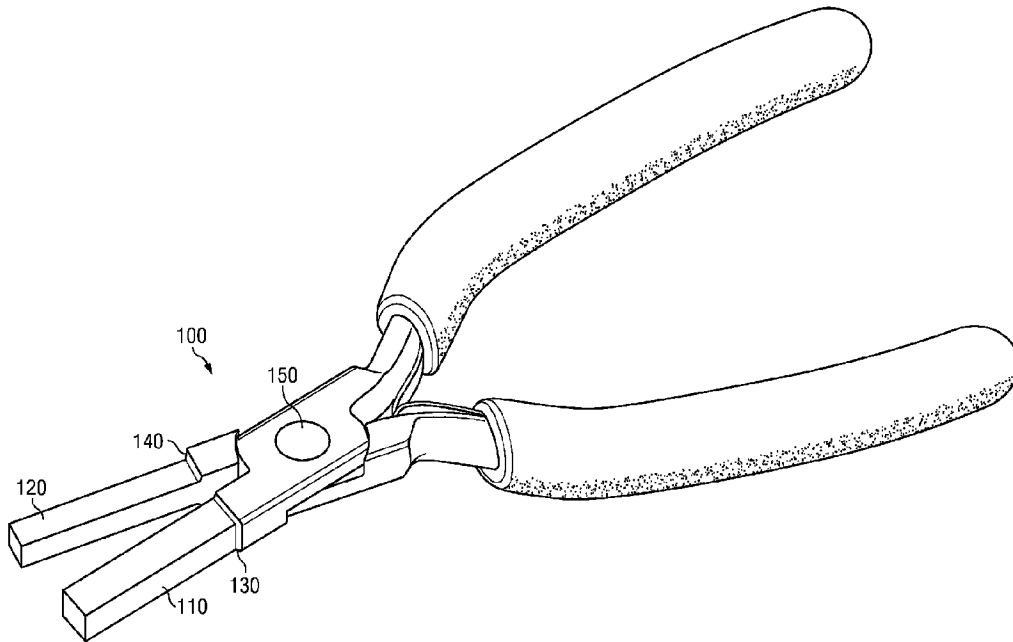




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(54) Titre : PINCE A BECS POUR BIJOUTERIE ET PROCEDE POUR SON UTILISATION  
 (54) Title: JEWELRY MANDREL PLIERS AND METHOD OF USING SAME



(57) **Abrégé/Abstract:**

The present invention provides a mandrel tool and method for more efficiently and consistently forming various shapes of material. In one embodiment of the invention, a pair of pliers having mandrel jaws that are shaped with a uniform cross sectional area throughout a length of the mandrel jaw is used to replace the traditional tapered mandrel. The mandrel pliers of the present invention may be used to grip wire or sheet metal and form it into unique shapes such as squares, triangles, ovals, or circles. Because the mandrel jaws have a uniform cross sectional area, the wire, for example, can be wrapped multiple times around the mandrel jaw when it is desired to produce multiples of the same shape. For added versatility, the pliers can have opposing mandrel jaws, each having a different size cross sectional area than the other so that a shape of a larger size can be created on one side of the pair of pliers and a shape of a smaller size can be reproduced on the other side of the pair of pliers.

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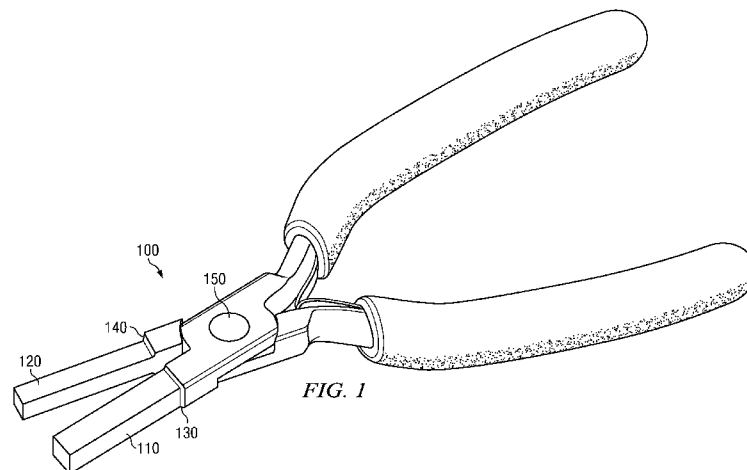
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(54) **Title:** JEWELRY MANDREL PLIERS AND METHOD OF USING SAME

