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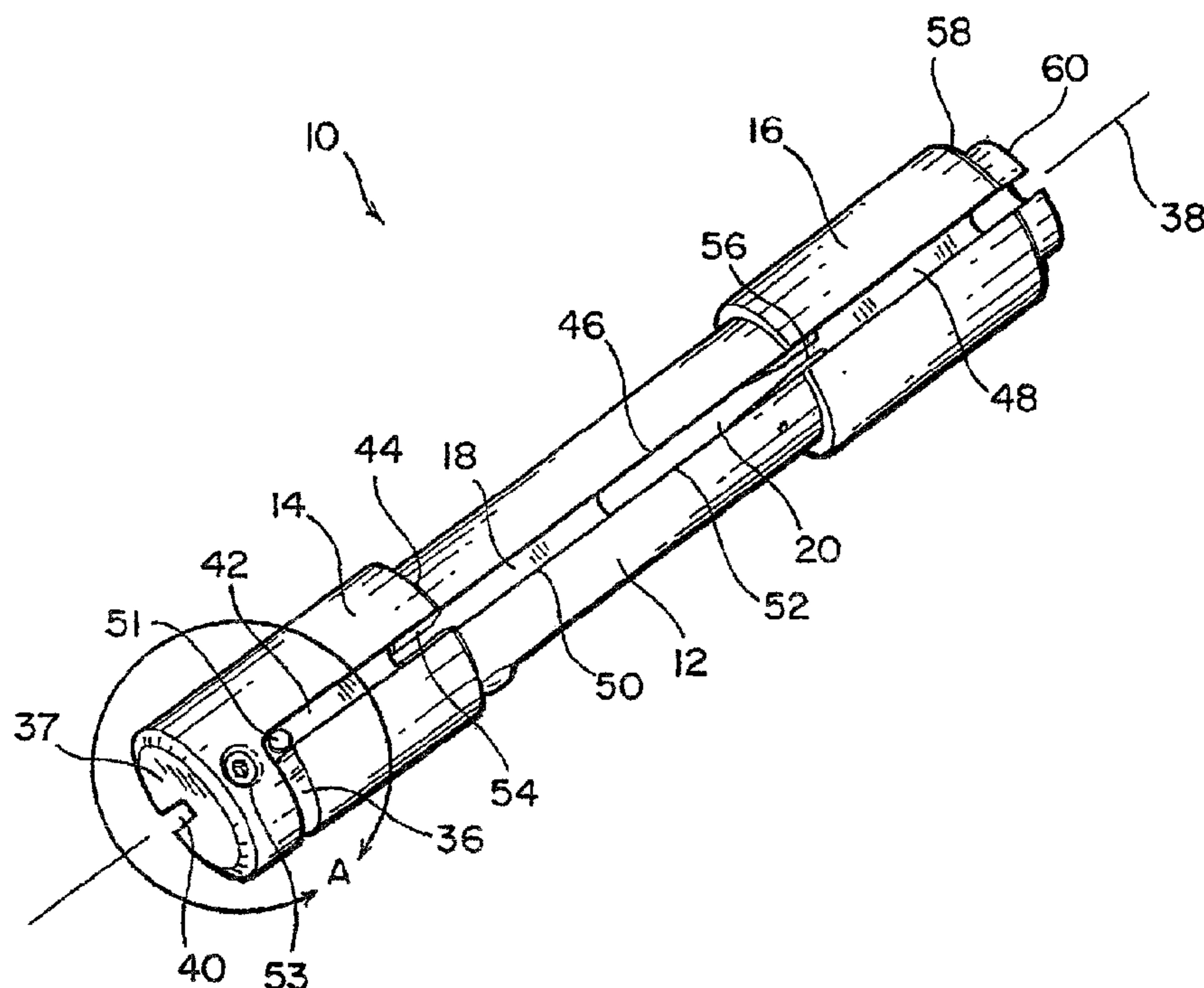
(72) Inventeurs/Inventors:
ROSSUM, EUGENE C., US;
JOHNSON, GERALD L., US;
WEEKS, GREGG EUGENE, US;
MORK, BRADY L., US

(73) Propriétaire/Owner:
ILLINOIS TOOL WORKS INC., US

(74) Agent: FINLAYSON & SINGLEHURST

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(54) Title: MANUALLY OPERATED WIRE TWISTING AND TYING TOOL AND METHOD OF TWISTING AND TYING THE WIRES TOGETHER



(57) Abrégé/Abstract:

A manually-operated baling wire twisting and tying tool, and a method of twisting and tying the wires together, comprises a first handle having a first wire-twisting implement mounted therein, and a second handle having a second wire-twisting implement mounted herein. An axially oriented slot is effectively defined within the tool throughout substantially the entire axial extent thereof for accommodating the wires, and when the first and second handles, having the first and second wire-twisting implements disposed therein, are rotated with respect to each other, the wires are twisted and tied together. A visually indicating mechanism is also provided upon the tool for indicating to the operator when a predetermined number of twists have been imparted to the wires.



ABSTRACT

A manually-operated baling wire twisting and tying tool, and a method of twisting and tying the wires together, comprises a first handle having a first wire-twisting implement mounted therein, and a second handle having a second wire-twisting implement mounted herein. An axially oriented slot is effectively defined within the tool throughout substantially the entire axial extent thereof for accommodating the wires, and when the first and second handles, having the first and second wire-twisting implements disposed therein, are rotated with respect to each other, the wires are twisted and tied together. A visually indicating mechanism is also provided upon the tool for indicating to the operator when a predetermined number of twists have been imparted to the wires.

MANUALLY OPERATED WIRE TWISTING AND TYING TOOL
AND METHOD OF TWISTING AND TYING THE WIRES TOGETHER

FIELD OF THE INVENTION

The present invention relates generally to manual-
5 ly operated tools and a method of using the same, and more
particularly to a new and improved manually operated wire
twisting and tying tool which is especially useful in con-
nection with the twisting and tying together of the free end
portions of baling wire used in connection with the binding
10 of baled products so as to secure the same in a compacted or
compressed state or condition.

BACKGROUND OF THE INVENTION

Various types of loose material or packaging com-
ponents are often processed and distributed in the form of
15 compressed or compacted bales so that a greater amount or
number of such loose material or packaging components may be
stored or shipped within a smaller space. In addition, it is
easier and more efficient to handle bales of material or
packaging components than to handle the loose material or
20 individual packaging components. When the loose material or

packaging components are compressed or compacted into bales, it is generally known to wrap and tie such bales with wire or other similar binding devices or members so as to secure and maintain the bales in their compressed or compacted form while being stored or shipped. Wire is the most preferable binding device due to its low cost and ease of handling and manipulation. One method of conventionally forming a compressed or compacted bale of material or components, and of subsequently securing and maintaining the same in its compressed or compacted state, comprises the steps of depositing the compressible material or components into an automatic baler wherein the material or components are compacted or compressed into a bale by means of a suitable ram mechanism, and subsequently, the bale is conducted through a plurality of spaced wire wrapping stations such that a plurality of wire strands are wrapped around the bale at different locations thereof.

In order to secure together the free end portions of the wire strands wrapped around the bale of material or components, automatic wire twisting and tying apparatus have been used in conjunction with, or as integral parts of, the automatic baler apparatus, however, such automatic apparatus have proven relatively complex in structure, large and bulky in size, and expensive to manufacture. In addition, it is known that, due to the stresses impressed upon and inherent within the baling wires as a result of the wrapping of the same around the compressed or compacted bale of material or components, one of the major difficulties, which is uniquely problematic in connection with the tying together of the free end portions of the baling wire wrapped around the bale

of material or components, comprises the fact that the free end portions of the baling wire normally tend to separate from each other. It is imperative, however, that the free end portions of the baling wire are maintained together in an overlapped state both before and during the twisting together of the free end portions of the baling wire in order to define or achieve the ultimately desired knotted structure which terminates the wrapped baling wire and maintains the wrapped baling wire in its secured state or condition upon the bale of material or components. Unfortunately, such automatic machines or mechanisms have not always been able to adequately address this problem or difficulty which has therefore rendered such automatic machines or mechanisms difficult and tedious to use.

