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Norman

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[54] **SPRING FORMING APPARATUS**

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[73] Assignee: **Stephen Baliski,** Gardena, Calif. ; a part interest

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[52] **U.S. Cl.** **72/66,** 72/140, 72/145, 140/149

[51] **Int. Cl.** **B21f 3/02,** B21f 3/04, B21f 3/10, B21f 7/00, B21f 23/00, B21f 35/00

[58] **Field of Search** 29/173; 72/66, 135, 72/140, 141, 142, 145; 140/89, 149

[56] **References Cited**

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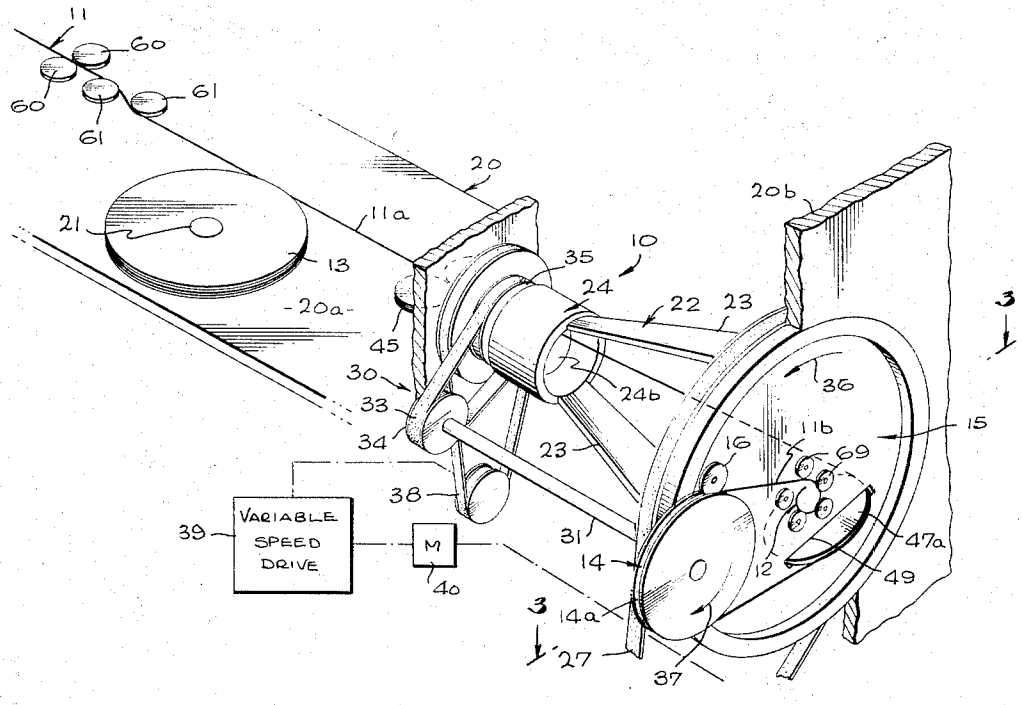
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Assistant Examiner—E. M. Combs
Attorney—Allan M. Shapiro

[57] **ABSTRACT**

A spring forming apparatus of the type wherein a wire is twisted substantially circumferentially between an isolator wheel and a feed wheel mounted for planetary motion on a revolving platen. The improvements include the use of a pinch wheel cooperating with a single feed wheel to grip the wire adjacent its exit from the twist mechanism, together with a simplified planetary drive system in which a portion of the drive assembly is bearing mounted to a cylindrical journal at the wire input end of the platen cage.