(57) **Abstract:** The present invention provides a mandrel tool and method for more efficiently and consistently forming various shapes of material. In one embodiment of the invention, a pair of pliers having mandrel jaws that are shaped with a uniform cross sectional area throughout a length of the mandrel jaw is used to replace the traditional tapered mandrel. The mandrel pliers of the present invention may be used to grip wire or sheet metal and form it into unique shapes such as squares, triangles, ovals, or circles. Because the mandrel jaws have a uniform cross sectional area, the wire, for example, can be wrapped multiple times around the mandrel jaw when it is desired to produce multiples of the same shape. For added versatility, the pliers can have opposing mandrel jaws, each having a different size cross sectional area than the other so that a shape of a larger size can be created on one side of the pair of pliers and a shape of a smaller size can be reproduced on the other side of the pair of pliers.

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## JEWELRY MANDREL PLIERS AND METHOD OF USING SAME

### BACKGROUND OF THE INVENTION

#### 1. Technical Field

[0001] The present invention relates to a tool for manufacturing jewelry and a method of using such tool. More particularly, this invention relates to a jewelry mandrel constructed in the form of pliers and method, which can be used by jewelers to fabricate jewelry into various shapes.

#### 2. Description of Related Art

[0002] Jewelers have long relied on tapered steel mandrels to fabricate wire or metal shapes for use in their jewelry designs. Tapered mandrels are available in cross sections of various shapes including round, square, triangle, oval, and hexagon. The mandrels are made of steel and provide a surface against which the jeweler can hammer to facilitate the shaping of the material being worked. The taper on the mandrel allows shapes of different sizes to be fabricated using a single mandrel. Although tapered steel mandrels are useful for certain tasks, they present the jeweler with challenges.

[0003] The taper on the mandrel makes it difficult to make shapes of the exact size when multiple items are being produced. The reason for this is that the circumference of the particular shape at issue has a tendency to stretch as it is worked on a tapered mandrel, particularly when working with wire. When making multiple items of the same size, each item must be formed one at time when it is made using a tapered mandrel. Because of the difficulty in placing the material in the exact same place on the tapered mandrel while hammering it into shape, the resulting shapes are often of a slightly different size.

[0004] To form a band from a strip of metal using a tapered mandrel, the band must frequently be removed and flipped so that the band does not become larger on one side than the other. The wider a particular band, the more difficult it becomes to keep both edges of the band the same size.

[0005] Moreover although a tapered mandrel can be used to produce a shape with sharp corners such a triangle or a square, it is not an easy task. The jeweler must first start with a closed ring or loop and then hammer it down around the mandrel until it produces a sharply defined shape. However, hammering a piece of soft wire or metal on a tapered mandrel often results in the shape being stretched beyond the circumference desired.

[0006] Finally, a tapered mandrel is awkward and is difficult to hold by hand. It can be placed in a large vise to hold it, but this method is time consuming and inconvenient. The vise also makes it difficult to obtain a good view of the entire piece in that the mandrel would need to be removed from the vise and rotated to obtain a good view of the back side of the mandrel.

[0007] It is therefore an object of the invention to provide a jewelry mandrel tool and method of using same that enables a user to easily, consistently, and repeatedly replicate the same shape and size. It is also an object of the invention to provide a tool for making numerous rings or other shapes in a more efficient manner and to provide a tool that makes it easier for the jeweler to view the work as it is being formed. It is an object of the invention to provide a tool that allows the wire or metal being formed to be gripped so that shapes can be made without the need for starting with a closed metal ring or tube.

**SUMMARY OF AN EMBODIMENT OF INVENTION**

[0008] The present invention provides a mandrel tool and method for more efficiently and consistently forming various shapes of material. In one embodiment of the invention, a pair of pliers having mandrel jaws that are shaped with a uniform cross sectional area throughout a length of the mandrel jaw is used to replace the traditional tapered mandrel. The mandrel pliers of the present invention may be used to grip wire or sheet metal and form it into unique shapes such as squares, triangles, ovals, or circles. Because the mandrel jaws have a uniform cross sectional area, the wire, for example, can be wrapped multiple times around the mandrel jaw when it is desired to produce multiples of the same shape. For added versatility, the pliers can have opposing mandrel jaws, each having a different size cross sectional area than the other so that a shape of a larger size can be created on one side of the pair pliers and a shape of a smaller size can be reproduced on the other side of the pair of pliers.