15 In order to reduce the complexities and costs involved in connection with the use of automatic wire twisting and tying apparatus, hand tying techniques have also been employed within the industry. One known hand tying technique comprises the formation of a pre-wound loop upon a first end portion of the baling wire, the insertion of the second end portion of the baling wire through such pre-wound loop, and the twisting of the non-looped end portion of the baling wire around itself. This technique, however, has exhibited several operational problems which have rendered the same undesirable. For example, the termination tie is often inconsistent, leading to an imbalance in the stress levels accommodated by each end portion of the baling wire. In addition, such termination tie has often proven to be insufficiently strong due to poor quality levels characteristic of the twists formed within the termination tie. Accordingly,

once the bale is removed from the baler apparatus, the failure of the tie leads to a failure of the bale and the need to reprocess the same. As a result, the industry has effectively rejected the use of such hand tying techniques and has
5 subsequently adopted the use of manually operated tying devices or mechanisms.

One example of such manually operated tying devices or mechanisms is disclosed within United States Patent 5,921,289 which issued to Johnson on July 13, 1999. In accordance with the teachings and description of such patent,
10 and as disclosed within **FIGURE 1**, which substantially corresponds to **FIGURE 1** of the noted patent, it is briefly noted that the manually operated baling wire tying device or mechanism of Johnson is generally indicated by the reference
15 character 10 and is seen to comprise upper and lower housing sections 12a,12b. Each one of the upper and lower housing sections 12a,12b comprises a cross-bar section 17, and a pair of legs 16a,16b project forwardly from each one of the cross-bar sections 17. The legs 16a,16b are respectively
20 provided with semi-cylindrical openings 21 for respectively housing bearing members 28 which in turn have hub portions 22 of twister gears 18a,18b rotatably disposed therein. Twister pinions 20a,20b are respectively fixedly mounted within the twister gears 18a,18b so as to be rotatable
25 therewith, and a cover 34 and a locking structure 36 are operatively associated with each one of the twister gear and pinion assemblies 18a,20a and 18b,20b. The outer covers 34, locking structures 36, bearing members 28, twister gears 18a,18b, and twister pinions 20a,20b are all individually
30 provided with a radial slot so as to form together a col-

lective slot 55 into which a pair of wires, to be twisted together, can be inserted.

The twister gears 18a,18b comprise bevel gears, with the teeth thereof being illustrated at 25, and a beveled drive gear 40, having teeth 42 integrally formed thereon, is effectively interposed between the twister gears 18a,18b such that the twister gears 18a and 18b are engaged with diametrically opposed regions of the drive gear 40. The beveled drive gear 40 is operatively connected to a drive shaft 50, and drive shaft 50 is fixedly connected to a crank handle 52. Accordingly, when the crank handle 52 is rotated in a predetermined direction, such as, for example, in the clockwise direction as viewed from the front of the device or mechanism 10 and oriented along the axis of the beveled drive gear 40, the latter is likewise rotated in the clockwise direction. Therefore, twister gear 18a, and its twister pinion 20a, will be rotated in the counterclockwise direction, as viewed along their respective axes and in the direction extending from the axially inner end of twister pinion 20a to the axially outer end of the hub portion 22 of twister gear 18a, while twister gear 18b and its twister pinion 20b will be rotated in the clockwise direction, as viewed along their respective axes and in the same direction as was used in connection with twister gear and pinion gear 18a,20a. Accordingly, since the twister gears 18a,18b and twister pinions 20a,20b are rotated in opposite directions, the wire end portions of the baling wire, which are disposed within the twister pinions 20a,20b, are effectively twisted with respect to each other around an axis which is common to such wire end portions and which extends along the common

slot 55 so as to form a twisted termination knot.

While the aforementioned baling wire twisting and tying apparatus operates satisfactorily, it is noted that the apparatus is nevertheless relatively complex and bulky in structure. In addition, while the same is manually operable, the apparatus does not comprise relatively simple structure comprising a relatively small size which would in fact enable an operator to readily hold or grasp the same in his or her hands while subsequently manipulating the apparatus in a relatively simple manner. Accordingly, a need exists in the art for a new and improved manually operated baling wire twisting and tying tool which is relatively simple in structure, and which is of such relatively small size as to readily enable the same to be held by an operator and easily manipulated for the performance of a baling wire twisting and tying operation.

SUMMARY OF THE INVENTION

Accordingly, the present invention seeks to provide a new and improved manually-operated baling wire twisting and tying tool or apparatus.

Another aspect of the present invention seeks to provide a new and improved manually-operated baling wire twisting and tying tool or apparatus which effectively overcomes the various operational drawbacks and disadvantages characteristic of **PRIOR ART** baling wire twisting and tying tools or apparatus.

5 An additional aspect of the present invention is to provide a new and improved manually-operated baling wire twisting and tying tool or apparatus which is relatively simple in structure and which is also relatively small in size.

10 A further aspect of the present invention is to provide a new and improved manually-operated baling wire twisting and tying tool or apparatus which is relatively simple in structure and which is relatively small in size so as to permit an operator to readily grasp and hold the same and thereby in turn readily permit the operator to simply perform a baling wire twisting and tying operation.

15 A last aspect of the present invention is to provide a new and improved manually-operated baling wire twisting and tying tool or apparatus which is relatively simple in structure and which is relatively small in size so as to permit an operator to readily grasp and hold the same and thereby in turn readily permit the operator to simply perform a baling wire twisting and tying operation whereby the resulting twisted and tied or knotted end portions of the baling wire will exhibit uniform consistency, will exhibit sufficient strength in order to withstand the various stresses inherently impressed thereon by means of the compressed or compacted bale of material or components, and will not tend to unravel as is often characteristic of hand-twisted and tied or knotted end portions of baling wire wrapped around the bale of material or components.

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The foregoing and other aspects are achieved in accordance with the teachings and principles of the present invention through the provision of a new and improved manually-operated baling wire twisting and tying tool or apparatus which comprises an axially elongated hand-held device comprising an axially central main housing section, a first wire-twisting housing section or handle having a first wire-gripping mechanism fixedly mounted therein, and a second wire-twisting housing section or handle having a second wire-gripping mechanism fixedly mounted therein. The first wire-twisting housing section or handle is fixedly mounted upon a first end of the axially central main housing section such that the first wire-gripping mechanism extends into the first end of the axially central main housing section, and the second wire-twisting housing section or handle is rotatably mounted upon a second opposite end of the axially central main housing section such that the second wire-gripping mechanism extends into the second end of the axially central main housing section. The first wire-twisting housing section or handle is provided with a radially inwardly extending slot oriented in a radial plane perpendicular to the longitudinal axis of the hand-held device so as to permit the pair of wires, which are to be twisted together, to be inserted into the device, and an axially oriented slot extending substantially the entire axial extent or longitudinal length of the device for accommodating the wires in preparation for the performance of the wire twisting and tying operation. An end cap is rotatably mounted upon the second wire-twisting housing section or handle so as

to effectively close the second axial end of the device and thereby prevent the wires from being inadvertently disengaged from the axially oriented slot once the wires are disposed within the axially oriented slot, whereupon rotational
5 movement of the second wire-twisting housing section or handle, having the second wire-gripping mechanism fixedly mounted therein, relative or with respect to the first wire-twisting housing section or handle, having the first wire-gripping mechanism fixedly mounted therein, the wires are
10 twisted and tied together. Upon completion of the wire twisting and tying operation, the end cap is rotated in the reverse direction so as to effectively open the second axial end of the device, and the twisted and tied-together wires can then be removed from the axially oriented radially inwardly extending slots. The device is then ready for use in
15 connection with a subsequent pair of wires to be twisted and tied together.