12 Claims, 7 Drawing Figures



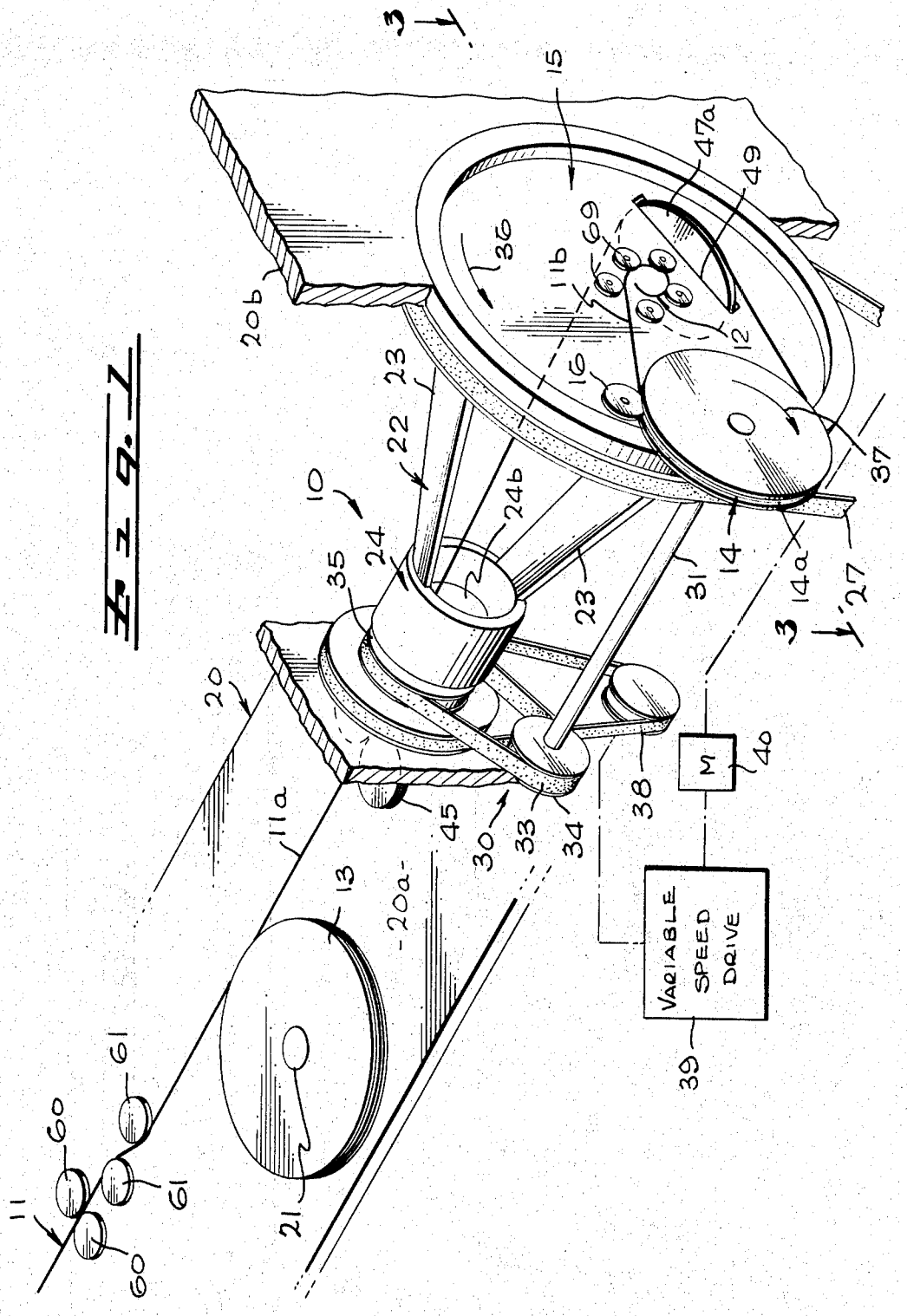
