable manner at its lower end on the bearing structure **11**.

Below the pulley **59** an arm **65** carries a block **66** in which are mounted a plurality of rollers **67** through which the wire **55** passes. These rollers bend the wire back and forth slightly and having a slight tendency to remove barrel stress but to a wholly inadequate extent. These rollers are conventional and need not be shown in detail.

The arm **61** slopes downwardly away from the machine, as shown in FIG. 1 and carries a plurality of plates **69** (FIG. 8) drilled as at **70** to receive a tube **71** of small diameter through which the wire **55** passes upwardly to the pulley **59**. The lower end of the arm **61** carries a bearing **73** rotatably supporting a pulley **74**. Extending downwardly from the pulley **74** is a short tubular section **75** to which the wire **55** is fed upwardly to the pulley **74**. The tube **75** may be supported by a bracket **76** welded or otherwise secured at its upper end to the bearing **73**.

The wire **55** is pulled upwardly to the tube **75** from a barrel **80** (FIG. 2) having a loose top **81** of slightly smaller diameter than the barrel, held in position by its own weight and provided with a plurality of sheet metal clips **82** overhanging the cover **81**. The clips **82** prevent too much wire from being pulled from the barrel and possibly becoming tangled. The line of pull to the pulley **74** is coaxial with the barrel **80**, as indicated by the line **85**. The pulled wire feeds between the cover **81** and each successive clip **82**, each clip snapping down against the cover **81** as the wire passes therebeyond. The barrel **80** and the associated elements form no part of the present invention, the latter being primarily concerned with the removal of the barrel stress from the wire.

The bearing **26** is provided with an upwardly extending portion **90** (FIG. 5) horizontally grooved as at **91** to form a guide for a relatively heavy bar **92** (FIG. 7) slotted as at **93** to receive an adjusting screw **94** carried by the upwardly extending bearing portion **90** to fix the bar **92** in longitudinally adjusted positions. One end of the bearing portion **90** rotatably supports a screw **95** having knurled head **96**, the screw **95** being threaded into the adjacent end of the bar **92** to move it longitudinally to adjusted positions.

The right-hand end of the bar **92** (FIG. 7) is slotted as at **98** to receive a block **99** carrying a plate **100** depending therefrom as shown in FIGS. 5 and 7. The block **99** is slotted as at **102** to receive a screw **103** for clamping the block **99** and plate **100** in adjusted positions laterally of the bar **92**.

A shaft **104** carried by the plate **100** rotatably supports a stress control wheel **105** having a peripheral groove **106** (FIG. 6) about which the wire **55** is turned once before passing through the coil forming device **40**. It will be noted that the stress control wheel **105** has its axis parallel to the axis of the mandrel **41**. Referring to FIG. 5 it will be apparent that the direction of winding of the wire **55** around the wheel **105** is the same as the direction of winding of the wire around the mandrel **41**, namely, counter-clockwise.

Operation

In starting the apparatus, the wire is pulled upwardly from the barrel **80**, fed through the tube **75**, around the pulley **74** thence upwardly through the tube **71** and around the pulley **59**. The leading end of the wire is threaded between the sets of rollers **67**, then wound once around the wheel **105** and inserted in the proper groove defined by two adjacent turns of the spiral member **50** (see FIG. 7). The wire extends within the adjacent arm **48** at the entering side of the wire around the mandrel. The wire is bent around the mandrel, following the space between the turns of the spiral member **50**. The mandrel **41** is tapered to increase in size toward the right-hand end thereof (FIG. 4). It will be apparent that the initial turns of wire about the mandrel will fit relatively loosely thereon (FIG. 3). With the sprocket **30** (FIG. 7) running free, the hand wheel **32** will be rotated in a clockwise direction looking from the left, and as the leading end portion of the wire therearound approaches the larger end of the mandrel, it will engage therewith and be frictionally held thereby.

The machine is now ready for operation, the sprocket **30** being driven to rotate the mandrel to wind the wire **55** thereon and feed it in coiled form from the right-hand end of the machine in FIGURE 1. The advancing end of the wire with the book **57** properly positioned with respect thereto, will enter the first opening **56**, and as the coil is continuously rotated, the leading end of the coil will thread through successive openings **56** throughout the width of the book. When the coil has been completely fed into position, the coil is clipped and crimped adjacent the book, whereupon the latter is advanced to the next station for the performance of the next operation. Another book is immediately brought into position ready for the next succeeding wire threading or book binding operation.