BRIEF DESCRIPTION OF THE DRAWINGS

Various other aspects, features and attendant advantages of the present invention will be more fully appreciated from the following detailed description when considered in connection with the accompanying drawings in which like reference characters designate like or corresponding parts throughout the several views, and wherein:
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25 **FIGURE 1** is an exploded perspective view of a conventional **PRIOR ART** hand-operable bale wire twisting and tying

ing apparatus;

FIGURE 2 is a perspective view of the new and improved manually-operated wire twisting and tying tool or device constructed in accordance with the teachings and principles of the present invention and showing the cooperative parts thereof;

FIGURE 3 is an enlarged view of the encircled area **A** as noted upon **FIGURE 2** showing in greater detail the radially oriented wire insertion and axially oriented wire accommodation slots as formed within the non-rotatable end of the new and improved manually-operated wire twisting and tying tool of the present invention;

FIGURE 4 is a perspective view similar to that of **FIGURE 2** showing, however, the new and improved manually-operated wire twisting and tying tool or device as viewed from the rotatable end of the tool or device of the present invention and showing the cooperative parts thereof;

FIGURE 5 is an enlarged view of the encircled area **B** as noted upon **FIGURE 4** showing in greater detail the disposition of the rotatable cap member rotatably disposed within the rotatable end of the new and improved manually-operated wire twisting and tying tool of the present invention for effectively closing the rotatable end of the axially oriented wire accommodation slot so as to prevent the inadvertent disengagement of the wires from the axially oriented wire accommodation slot;

FIGURE 6 is a perspective view similar to that of **FIGURE 2** showing, however, the new and improved manually-operated wire twisting and tying tool or device as viewed from the opposite lateral side of the tool or device of the present invention and showing the cooperative parts thereof;

FIGURE 7 is an enlarged view of the encircled area **C** as noted upon **FIGURE 6** showing in greater detail the rotatable gauge member, rotatably mounted upon the end of the axially central main housing section which is disposed adjacent to the rotatable end of the new and improved manually-operated wire twisting and tying tool of the present invention, for effectively indicating or monitoring the number of revolutions of the rotatable end of wire twisting and tying tool, with respect to the fixed end of the wire twisting and tying tool, such that the tool can impress or form a predetermined number of twists upon or within the pair of wires that are to be twisted and tied together; and

FIGURE 8 is a front elevational view of a pair of baling wires twisted and tied together by means of the new and improved manually-operated wire twisting and tying tool or device illustrated within **FIGURES 2-7**.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring now to the drawings, and more particularly to **FIGURES 2** and **3** thereof, the new and improved manually operated wire twisting and tying tool or device, as

constructed in accordance with the principles and teachings of the present invention and showing the cooperative parts thereof, is illustrated and is generally indicated by the reference character 10. More particularly, the manually-operated wire twisting and tying tool or device 10 of the present invention is seen to having a substantially axially elongated cylindrical configuration comprising an axially central main tubular housing or support section 12, a first wire-twisting housing section or handle 14 which is effectively fixed upon or within a first axial end of main tubular housing or support section 12, and a second wire-twisting housing section or handle 16 which is effectively rotatably mounted upon or within a second axial end of main tubular housing or support section 12. A first wire-gripping mechanism or implement 18 is fixedly mounted within the first wire-twisting housing section or handle 14 whereby the first wire-gripping mechanism or implement 18 is fixed with respect to both the first wire-twisting housing section or handle 14 and main tubular housing or support section 12, and a second wire-gripping mechanism or implement 20 is correspondingly fixedly mounted within the second wire-twisting housing section or handle 16 whereby the second wire-gripping mechanism or implement 20 is therefore rotatable, along with the second wire-twisting housing section or handle 16, with respect to main tubular housing or support section 12, first wire-twisting housing section or handle 14, and first wire-gripping mechanism or implement 18.

More particularly, as can best be seen or appreciated from **FIGURES 2,4** and 6, the axially inner end of the first wire-twisting housing section or handle 14 is adapted

to be mounted upon or over the first axial end of the axially central main housing section 12 in an enveloping manner such that the first wire-gripping mechanism or implement 18 extends into and is axially disposed within the interior portion of the first axial end of the axially central main tubular housing section 12. In order to fixedly secure the first wire-twisting housing section or handle 14 and the first wire-gripping mechanism or implement 18 upon and within the first axial end of the axially central main tubular housing section 12, respectively, a first suitable fastener 22, as best seen in **FIGURE 6**, is inserted through suitable apertures, not shown, respectively formed within the first axial end of the axially central main tubular housing section 12 and the first wire-gripping mechanism or implement 18 so as to fixedly secure the first wire-gripping mechanism or implement 18 within the first axial end of the axially central main tubular housing section 12. In a similar manner, a second suitable fastener 24, as best seen in **FIGURES 4 and 6**, is inserted through suitable apertures, not shown, respectively formed within the first wire-twisting housing section or handle 14 and the first wire-gripping mechanism or implement 18 so as to fixedly secure the first wire-twisting housing section or handle 14 and the first wire-gripping mechanism or implement 18 together.

As can best be appreciated from **FIGURES 4, 6, and 7**, in order to rotatably secure the second wire-twisting housing section or handle 16 and the second wire-gripping mechanism or implement 20 upon and within the second axial end of the axially central main tubular housing section 12, respectively, a suitable fastener 26 is inserted through

suitable apertures, not shown, respectively formed within the second wire-twisting housing section or handle 16 and the second wire-gripping mechanism or implement 20 so as to fixedly secure the second wire-gripping mechanism or implement 20 within the second wire-twisting housing section or handle 16. In addition, an outer peripheral wall portion of the second wire-gripping mechanism or implement 20 is provided with a circumferentially extending recessed portion or groove, not shown, and a suitable set screw or pin 28 is inserted through a side-wall portion of the second axial end of the axially central main tubular housing section 12 which is disposed adjacent to the second wire-twisting housing section or handle 16 so as to effectively engage the circumferentially extending recessed portion or groove, not shown, defined within the outer peripheral wall portion of the second wire-gripping mechanism or implement 20.

In this manner, the assembly comprising the second wire-twisting housing section or handle 16 and the second wire-gripping mechanism or implement 20 is axially locked or retained within the second axial end of the axially central main tubular housing section 12. However, such assembly comprising the second wire-twisting housing section or handle 16 and the second wire-gripping mechanism or implement 20 is nevertheless permitted to undergo rotational movement with respect to the axially central main tubular housing section 12, and more importantly, with respect to the first wire-gripping mechanism or implement 18 fixedly mounted within the assembly comprising the first axial end of the axially central main tubular housing section 12 and the first wire-twisting housing section or handle 14.

In order to insert a pair of wires, as shown as 30 and 32 in **FIGURE 8**, into the new and improved manually operated wire twisting and tying tool or device 10 of the present invention, and in order to further properly axially
5 dispose the wires 30,32 within the tool or device 10 such that a wire twisting and tying operation can be properly performed upon the wires 30,32 in order to achieve, for example, a twelve-loop twist and tie section within the wires 30,32, as disclosed at 34 in **FIGURE 8**, the new and improved
10 manually operated wire twisting and tying tool or device 10 of the present invention is provided with additional unique structure. With reference again being made to **FIGURES 2,3,** and 6, the first wire-twisting housing section or handle 14 is provided with a first radially inwardly extending slot or
15 groove 36 which is oriented within a radial plane which is perpendicular to the longitudinal axis of the hand-held device or tool 10. As can readily be appreciated from **FIGURES 2,3,** and 6, the slot or groove 36 is located at an axial position which is located axially inwardly from an end face 37
20 of the first wire-twisting housing section or handle 14 and extends radially inwardly from the outer peripheral surface of the first wire-twisting housing section or handle 14 to, and even slightly beyond, the longitudinal axis 38 of the tool or device 10.

25 In addition, as can best be seen from **FIGURE 6**, the first wire-twisting housing section or handle 14 is further provided with a second radially inwardly extending slot or groove 40 which is oriented within an axial plane which is parallel to the longitudinal axis of the hand-held device
30 or tool 10. The second radially inwardly extending slot or

groove 40 extends axially from the end face 37 of the first wire-twisting housing section or handle 14 to the first radially inwardly extending slot or groove 36 so as to intersect the first radially inwardly extending slot or groove 36, and also extends radially inwardly from the outer peripheral surface of the first wire-twisting housing section or handle 14 to, and even slightly beyond, the longitudinal axis 38 of the tool or device 10. As may be additionally appreciated from FIGURES 2,3, and 6, if the end face 37 of the first wire-twisting housing section or handle 14 is the face of a clock, the slot or groove 40 commences radially inwardly from the nine o'clock position thereof.

In a similar manner, the first wire-twisting housing section or handle 14 is provided with a third radially inwardly extending slot or groove 42 which is likewise oriented within an axial plane which is parallel to the longitudinal axis of the hand-held device or tool 10. The third radially inwardly extending slot or groove 42 extends axially from the end 44 of the first wire-twisting housing section or handle 14, which is disposed opposite the end face 37, to the first radially inwardly extending slot or groove 36 so as to likewise intersect the first radially inwardly extending slot or groove 36. In addition, third radially inwardly extending slot or groove 42 also extends radially inwardly from the outer peripheral surface of the first wire-twisting housing section or handle 14 to, and even slightly beyond, the longitudinal axis 38 of the tool or device 10. With respect to the end face 37 of the first wire-twisting housing section or handle 14, and again considering the same to be the face of a clock, it may be additionally appreciated

ed from FIGURES 2,3, and 6 that the third radially inwardly extending slot or groove 42 commences radially inwardly from the three o'clock position thereof. It can therefore be appreciated further that the second radially inwardly extending slot or groove 40 and the third radially inwardly extending slot or groove 42 are effectively connected to each other through the intermediary of the first radially inwardly extending slot or groove 36 for a purpose which will be explained more fully shortly hereinafter.