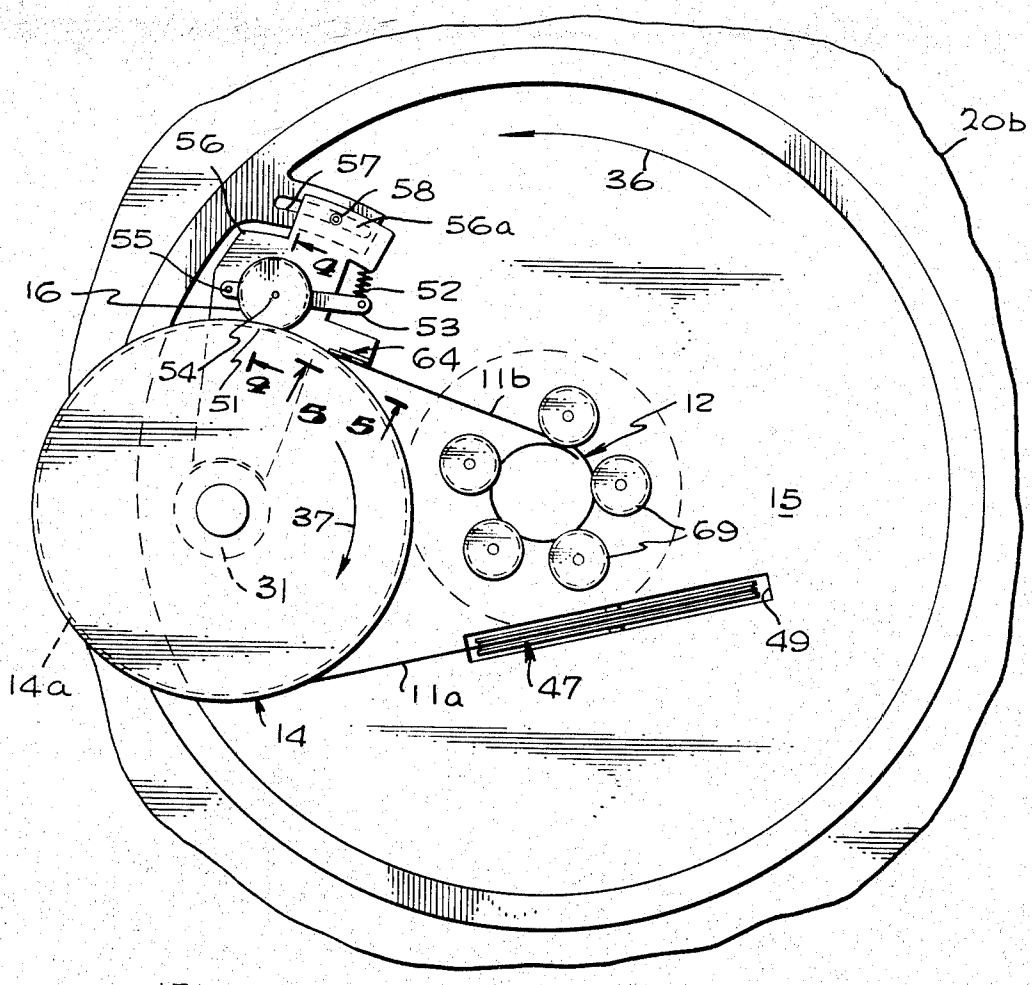