#### BRIEF DESCRIPTION OF THE DRAWINGS

[0009] **Fig. 1** is a perspective view of a pair of mandrel pliers in accordance with an embodiment of the present invention.

[0010] **Fig. 2** is an end view of a pair of mandrel pliers in accordance with an embodiment of the present invention.

[0011] **Figs. 3-7** illustrate a method of using a pair of mandrel pliers to make a square jump ring in accordance with an embodiment of the invention.

[0012] **Figs. 8-10** illustrate a method of using a pair of mandrel pliers to make a square tube in accordance with an embodiment of the invention.

[0013] **Fig. 11** is a perspective view of some examples of shapes that can be made using an embodiment of the mandrel pliers and method of the present invention.

[0013A] **Figs. 12-13** illustrate perspective views of mandrel pliers with oversized mandrel jaws.

**DETAILED DESCRIPTION**

[0014] Referring now to **Fig. 1**, a perspective view of a pair of mandrel pliers in accordance with an embodiment of present invention is illustrated. The pliers **100** have mandrel jaws **110**, **120**, each having a uniform square cross sectional area along a length from the tip of the mandrel jaw to the raised areas **130**, **140** that are near the pivot **150** of the pliers **100**. To allow more versatility for the pliers **100** and to require fewer pliers to be purchased by the jeweler to manufacture shapes of various sizes, the mandrel jaws **110**, **120** can be constructed of different dimensions. As illustrated, the cross sectional area of the mandrel jaw **110** is larger than the cross sectional area of the opposing mandrel jaw **120**.

[0015] Referring now to **Fig. 2**, an end view of a pair of mandrel pliers in accordance with an embodiment of the present invention is illustrated. The upper mandrel jaw **110** has a larger cross sectional area than the lower mandrel jaw **120**.

[0016] Although mandrel jaws **110**, **120** are illustrated in the form of square mandrels, various shapes can be utilized for the mandrel jaw **110**, **120** without departing from the spirit and scope of the invention. For example, the mandrel jaws could be triangular, round, oval, rectangular, or any other shape that is desired by a jeweler for shaping jewelry. Additionally, the opposing jaws could each be a different shape. For example, one jaw could have a triangular cross section and the other jaw could have a square cross section.

[0017] Referring now to **Figs. 3-7**, a method of using the mandrel pliers **100** to make a square jump ring in accordance with an embodiment of the invention is illustrated. To make square jump rings (or links) with the pliers **100**, the wire **310** is placed between the mandrel jaws **110**, **120** and gripped firmly as the user wraps the wire **310** around the outside of the mandrel jaw **110** while pulling tightly on the wire **310**. Once the wire is wrapped around to the opposing side of the mandrel pliers **100** the mandrel jaws **110**, **120** are then opened by the user to allow the user to continue wrapping the wire around the mandrel jaw **110**. Once the wire is placed through the space **410** between the mandrel jaws **110**, **120**, the user re-grips the wire and repeats the process pulling the wire tightly around the mandrel jaw **110** again as shown in **Fig. 4**. This process is continued until the desired number of wraps is reached. The bends of the coil **510** at

the corners of the mandrel jaw **110** can be sharpened by hammering the three exposed sides of the coil directly onto the mandrel jaw **110** with a hammer **520** as shown in **Fig. 5**. After forming, the coil **510** is slid off of the mandrel jaw **110**. The coil **510** can be used as is to make jewelry or the coil can be cut as shown in **Fig. 6** to produce a square jump ring **710** as shown in **Fig. 7**.

[0018] Referring now to **Figs. 8-10**, a method of using the mandrel pliers **100** to make a square tube in accordance with an embodiment of the invention is illustrated. To make a square tube with the pliers **100**, a strip of sheet metal **810** is placed between the mandrel jaws **110**, **120** and gripped firmly as the user wraps the strip of sheet metal **810** around the outside of the mandrel jaw **110** while pulling tightly on the sheet metal **810**. Depending on the thickness and flexibility of the sheet metal **810**, it may be desirable to square each corner off more precisely by hammering directly on the mandrel jaw of the pliers after each bend as shown in **Fig. 9**. Once the formation of the sheet metal is completed, the square tube **1010** can be slid off the mandrel jaw **110** as shown in **Figure 10**. The excess sheet metal **810** can then be trimmed adjacent to the square tube **1010**. To complete the square tube, the joint may be soldered as is known in the art.