10 Continuing further, and as can best be appreciated from FIGURE 2, it is additionally seen that the axially central main tubular housing section 12 is provided with an axially oriented slot 46 which is defined within a peripheral side wall thereof, and that the second rotatable wire-twisting housing section or handle 16 is provided with a fourth axially oriented, radially inwardly extending slot or groove 15 48 which is similar to the third axially oriented, radially inwardly extending slot or groove 42 as defined within the first fixed wire-twisting housing section or handle 14.

20 Still yet further, the first and second wire-gripping mechanisms or implements 18,20 are respectively provided with fifth and sixth axially oriented, radially inwardly extending slots or grooves 50,52 which are also similar to the third and fourth axially oriented, radially inwardly extending slots or grooves 42,48 as defined within the first fixed and second rotatable wire-twisting housing sections or handles 14,16. More particularly, it can be further appreciated that when the first fixed wire-twisting housing section or handle 14 is assembled together with the axially central

25 30 main tubular housing section 12 and the first wire-gripping

mechanism or implement 18, the third and fifth axially oriented slots 42 and 50 of the first fixed wire-twisting housing section or handle 14 and the first wire-gripping mechanism or implement 18 are respectively coaxially aligned with respect to each other. In a similar manner, when the assembly comprising the second rotatable wire-twisting housing section or handle 16 and the second wire-gripping mechanism or implement 20 are disposed at a predetermined circumferentially rotatable **START** position in preparation for the initiation or commencement of a wire-twisting and tying operation or procedure, as will be discussed more fully hereinafter, the fourth and sixth axially oriented slots 48 and 52 of the second rotatable wire-twisting housing section or handle 16 and the second wire-gripping mechanism or implement 20 will be respectively coaxially aligned with respect to the third and fifth axially oriented slots 42 and 50 of the first fixed wire-twisting housing section or handle 14 and the first wire-gripping mechanism or implement 18. In this manner, a single continuous axially oriented slot, comprising third, fifth, sixth, and fourth slot portions or components 42,50,52,48, is effectively defined throughout substantially the entire longitudinal extent or length of the tool or device 10.

In operation, when the pair of wires 30,32, as are shown in **FIGURE 8**, are to be twisted and tied together so as to form the looped or knotted portion 34 as is also illustrated within **FIGURE 8**, the pair of wires 30,32 are initially radially inserted into the first radially inwardly extending slot or groove 36 such that the longitudinal extents or axes of the wires 30,32 are substantially perpendicular

to the longitudinal axis 38 of the tool or device 10. Due to the aforementioned effective interconnection of the second and third axially oriented, radially inwardly extending slots or grooves 40,42, formed within diametrically opposite sides of the first fixed wire-twisting housing section or handle 14, as facilitated by means of the intermediary first radially inwardly extending slot or groove 36, the tool or device 10 is then able to be pivoted 90° from its original disposition or orientation such that relatively short or minor sections of the pair of wires 30,32 will now be disposed within the second axially oriented slot or groove portion 40 while the relatively long or major free end portions of the wires 30, 32 will now be disposed coaxially within the aforementioned single continuous or common axially oriented slot defined by means of the third, fifth, sixth, and fourth axially oriented slot portions or components 42,50,52,48. The free ends of the wires 30,32 may be axially pulled through the slots 42, 50,52,48 so as to effectively render the same taut and without any slack, and in order to effectively grip the wires 30,32 and prevent the same from loosening around the bale, a pair of rubber plugs 51 are fixedly secured within slots 40 and 42 by means of set screws 53 which are inserted into the first fixed wire-twisting housing section or handle 14 from opposite diametrical positions thereof, although only the rubber plug 51 which is secured within slot 42 is visible in FIGURES 2 and 3.

It is noted further that each one of the first and second wire-gripping mechanisms or implements 18,20 is provided with suitable wire-engaging means 54,56, which may be, for example, similar to the staggered pins 60a,60b as dis-

closed within the aforementioned United States Patent 5,921,289 to Johnson, and in this manner, the axially central portions of the wires 30,32 are respectively properly and securely retained and oriented within the first and second wire-grip-
5 ping mechanisms or implements 18,20 in preparation for the wire-twisting and tying operation or procedure to be subsequently performed thereon. In order to effectively close the end 58 of the tool or device 10, which is disposed opposite the wire-insertion end thereof, so as to effectively prevent
10 the free end portions of the wires 30,32 from becoming dislodged from their axially oriented captured positions within the axially oriented third, fifth, sixth, and fourth slot portions or components 42,50,52,48 of the tool or device 10 during a wire-twisting and tying operation, the second ro-
15 tatable wire-twisting housing section or handle 16 has a cap member 60 rotatably mounted within the end face thereof as best seen in **FIGURES 4 and 5**. The cap member 60 is provided with an axially oriented, radially inwardly extending slot 62 which is alternatively capable of being aligned or non-
20 aligned with respect to the fourth axially oriented slot portion 48 as defined within the second rotatable wire-twisting housing section or handle 16.

When the cap member 60 is rotated to a first position as shown in **FIGURES 4 and 5**, the axially oriented slots
25 62,48 of the cap member 60 and second rotatable wire-twisting housing section or handle 16 are aligned with respect to each other so as to permit radial insertion of the wires 30, 32 therewithin. When, however, the cap member 60 is rotated with respect to the second rotatable wire-twisting housing
30 section or handle 16 through a clockwise angular rotation

of, for example, 180°, as viewed in FIGURES 4 and 5, axially oriented slot 62 of cap member 60 will no longer be aligned with slot 48 of second rotatable wire-twisting housing section or handle 16 whereby the free end portions of the wires 30,32 will effectively be prevented from becoming dislodged or withdrawn from the slot 48 of the second rotatable wire-twisting housing section or handle 16. Upon completion of the wire twisting and tying operation, the cap member 60 can be rotated in the counterclockwise direction back to its original position whereby slot 62 is again aligned with slot 48 of second rotatable wire-twisting housing section or handle 16 such that the completed wires 30,32 can be removed from the tool or device 10. In order to define the extreme limits to which the cap member 60 can be rotated in the aforementioned clockwise and counterclockwise directions so as to in turn define the slot alignment and non-alignment positions, a shoulder bolt 64 is fixedly mounted within the end face of the second rotatable wire-twisting housing section or handle 16, and the cap member 60 is provided with an arcuately configured slot or groove 66. Accordingly, when the cap member 60 is disposed at the illustrated extreme position corresponding to or defining the alignment position of the slot portions 48,62, a first end portion of the arcuate groove or slot 66 will encounter the shoulder bolt 64, whereas when the cap member 60 is rotated to its other extreme position corresponding to or defining the non-alignment position of the slot portions 48,62, a second opposite end portion of the arcuate groove or slot 66 will encounter the shoulder bolt 64.

With reference lastly being made to FIGURES 4,6,

and 7, a last unique feature of the new and improved manually-operated wire twisting and tying tool or device 10 of the present invention resides in the provision of a visual indicating mechanism or gauge means for ensuring that a predetermined number of twists have been impressed upon or imparted to the wires 30,32 during a particular wire twisting and tying operation or procedure. In this manner, the operator can be assured that the twelve-loop twist and tie section within the wires 30,32, as disclosed at 34 in **FIGURE 8**,
10 has in fact been achieved.