3
15
47a
49
69
36
11b
20b
12
16
23
22
10
24b
24
35
14
14a
27
37
31
23
3
20
11a
45
30
33
34
38
M
40
13
20a
VARIABLE SPEED DRIVE
39
61
60
61
60
11
21

FIG. 1

Fig. 2



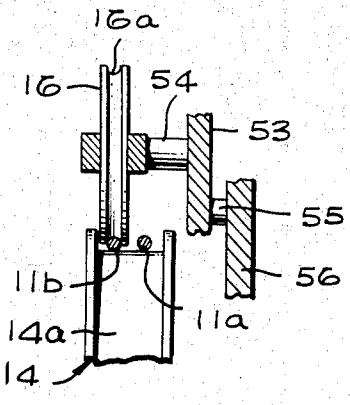
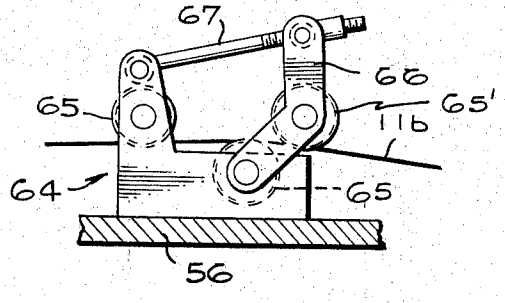
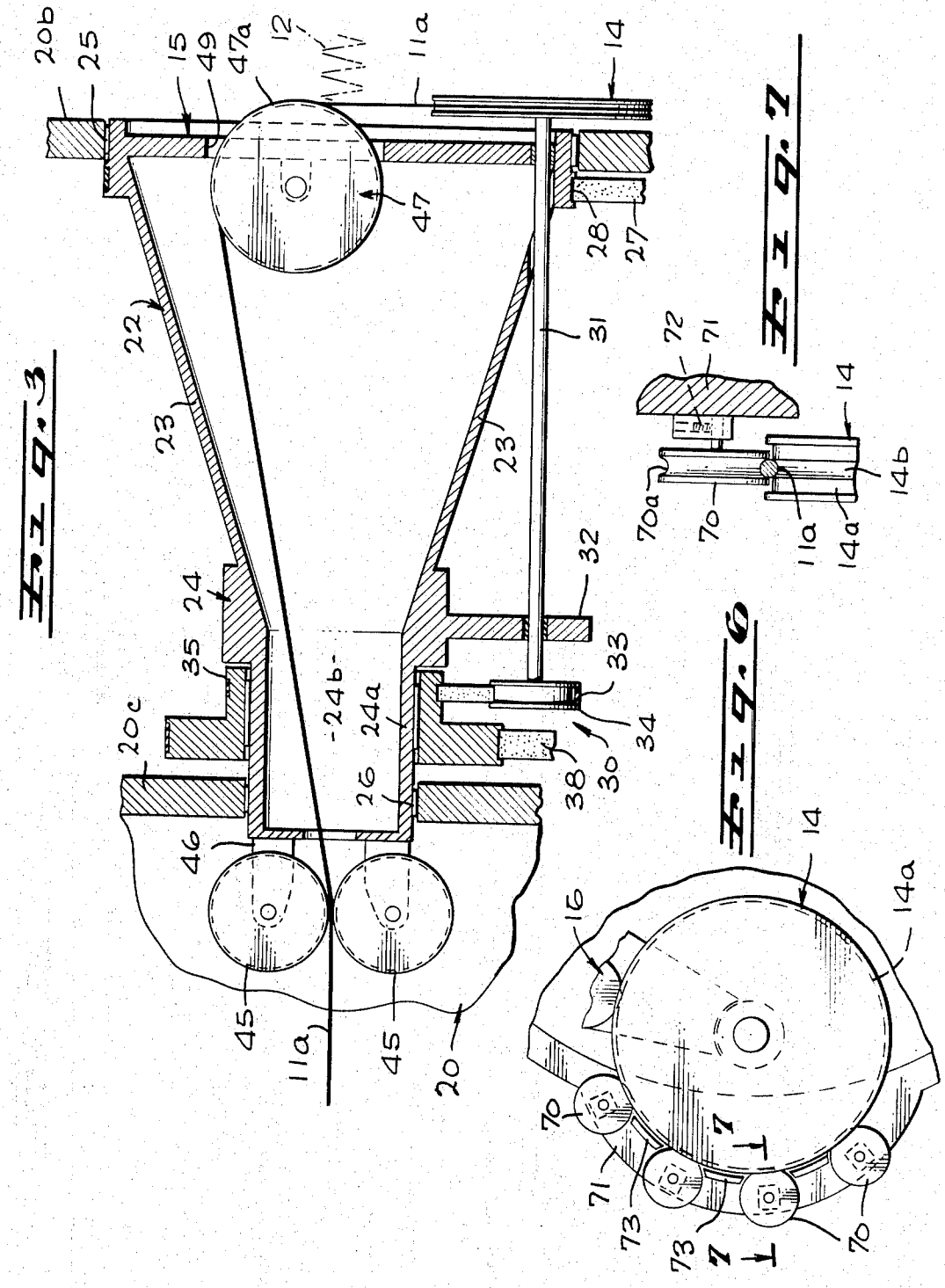