Spiral stresses are particularly disadvantageous in the making of larger coils for larger books. The wire is pulled upwardly from the barrel along the line **85** in FIG. 2, representing the axis of the barrel **80**. The wire is uncoiled from the barrel by following around the edge of the cover **81**. The inherent stresses in the wire occurring during the drawing and coiling of the wire in the barrel **80** remain therein and result in the winding of coils of varying pitches. With a coil ⅞" in diameter, the pitch of the resultant coil made by the device **40** will vary every 10 or 12 turns around the mandrel and it is this fact that causes a serious binding action to occur as the coil is fed through the openings **56** (FIG. 1).

By turning the wire about the stress control wheel **105** the barrel stress is completely relieved and stresses are set up in the wire in the same direction that it will turn about the mandrel **41**. Thus a continuous coil of uniform pitch is provided and all binding action in the book openings **56** is eliminated.

While the wire is guided in its movement along the mandrel **41** between the turns of the spiral member **50** such member does not control the pitch of the coil. The pitch is controlled by the relative position of the stress control wheel **105** relative to the point of entry of the wire between turns of the spiral member **50** into engagement with the mandrel **41**. By loosening the screw **94** (FIG. 7) turning the knob **96** to move the bar **92** and stress control wheel **105** to the left, the pitch of the coil may be increased. Conversely, moving the stress control wheel assembly to the right will reduce the pitch of the coil. After suitable adjustment has been made, the screw **94** will be tightened.

It is preferred that the wire **55** move downwardly from the stress control wheel substantially vertically into engagement with the mandrel **41**, as shown in FIGURE 3.

If the position of the stress control wheel is adjusted to the left in FIGURE 3 by loosening the screw **103** to the point where the wire inclines downwardly and to the right, the wire may engage one of the arms **48**, which would be disadvantageous. Therefore, depending upon the size of the mandrel **41** being used, the screw **103** is loosened and the stress control wheel adjusted laterally of the mandrel so that the point of tangency of the wire **55** where it leaves the groove **106** is directly above the point of tangency of the wire initially engaging the mandrel **41**, or slightly to the right thereof. Thus, any interference from the arms **48** is avoided.

From the foregoing it will be apparent that the stress control wheel **105** cooperates with the associated elements of the apparatus to completely eliminate "barrel stresses" so as to provide continuous book binding coils of uniform pitch. This uniformity is further insured by the fact that the turning of the wire about the stress control wheel is in the same direction that the wire turns about the mandrel **41**, thus introducing favorable stresses into the wire to facilitate the coil winding operation.

It is to be understood that the form of the invention shown and described is to be taken as a preferred example of the same, and that various changes in the shape, size and arrangement of parts may be made as do not depart from the spirit of the invention or the scope of the appended claims.

What is claimed is:

1. In a mechanism for forming wire coils of uniform pitch, a coil forming device around which wire is wound to form a coil, means for feeding wire to said device, and means engaging the wire in advance of its engagement with said device for removing stresses previously introduced into the wire so that the resultant coil will possess uniformity of pitch throughout, said stress removing means comprising a member provided with an arcuately curved surface having its axis parallel to the axis of said coil forming device and around which the wire passes in the same direction of curvature as around said coil forming device and directly from which curved surface the wire passes directly to said coil forming device.

2. A mechanism according to claim **1** wherein said coil forming device comprises a mandrel, said stress removing means comprising a wheel having its axis parallel to said mandrel and around which the wire passes in the same direction of curvature as around said mandrel and from which the wire passes directly to said mandrel to remove previously formed stresses from the wire.

3. A mechanism according to claim **1** wherein said coil forming device comprises a mandrel, said stress removing means comprising a freely rotatable wheel around which the wire is wound prior to its engagement with said mandrel to remove previously formed stresses in the wire, said wheel having its axis parallel to the axis of said mandrel, the wire partaking of a single turn around said wheel in the same direction that the wire is wound on said mandrel and passing directly from said wheel to said mandrel.

4. In a mechanism for forming wire coils of uniform pitch, a source of coiled wire from which the wire is drawn, a coil forming device around which wire supplied thereto from said source is wound to form a coil, and means arranged between said source and said device for removing from the wire any stresses introduced thereinto prior to engagement of the wire with said stress removing means, said coil forming device comprising a mandrel, said stress removing means comprising a wheel around which the wire is turned in the same direction as around said mandrel and from which wheel the wire passes directly into engagement with said mandrel.

5. A mechanism according to claim **4** wherein said wheel has its axis parallel to said mandrel and is freely rotatable and around which the wire passes before moving into engagement with said mandrel.

6. A mechanism according to claim **5** wherein said wheel has its axis parallel to the axis of said mandrel and around which wheel the wire passes through at least one turn in the same direction as it is wound on said mandrel whereby stresses in the wire prior to its engagement with said wheel are removed therefrom and said wheel introduces stresses into the wire corresponding to the stresses which will be introduced thereinto by winding the wire on said mandrel.

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