More particularly, a gear member 68 is rotatably mounted upon the axially central main housing section 12, by means of a suitable fastener 70, at a position adjacent to the second rotatable wire-twisting housing section or handle
15 16. The gear member 68 is provided with, for example, twelve teeth 72 upon the external circumferential periphery thereof, wherein the teeth 72 are equiangularly spaced apart through means of an angular spacing of 30°. A plate member 74 is fixedly mounted atop the gear member 68, and a first, diametrically extending scribe line 76 is provided upon the
20 upper surface of the plate member 74. A second scribe line 78 is provided upon the second rotatable wire-twisting housing section or handle 16, and the axially inner end face 80 of the second rotatable wire-twisting housing section or
25 handle 16 is provided with an engagement pin 82 which is adapted to successively engage the individual gear teeth 72 of the gear member 68 each time the second rotatable wire-twisting housing section or handle 16, and its operatively associated second wire-gripping implement or mechanism 20,
30 complete a revolution around the longitudinal axis 38 rela-

tive to the first fixed wire-twisting housing section or handle 14, and its operatively associated first wire-gripping mechanism or implement 18, during the performance of a wire twisting and tying operation or procedure. Accordingly, when a wire twisting and tying operation or procedure is to be performed, and as has been noted hereinbefore, the second rotatable wire-twisting housing section or handle 16, and its operatively associated second wire-gripping mechanism or implement 20, are rotated around longitudinal axis 38 so as to be disposed at a **START** position such that the slot portions 48,52 of the second rotatable wire-twisting housing section or handle 16, and its operatively associated second wire-gripping mechanism or implement 20, will be initially coaxially aligned with the slot portions 42,50 of the first fixed wire-twisting housing section or handle 14 and its operatively associated first wire-gripping mechanism or implement 18. At this point in time, the first scribe line 76 of plate member 74 should also be co-linearly aligned with respect to the second scribe line 78 of the second rotatable wire-twisting housing section or handle 16, however, if the angular disposition or orientation of the gear and plate members 68,74 is such that the first scribe line 76 of plate member 74 is not aligned or disposed in a co-linear manner with respect to the second scribe line 78 of the second rotatable wire-twisting housing section or handle 16, the gear and plate members 68,74 may be manually rotated until the first and second scribe lines 76,78 are in fact aligned in a co-linear manner with respect to each other.

It is to be noted that, in connection with the mounting of the gear and plate member assembly 68,74 upon

the axially central main housing section 12, the underside or undersurface of the gear member 68 is provided with a plurality of small, spring-biased ball members, not shown, which are arranged in an equiangularly spaced apart manner
5 corresponding to that of the gear teeth 72, and that the upper surface portion of the axially central main housing section 12, upon which the gear member 68 is rotatably mounted, is correspondingly provided with a similar array of detents or recesses, also not shown, for accommodating the
10 ball members of the gear member 68. As the gear member 68 is therefore rotated in, for example, the clockwise direction as viewed in **FIGURES 6 and 7**, the ball and detent members will permit the gear and plate members 68,74 to be serially moved to, and retained at, successive angular positions
15 which can be readily visually determined, perceived, or appreciated by means of an operator as a result of the relative angular disposition of the first scribe line 76 of the plate member 74 with respect to the second scribe line 76 of the second rotatable wire-twisting housing section or handle
20 16.

Accordingly, the gear and plate members 68,74 can in fact be manually rotated to their **START** positions at which the first and second scribe lines 76,78 are in fact aligned with each other in a co-linear manner. It is also to
25 be noted at this point in time that the engagement pin 82, mounted upon the second rotatable wire-twisting housing section or handle 16, will be disposed angularly beyond a first gear tooth 72 of the gear member 68 which is likewise effectively disposed at the **START** position and co-linearly
30 aligned with the first and second scribe lines 76,78. In

this manner, when the second rotatable wire-twisting housing section or handle 16, and its operatively associated second wire-gripping mechanism or implement 20, have in fact been rotated around longitudinal axis 38 so as to complete one revolution with respect to the first rotatable wire-twisting housing section or handle 14, and its operatively associated first wire-gripping mechanism or implement 18 so as to impress upon, or form within, the wires 30,32 a first one of the twelve loops of the knotted or tied portion 34, the engagement pin 82 will now encounter the first gear tooth 72 of the gear member 68 so as to cause the gear member 68 to rotate through its first angular displacement of 30°. The first scribe line 76 of the plate member 74 will now no longer be co-linearly aligned with the second scribe line 78 of the second rotatable wire-twisting housing section or handle 16, however, when the second rotatable wire-twisting housing section or handle 16, and its operatively associated second wire-gripping mechanism or implement 20, have in fact undergone six complete revolutions, the gear and plate members 68,74, and the first diametrically extending scribe line 76 disposed upon the plate member 74, will have undergone an angular displacement of 180° such that the first diametrically extending scribe line 76 of the plate member 74 will again be co-linearly aligned with the second scribe line 78 of the second rotatable wire-twisting housing section or handle 16 so as to thereby indicate to the operator that the wire twisting and tying operation has in fact been completed.

Upon completion of the entire wire twisting and tying operation, it has been determined that the second ro-

tatable wire-twisting housing section or handle 16, and its operatively associated second wire-gripping mechanism or implement 20, should be rotated an additional quarter-turn or 90°, and then rotated backwardly in a reverse direction a quarter-turn or 90°, so as to effectively twist the wires 30, 32 slightly beyond the final twist or tie point and to subsequently relieve the pressure inherent within such twisted and tied section 34 whereby the wires 30,32 may then be easily removed from the first and second wire-gripping mechanisms or implements 18,20 of the tool or device 10. It is noted that as a result of the last rotation of the second rotatable wire-twisting housing section or handle 16, and the disposition of the engagement pin 82 thereon, the engagement pin 82 will have already encountered the sixth tooth 72 of the gear member 68 and will have rotated the gear member 68 so as to complete the aforementioned 180° rotation. In addition, due to the particular form, shape, or inclined configuration of the forward and rear faces, not shown in detail, of the individual gear teeth 72 disposed upon the gear member 68, the engagement pin 82 of second rotatable wire-twisting housing section or handle 16 will not encounter or interfere with any of the gear teeth 72 disposed upon the gear member 68 during this latter quarter-turn or 90° additional rotation of the second rotatable wire-twisting housing section or handle 16. The tool or device 10 is then ready for use in conjunction with a new wire-twisting operation or procedure.

Thus, it may be seen that in accordance with the principles and teachings of the present invention, there has been disclosed a new and improved manually-operated wire

twisting and tying tool or device which is relatively simple in structure and relatively small in size as to be readily grasped within, and manipulated by, the hands of an operator. The tool or device comprises two handle structures which
5 have wire-twisting mechanisms incorporated therein and which are relatively rotatable with respect to each other so as to impress upon or form within a pair of wires a predetermined number of twists or loops dependent upon the number of revolutions that one of the handle structures, and its operatively
10 tively associated wire-twisting mechanism, undergoes with respect to the other handle structure and its operatively associated wire-twisting mechanism. A gauge mechanism is also integrally incorporated upon the tool or device so as to readily indicate to an operator when the predetermined number
15 ber of relative revolutions of the handles, and that of the operatively associated wire-twisting mechanisms, have been achieved.

Obviously, many variations and modifications of the present invention are possible in light of the above
20 teachings. It is therefore to be understood that within the scope of the appended claims, the present invention may be practiced otherwise than as specifically described herein.

25

The embodiments of the invention in which an exclusive property or privilege is claimed are defined as follows:

1. A manually-operated wire twisting and tying tool for twisting and tying a pair of wires together, comprising:

a support member;

a first handle member mounted upon a first end of said support member and adapted to be grasped by one hand of an operator;

a first wire-twisting implement mounted within said first handle member;

a second handle member mounted upon a second end of said support member and adapted to be grasped by another hand of an operator;

a second wire-twisting implement mounted within said second handle member;

axially oriented slot means, extending through said support member, said first handle member, said first wire-twisting implement, said second handle member, and said second wire-twisting implement, for accommodating the pair of wires to be twisted and tied together in preparation for a wire twisting and tying operation; and

a radially oriented slot oriented within a radial plane which is substantially perpendicular to said axially oriented slot means and which intersects said axially oriented slot means so as to permit the wires, that are to be twisted and tied together, to be inserted through said radially oriented slot and into said axially oriented slot means in preparation for a wire twisting and tying operation,

said first and second handle members, having said first and second wire-twisting implements mounted therein, being rotatable with respect to each other such that when said first and second handle members are rotated with respect to each other, said first and second wire-twisting implements of said first and second handle members impart twists to the pair of wires so as to effectively tie the pair of wires together.