Fig. 4

Fig. 5




20b
25
15
49
47a
12
11a
14
47
28
27
22
23
31
23
32
24
35
33
-24b-
24a
34
20c
26
30
38
46
45
45
11a
20
FIG. 3
72
71
14
14b
70a
70
11a
14a
FIG. 7
FIG. 6
14
14a
16
70
71
73
73
70
7
7

SPRING FORMING APPARATUS

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention relates to a simplified apparatus for forming a spring by substantially circumferentially twisting a portion of wire restrained between an isolator wheel at the input and a cooperating pinch wheel and planetary feed wheel at the output.

2. Description of the Prior Art

The inventor's U.S. Pat. No. 3,541,828 entitled SPRING FORMING APPARATUS AND PROCESS describes the manufacture of springs by circumferentially twisting an isolated length of wire to less than the elastic limit, then releasing the wire to form the spring. Springs so formed may exhibit greater working stress than obtainable with springs of the same material and index but fabricated by prior art mandril wrapping techniques. Less wire is needed to form a spring of the same working stress. In the bedding industry, where many springs are used, substantial reduction in final product cost may result. One object of the present invention is to provide an improved apparatus for forming coil springs using this patented process.

The same patent also discloses apparatus for forming such springs. Wire from a spool is fed via an isolator wheel to a revolving platen carrying a planetary feed wheel. The wire is retrained between the feed wheel and a metal guide band which is held taught by a separate bias wheel on the platen. As the platen revolves, the section of wire between the isolator wheel and the feed wheel is twisted; the wire emergent from the feed wheel releases into a coil spring. Excellent performance is achieved using this apparatus. However, continuous flexing limits the lifetime of the guide band, necessitating periodic replacement. Another object of the present invention is to eliminate both the wire restraining guide band and the associated bias wheel.

The patented apparatus employs an oil immersed, double planetary gear system carried by the platen and facilitating dynamic control of the planetary ratio,i.e., the relative rotation rate of the platen and the feed wheel. A feedback system incorporating such planetary ratio control insures that the spring does not rotate as it emerges from the machine. The gear system is complex, and provision must be made to compensate for oil driven toward the platen periphery by centrifugal force. Thus it is a further object of the invention to provide a spring forming apparatus having a simplified planetary drive mechanism using neither complicated sets of gears nor oil immersion, yet permitting dynamic control of the planetary ratio.

SUMMARY OF THE INVENTION

These and other objectives are achieved by a spring forming apparatus wherein the platen forms the base of a generally conical platen cage having a cylindrical journal at the apex. The platen cage is mounted for rotation about the conical axis, and carries a planetary feed wheel affixed to a shaft projecting through the platen. A belt connects the feed wheel shaft to a drive pulley mounted in bearing relationship with the cage cylindrical journal and driven at a controllable rate. As the platen revolves, the independent rate and direction of rotation of the drive pulley establishes the planetary ratio.

Wire from the isolator wheel enters the platen cage through the cylindrical journal and is guided by a slot wheel through the platen to the feed wheel. A pinch wheel engages the wire against the feed wheel periphery to isolate the twisting forces from the emergent wire which, when relieved, assumes a coil shape. Use of the pinch wheel, optionally in conjunction with a set of idler rollers at the feed wheel periphery, eliminates the need for a guide band and its associated bias wheel.

BRIEF DESCRIPTION OF THE DRAWINGS

A detailed description of the invention will be made with reference to the accompanying drawings wherein like numerals designate corresponding elements in the several figures.

FIG. **1** is a simplified pictorial view of a spring forming apparatus in accordance with the present invention.