2. The manually-operated wire twisting and tying tool as set forth in claim 1, wherein:
said support member comprises an elongated tubular housing defining a longitudinal axis around which said first and second handle members are relatively rotatable with respect to each other.
3. The manually-operated wire twisting and tying tool as set forth in claim 2, wherein:
said first handle member and said first wire-twisting implement are fixedly mounted within said first end of said support housing; and
said second handle member and said second wire-twisting implement are rotatably mounted within said second end of said support housing.
4. The manually-operated wire twisting and tying tool as set forth in claim 2, wherein said axially oriented slot means comprises:
a first axially oriented slot defined within said first handle member;
a second axially oriented slot defined within said first wire-twisting implement mounted within said first handle member;
a third axially oriented slot defined within said second wire-twisting implement mounted within said second handle member; and
a fourth axially oriented slot defined within said second handle member;
said first, second, third, and fourth slots respectively defined within said first handle member, said first wire-twisting implement, said second wire-twisting implement, and said second handle member being axially alignable with respect to each other so as to define together a single axially oriented slot extending throughout substantially the entire length of said tool so as to house and accommodate the pair of wires to be twisted and tied together in preparation for a wire twisting and tying operation.

5. The manually-operated wire twisting and tying tool as set forth in claim 4, further comprising:

a cap member, having a fifth axially oriented slot defined therein, rotatably mounted upon said second handle member for movement between a first position at which said fifth axially oriented slot of said cap member is axially aligned with said single axially oriented slot extending throughout substantially the entire length of said tool so as to permit insertion of the pair of wires into said single axially oriented slot extending throughout substantially the entire length of said tool in preparation for the performance of a wire twisting and tying operation, and a second position at which said fifth axially oriented slot of said cap member is axially non-aligned with said single axially oriented slot extending throughout substantially the entire length of said tool so as to prevent withdrawal of the pair of wires from said single axially oriented slot extending throughout substantially the entire length of said tool during the performance of a wire twisting and tying operation.

6. The manually-operated wire twisting and tying tool as set forth in claim 5, wherein:

a pin is fixedly mounted within an end portion of said second handle member; and

an arcuately shaped slot is defined within said cap member for operative engagement with said pin fixedly mounted within said end portion of said second handle member such that opposite ends of said arcuately shaped slot define said first and second positions.

7. The manually-operated wire twisting and tying tool as set forth in claim 4, wherein:

said first axially oriented slot is defined upon one lateral side of said first handle member;

a sixth axially oriented slot is defined upon an opposite lateral side of said first handle member; and

said radially oriented slot is defined within said first handle member so as to interconnect said first and sixth axially oriented slots so as to permit the wires, that are to be twisted and tied together, to be inserted into said single axially oriented slot extending throughout substantially the entire length of said tool in preparation for a wire twisting and tying operation.

8. The manually-operated wire twisting and tying tool for twisting and tying tool as set forth in claim 1, further comprising:

visual indicating means for indicating to an operator when a predetermined plural number of revolutions between said first and second handle members, and said first and second wire-twisting implements mounted therein, has been completed so as to ensure the proper twisting and tying together of the pair of wires.

9. The manually-operated wire twisting and tying tool as set forth in claim 8, wherein:

said support member defines a longitudinal axis; and

a plate member is rotatably mounted upon said support member;

said visual indicating means comprising a first scribe line defined upon said plate member, and a second scribe line defined upon said second handle member such that when a wire twisting operation is being initiated, said first and second scribe lines will be co-linearly aligned with each other, and when said wire twisting operation is completed, said first and second scribe lines will again be co-linearly aligned with each other.

10. The manually-operated wire twisting and tying tool as set forth in claim 9, further comprising:

a gear member, upon which said plate member is fixedly mounted, rotatably mounted upon said support member and comprising a plurality of circumferentially spaced gear teeth; and

an engagement pin mounted upon said second handle member for successively engaging said gear teeth of said gear member as said second handle member is rotated around said longitudinal axis so as to rotate said gear member, and said plate member fixedly mounted thereon, a predetermined angular extent so as to again cause co-linear alignment of said first and second scribe lines defined upon said plate member and said second handle member thereby indicating completion of the wire twisting and tying operation.

11. The manually-operated wire twisting and tying tool as set forth in claim 10, wherein:
said first scribe line defined upon said plate member extends diametrically across said plate member; and
said gear teeth formed upon said gear member are circumferentially spaced through angular extents of 30° whereupon said first and second scribe lines of said plate member and said second handle member will be aligned with respect to each other after six revolutions of said second handle member around said longitudinal axis which causes said plate member to undergo a rotational movement comprising 180° .
12. The manually-operated wire twisting and tying tool as set forth in claim 8, wherein:
said support member comprises an elongated tubular housing defining said longitudinal axis around which said first and second handle members are relatively rotatable with respect to each other.
13. The manually-operated wire twisting and tying tool as set forth in claim 12, wherein:
said first handle member and said first wire-twisting implement are fixedly mounted within said first end of said support tubular housing; and
said second handle member and said second wire-twisting implement are rotatably mounted within said second end of said support housing.
14. The manually-operated wire twisting and tying tool as set forth in claim 12, wherein said axially oriented slot means comprises:
a first axially oriented slot is defined within said first handle member;
a second axially oriented slot is defined within said first wire-twisting implement mounted within said first handle member;
a third axially oriented slot is defined within said second wire-twisting implement mounted within said second handle member; and

a fourth axially oriented slot is defined within said second handle member;

said first, second, third, and fourth slots respectively defined within said first handle member, said first wire-twisting implement, said second wire-twisting implement, and said second handle member being axially alignable with respect to each other so as to define together a single axially oriented slot extending throughout substantially the entire length of said tool so as to house and accommodate the pair of wires to be twisted and tied together in preparation for a wire twisting and tying operation.

15. The manually-operated wire twisting and tying tool as set forth in claim 14, further comprising:

a cap member, having a fifth axially oriented slot defined therein, rotatably mounted upon said second handle member for movement between a first position at which said fifth axially oriented slot of said cap member is axially aligned with said single axially oriented slot extending throughout substantially the entire length of said tool so as to permit insertion of the pair of wires into said single axially oriented slot extending throughout substantially the entire length of said tool in preparation for the performance of a wire twisting and tying operation, and a second position at which said fifth axially oriented slot of said cap member is axially non-aligned with said single axially oriented slot extending throughout substantially the entire length of said tool so as to prevent withdrawal of the pair of wires from said single axially oriented slot extending throughout substantially the entire length of said tool during the performance of a wire twisting and tying operation.

16. The manually-operated wire twisting and tying tool as set forth in claim 15, wherein:

a pin is fixedly mounted within an end portion of said second handle member; and

an arcuately shaped slot is defined within said cap member for operative engagement with said pin fixedly mounted within said end portion of said second handle member such that opposite ends of said arcuately shaped slot define said first and second positions.

17. The manually-operated wire twisting and tying tool as set forth in claim 14, wherein:
 said first axially oriented slot is defined upon one lateral side of said first handle member;
 a sixth axially oriented slot is defined upon an opposite lateral side of said first handle member; and

a radially oriented slot is defined within said first handle member so as to interconnect said first and sixth axially oriented slots so as to permit the wires, that are to be twisted and tied together, to be inserted into said single axially oriented slot extending throughout substantially the entire length of said tool in preparation for a wire twisting and tying operation.

18. A method of twisting and tying a pair of wires together, by using a manually-operated wire twisting and tying tool, comprising the steps of:

providing a support member;

mounting a first handle member, adapted to be grasped by one hand of an operator, upon a first end of said support member;

providing a first wire-twisting implement within said first handle member;

mounting a second handle member, adapted to be grasped by another hand of an operator, upon a second end of said support member;

providing a second wire-twisting implement within said second handle member;

providing axially oriented slot means, that extends through said support member, said first handle member, said first wire-twisting implement, said second handle member, and said second wire-twisting implement, for accommodating the pair of wires to be twisted and tied together in preparation for a wire twisting and tying operation;

providing a radially oriented slot that is oriented within a radial plane which is substantially perpendicular to said axially oriented slot means and which intersects said axially oriented slot means;

inserting the pair of wires, that are to be twisted and tied together, into said radially oriented slot;

pivoting said tool such that the pair of wires to be twisted and tied together are effectively transferred from said radially oriented slot to said axially oriented slot means in preparation for a wire twisting and tying operation; and

rotating said first and second handle members, having said first and second wire-twisting implements mounted therein, with respect to each other such that said first and second wire-twisting implements of said first and second handle members impart twists to the pair of wires so as to effectively tie the pair of wires together.

19. The method as set forth in claim 18, wherein said step of providing said axially oriented slot means further comprises the steps of:

providing a first axially oriented slot within said first handle member;

providing a second axially oriented slot within said first wire-twisting implement mounted within said first handle member;

providing a third axially oriented slot within said second wire-twisting implement mounted within said second handle member; and

providing a fourth axially oriented slot within said second handle member such that said first, second, third, and fourth slots respectively defined within said first handle member, said first wire-twisting implement, said second wire-twisting implement, and said second handle member are axially alignable with respect to each other so as to define together a single axially oriented slot extending throughout substantially the entire length of said tool so as to house and accommodate the pair of wires to be twisted and tied together in preparation for a wire twisting and tying operation.

20. The method as set forth in claim 19, further comprising the steps of:

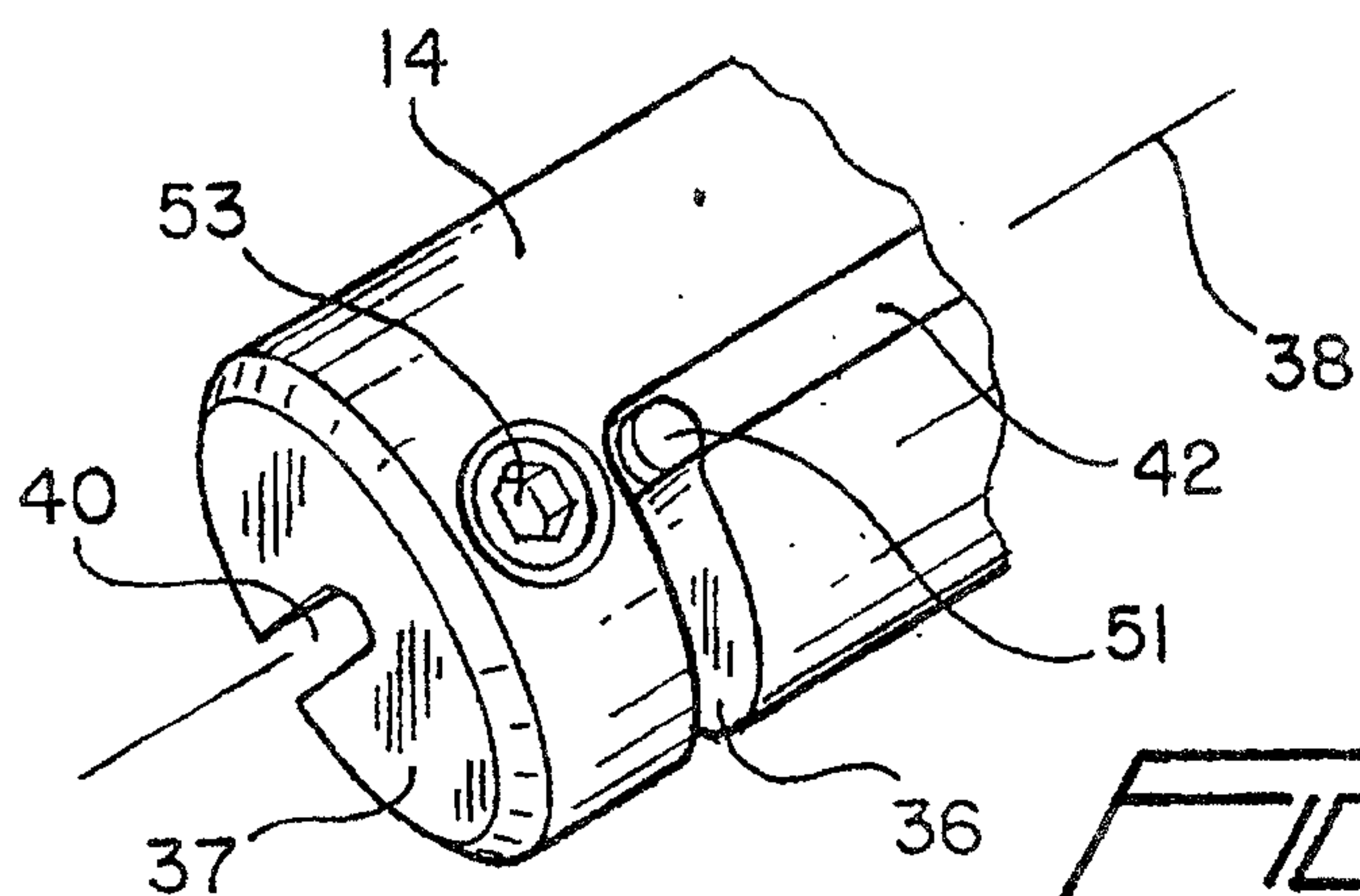
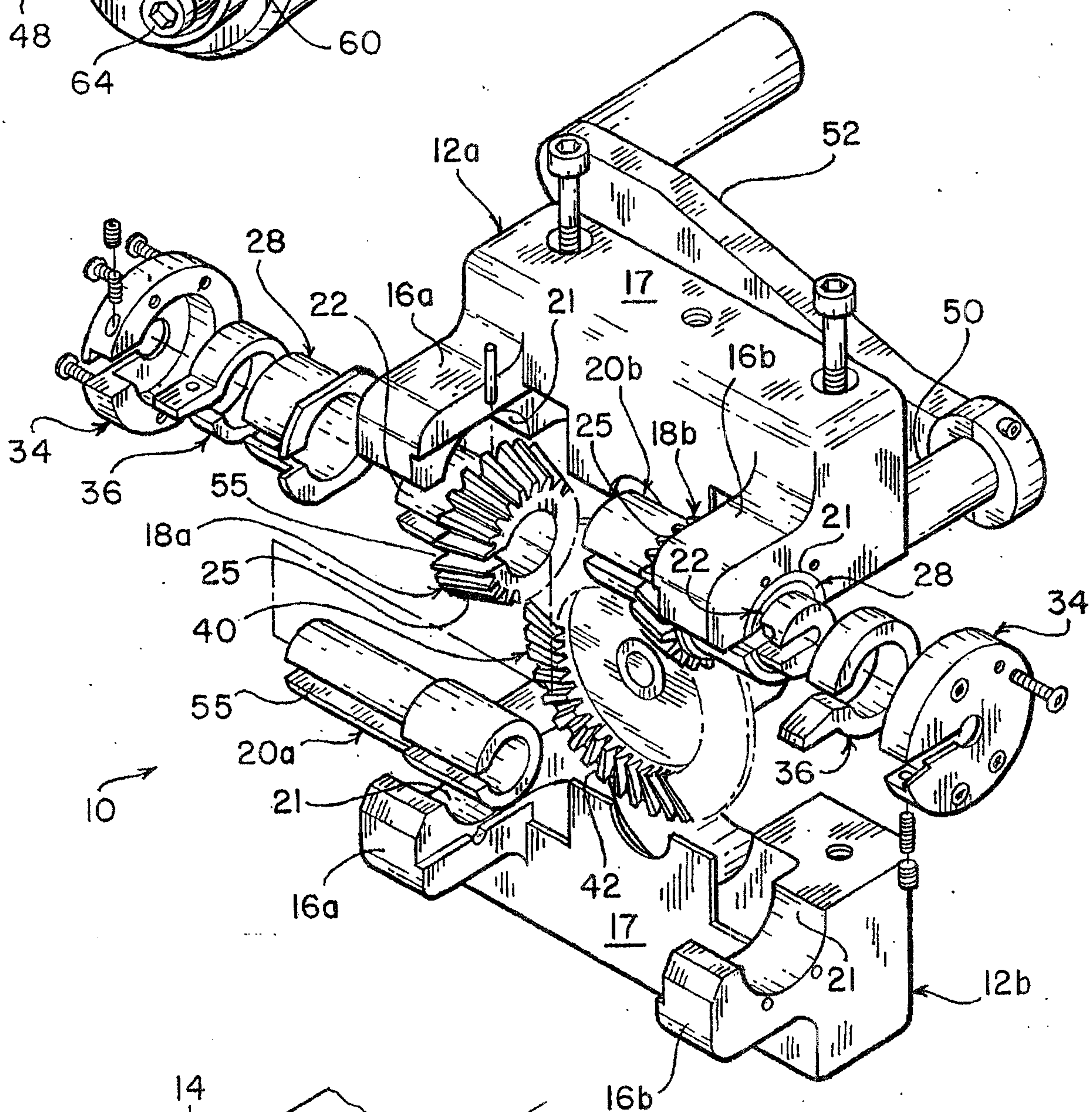
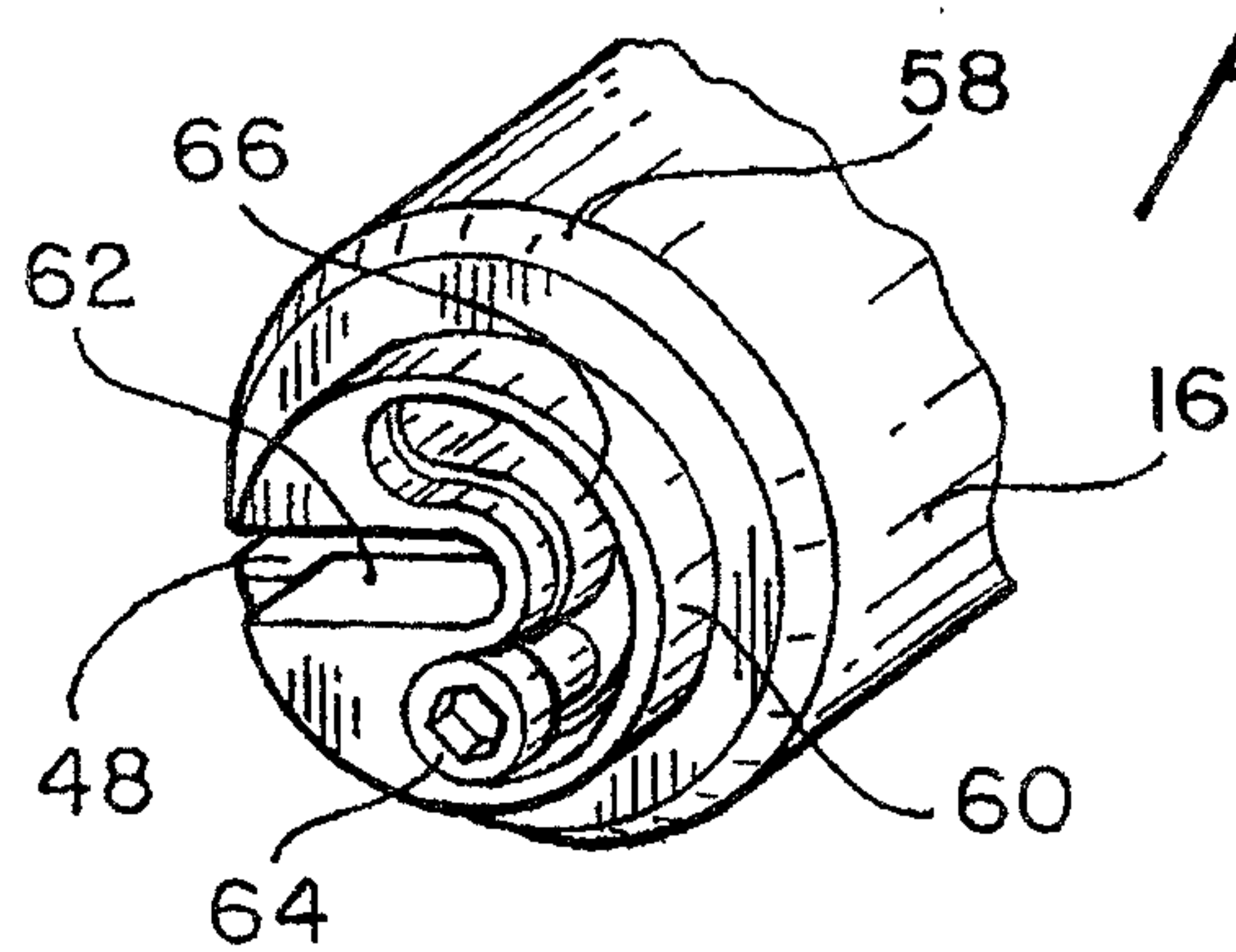
forming said first axially oriented slot within one lateral side of said first handle member;