FIG. **2** is an end view of the apparatus of FIG. **1**, showing details of the platen, feed wheel and pinch wheel.

FIG. **3** is a transverse sectional view of the spring forming apparatus, as seen along the line **3—3** of FIG. **1**.

FIG. **4** is a fragmentary sectional view of the feed wheel and pinch wheel, as seen along the line **4—4** of FIG. **2**.

FIG. **5** is a fragmentary side view of the pitch control wheels, as seen along the line **5—5** of FIG. **2**.

FIG. **6** is a fragmentary end view of another embodiment using idler rollers in conjunction with the feed wheel.

FIG. **7** is a fragmentary sectional view of the feed wheel and a typical idler roller, as seen along the line **7—7** of FIG. **6**.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

The following detailed description is of the best presently contemplated modes of carrying out the invention. This description is not to be taken in a limiting sense, but is made merely for the purpose of illustrating the general principles of the invention since the scope of the invention best is defined by the appended claims.

Operational characteristics attributed to forms of the invention first described shall also be attributed to forms later described, unless such characteristics are obviously inapplicable or unless specific exception is made.

Referring now to the drawings, the inventive apparatus **10** (FIG. **1**) forms a wire **11** supplied from a spool or other source into a coil spring **12**. The spring **12** is produced by substantially circumferentially twisting the section of wire **11***a* between an isolator wheel **13** and a feed wheel **14** mounted for planetary motion on a revolving platen **15**. A pinch wheel **16** presses the wire **11** against the feed wheel periphery **14***a* to isolate the twisting forces from the wire **11***b* emerging from the feed wheel **14**. This released wire **11***b* assumes a coil shape as a result of the imparted circumferential twist.

The apparatus **10** is mounted on a stationary frame **20** having a horizontal table **20***a* to which the isolator wheel **13** is mounted by a vertical shaft **21**. The frame **20** also supports a generally conical platen cage **22**. The platen **15** forms the base of the cage **22** and is connected by rigid cage members **23** to a cylindrical journal **24** at the apex of the cage **22**. The platen **15** is supported by a frame member **20***b* via a bearing **25**, and

the journal **24** is mounted by a bearing **26** to a frame member **20***c*. This arrangement permits the entire platen cage **22** to revolve about the common axis through the journal **24** and the platen **15**, when driven by a belt **27** engaging a groove **28** at the periphery of the platen **13**. Preferably, the common axis of the cage **22** is tangential to the isolator wheel **13**.

A simple assembly **30** is used to drive the planetary feed wheel **14**. The feed wheel **14** is affixed to a shaft **31** (FIGS. 1 and 3) extending through the platen **15**, a cage member **23** and a support bracket **32** (omitted in FIG. 1). A belt **33** connects a pulley **34** on the shaft **31** to another pulley **35** mounted in bearing relationship about a portion **24***a* of the cage cylindrical journal **24**. As the platen cage **22** revolves in a counterclockwise direction (arrow **36** in FIG. 1) the feed wheel **14** will rotate about the shaft **31** axis in a clockwise direction (arrow **37**).

The planetary ratio (i.e., the number of rotations of the feed wheel **15** for each revolution of the platen **13**) is determined by the direction and rate of rotation of the pulley **35**. The pulley **35** itself is driven via a belt **38** and a variable spped drive **39** by a motor **40**. The motor **40** also may drive the platen cage **22** directly via the platen belt **27**. Adjustment of the variable speed drive **40** controls the planetary ratio and hence the feed rate of the emerging wire **11***b*. The simplified drive assembly **30** completely eliminates the relatively complicated, oil immersed double planetary gear system described in the above mentioned U.S. patent. The wire section **11***a* from the isolator wheel **13** is directed into the cage **22** by a pair of coplanar drive wheels **45** mounted on support brackets **46** projecting rearwardly from the cylindrical journal **24**. The wire **11**a thence goes through the interior **24***b* of the journal **24** and around a peripheral portion of a "slot" wheel **47** mounted to the cage **22** by a shaft **48** having an axis in a plane parallel to the platen **15**. A sector **47***a* of the wheel **47** projects through a slot **49** (FIGS. 2 and 3) in the platen **15** so as to guide the wire **11***a* into the plane of the feed wheel **14**.