forming a fifth axially oriented slot within an opposite lateral side of said first handle member; and

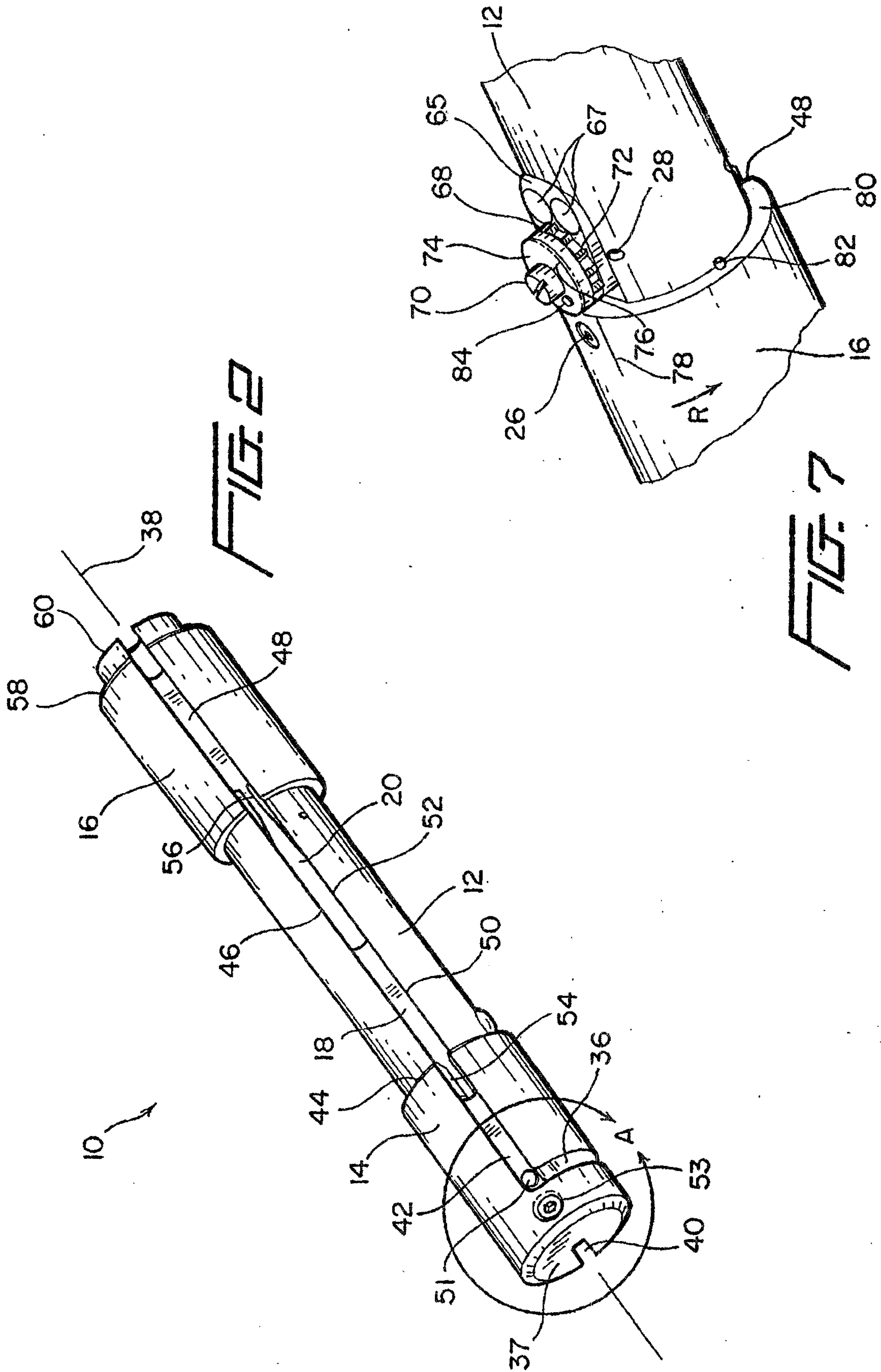
forming said radially oriented slot within said first handle member so as to interconnect said first and fifth axially oriented slots.

21. The method as set forth in claim 19, further comprising the step of:

rotatably mounting a cap member, having a sixth axially oriented slot defined therein, upon said second handle member for movement between a first position at which said sixth axially oriented slot of said cap member is axially aligned with said single axially oriented slot extending throughout substantially the entire length of said tool so as to permit insertion of the pair of wires into said single axially oriented slot extending throughout substantially the entire length of said tool in preparation for the performance of a wire twisting and tying operation, and a second position at which said sixth axially oriented slot of said cap member is axially non-aligned with said single axially oriented slot extending throughout substantially the entire length of said tool so as to prevent the withdrawal of the pair of wires from said single axially oriented slot extending throughout substantially the entire length of said tool during the performance of a wire twisting and tying operation.



Edgar A. Sengeler
PATENT AGENTS



William W. Singleton
PATENT AGENTS