In the embodiment of FIG. **1** the wire **11***b* from the slot wheel **47** loops around the feed wheel periphery **14***a* approximately one and a half times. The pinch wheel **16** has a peripheral groove **16***a* (FIG. **4**) which "pinches" or presses the wire **11** radially against the feed wheel **14** at the point **51** where the wire **11***b* emerges from the feed wheel **14**. The bias force is provided by a compression spring **52** acting against a lever arm **53** carrying the shift **54** of the pinch wheel **16**.

Preferably the wire **11***b* should emerge from the pinch wheel **16** in a line tangential both to the spring **12** being formed and to the feed wheel **14**. To fabricate springs **12** having different diameters, the pinch wheel **16** may be mounted (FIG. **2**) so as to allow arcuate adjustment of the contact point **51**. Thus, the lever **53** is pivotally supported at **55** to a bracket **56** adapted to pivot about the axis of the feed wheel shaft **31**. An arcuate guide **57** on the platen **15** receives a nut or other fastener **58** at the outer end **56***a* of the bracket **56**. By loosening the nut **58** and pivoting the bracket **56**, the pinch wheel **16** can be positioned to the required point **51**. The pinch wheel **16** isolates the emergent wire section **11***b* from the circumferential twisting forces imparted by revolution of the platen **15**. The isolator wheel **13** (FIG. **1**) isolates these twisting forces from the portion of wire **11***c* entering from the source. To this end, the wire **11** forms one or more loops around the periphery of the isolator wheel **13**. Appropriate tension of the wire section **11***a* between the isolator wheel **13** and the pinch wheel **16** is insured by a pair of drag wheels **60** mounted on the table **20***a* on opposite sides of the wire **11** and biased to provide the necessary drag. An offset pair of "cast killer" rollers **61** also may be used to break the cast of the wire from a spool or other source, thereby aiding uniformity of the produced spring **12**.

The twisted wire **11***b* emerging from the feed wheel **14** assumes a coil shape. However, the natural pitch and/or diameter may differ from the desired value. Accordingly, a pitch control wheel assembly **64** (FIG. **5**) mounted on the bracket **56** limits the pitch assumed by the wire **11***b*. The wire **11***b* is guided by the rollers **65** through an angle established by a lever arm **66** carrying the wheel **65'** and adjusted by a screw **67**. A set of diameter control wheels **69** mounted on the platen **15** control the spring **12** diameter. The radial spacing of the rollers **69** with respect to the center of the platen **15** is adjusted to produce springs of larger or smaller diameter. When such adjustment is made, the pinch wheel **16** position is adjusted correspondingly.

As an alternative to looping the wire **11***b* completely around the feed wheel **14**, the arrangement of FIGS. **6** and **7** may be employed. There, several idler rollers **70** guide the wire **11***b* around a portion of the feed wheel **14**. The grooved periphery **70***a* of each roller **70** is aligned with a wire-receiving groove **14***b* in the feed wheel periphery **14***a*. The idler rollers **70** all are mounted on a support bracket **71** fixed to the platen **15**. Individual bias springs **72** urge each roller **70** toward the feed wheel **14**, and retainers **73** prevent the wire **11**a from looping away from the feed wheel **14** between adjacent idler rollers **70**.

Use of the feed wheel **14** and pinch wheel **16**, with the arrangement of either FIG. **1** or FIG. **7**, eliminates wire restraining band and bias wheel, as discussed above.

The apparatus **10** of FIG. **1** is configured to form left handed springs **12**. To form right handed springs, the slot wheel **47** is mounted on the side of the platen cage axis opposite that shown in FIG. **1**, and the pinch wheel **16** is situated against the lower periphery of the feed wheel **14**. Rotation of the cage **22** and the feed wheel **14** is opposite that indicated by the arrows **36** and **37**.

By appropriately controlling the direction and rate of rotation of the drive pulley **35**, the spring **12** will emerge from the apparatus **10** without rotation. Such control may be accomplished by a feedback system utilizing a spring rotation sensor (not shown) cooperating with the variable speed drive **39**. The belt **33** and the pulleys **34, 35** may be replaced by appropriate gears. The spring **12** produced by the apparatus **10** may be fed directly to other equipment to be shaped into a bedspring, mattress assembly or the like. Identical right and left hand spring formers **10** may be interconnected to insure simultaneous spring formation. Intending to claim all novel, useful and unobvious features shown or described, the applicant:

I claim

1. Apparatus for forming a spring from a wire supplied from a source, comprising:

a generally conical platen cage having a cylindrical journal at the apex and a platen at the base, said

cage being mounted to revolve about the common axis of said journal and base,

a feed wheel affixed to a shaft journaled through said platen parallel to said common axis but spaced therefrom,

drive means for rotating said feed wheel shaft via a drive pulley in bearing relationship with said journal,

a pinch wheel on said platen and biased to pinch wire against the periphery of said feed wheel,

a slot wheel mounted in said cage to rotate about an axis generally parallel to said platen, the periphery of said slot wheel projecting beyond said platen,

an isolator wheel spaced from said cage and mounted to rotate only about an axis generally perpendicular to said common axis,

wire from said source looping about the periphery of said isolation wheel, thence through said cylindrical journal, around said slot wheel and around at least a portion of the periphery of said feed wheel to said pinch wheel, revolution of said cage imparting a substantially circumferential twist to the portion of wire between said isolation wheel and said pinch wheel, twisted wire emergent from between said feed and pinch wheels releasing into a coil spring.

2. Spring forming apparatus according to claim **1** wherein said pinch wheel presses said wire at the point where tangentially emergent from said feed wheel, and including means for arcuately positioning said pinch wheel to adjust said point.

3. Spring forming apparatus according to claim **2** wherein said means for positioning comprises an arm mounted to pivot about the axis of said feed wheel shaft, said pinch wheel being mounted on said arm, means for maintaining said arm at a selected arcuate position, and means for biasing said pinch wheel radially toward said feed wheel.

4. Spring forming apparatus according to claim **3** further comprising pitch control wheels mounted on said arm for restraining the pitch assumed by said emergent twisted wire.

5. Spring forming apparatus according to claim **1** wherein said drive means comprises;

a first belt connecting said feed wheel shaft and said drive pulley, and

means for rotating said drive pulley at a selectable rate.

6. Spring forming apparatus according to claim **5** wherein said means for rotating comprises;

a drive motor,

a variable speed drive coupling said drive motor to said drive pulley, adjustment of said variable speed drive controlling the relative rotation rate of said platen and said feed wheel, said relative rate being adjustable so that the spring formed by said apparatus does not rotate.

7. Spring forming apparatus according to claim **6** wherein said drive motor also revolves said platen.

8. Spring forming apparatus according to claim **1** wherein the direction of rotation of said platen establishes whethere said spring is right or left handed, said slot wheel being situated on one side of said common axis for formation of right handed springs and on the other side of said common axis for formation of left handed springs.

9. Spring forming apparatus according to claim **1** further comprising one or more idler rollers positioned about the periphery of said feed wheel to guide said wire thereabout.

10. Spring forming apparatus according to claim **9** wherein said idler rollers all are mounted on a support fixed to said platen, each idler roller being biased radially toward said feed wheel, and retainers between said idler rollers to retain said wire against feed wheel periphery.

11. Spring forming apparatus according to claim **1** together with means for providing slight drag on said wire between said source and said isolator wheel.

12. Spring forming apparatus according to claim **11** together with means for breaking the cast of said wire before entry to said isolator wheel.

* * * * *