[0019] Referring now to **Fig. 11**, some examples of shapes that can be made using the method of the present invention are illustrated. These shapes have many applications for a jewelry designer. The tubes can be soldered together to make big-hole beads or the jeweler can make bezels for setting stones or holding resin. A disk can also be soldered to each end of the tube to create matching hollow beads. The square coils can be linked together, fused, or soldered to make a fancy tube **1110**. As previously discussed, the square coils can also be cut to make jump rings or links that can be flattened and textured with hammers.

[0020] Referring now to **Figs. 12 and 13**, perspective views of mandrel pliers with oversized mandrel jaws is illustrated. The pliers of **Fig. 12** have oversized cylindrical jaws **1210**, **1220**. The jaws each have a different cross-sectional area to allow circular shapes of different sizes to be formed. Similarly, the pliers of **Fig. 13** have oversized cylindrical jaws **1210**, **1220**. The jaws each have a different cross-sectional area to allow circular shapes of different sizes to be formed. Pliers with oversized jaws can be constructed by first forming the desired mandrel jaws **1320**, **1310** and then welding the mandrel jaws to the ends **1340**, **1350** of the plier handle assembly. The pliers of **Fig. 1** can be formed by machining the mandrel jaws **110**, **120** and one half of the

plier assembly from a single piece of stock. Because of the large size of the mandrel jaws of the pliers illustrated in **Figs. 12 and 13**, welding of the mandrel jaws to the plier assembly may be a more efficient method of manufacturing the pliers than machining would be.

**[0021]** The tool and method of the present invention thus provides an efficient and consistent method for a jeweler to make shapes using mandrels. When making shapes with sharp corners it is no longer necessary to join a loop together and form it by hammering it on a tapered mandrel. Because the loop can be left opened, the shapes can be more easily joined directly to each other before soldering them closed. A step is saved and finishing is easier because the jeweler does not have to cut the shape open and then re-solder. In addition, there are applications for open shapes to be used where it is not necessary to solder it closed, in which case, the step of cutting the formed link is saved.

**[0022]** The jeweler can make square, oval, circular, triangular, rectangular and other shapes in multiples rather than one at a time as is required when using a tapered mandrel. The jeweler can also maintain a consistent circumference of the shaped piece without having to flip the piece over repetitively as is required when working wired pieces of material on a tapered mandrel. A vise is no longer necessary because the jeweler can easily grip the material by hand using the mandrel pliers. The mandrel pliers allow the jeweler a good view of both the front and the back of the piece by changing the position of the handle on the pliers as the material is being worked. This makes it possible to wrap perfect coil in various shapes as desired by a jeweler.

**[0023]** Although the invention is described above and in the drawings using mandrel jaws of the same shapes, square, circular, etc., the invention is not limited to jaws of the same shape. For example, one jaw could be a square shape and the other rectangular. One could be triangular and the other circular. The mandrel jaws can also be chosen such that special shapes like hearts or teardrops can be formed. One jaw could be of a “v” or triangular shape that mates with an opposing heart shaped jaw to allow the formation of a crisp “v” or cleft in the top of the heart. Alternatively, one jaw could be of a “v” shape that mates with the bottom of the teardrop on a teardrop shaped opposing jaw. Numerous other shapes could also be formed with the mandrel pliers of the present invention by using various shapes on the jaws of the pliers.

[0024] Although the invention hereof has been described by way of a preferred embodiment, it will be evident that other adaptations and modifications can be employed without departing from the spirit and scope thereof. The terms and expressions employed herein have been used as terms of description and not of limitation; and thus, there is no intent of excluding equivalents, but on the contrary it is intended to cover any and all equivalents that may be employed without departing from the spirit and scope of the invention. For example, the shapes of the mandrel jaws could be any shape desired by the jeweler, including non-traditional shapes.

**CLAIMS:**

1. A pair of mandrel pliers for forming a material during the manufacture of jewelry, said pair of mandrel pliers comprising:
  - a first member having a first handle on a first proximal end of said first member and a first mandrel jaw on a distal end of said first member;
  - a second member having a second handle on a proximal end of said second member and a second mandrel jaw on a first distal end of said second member;
  - wherein said first member and said second member are attached at a connection point that divides the first member into the first proximal end and the first distal end, and divides the second member into the second proximal end and the second distal end;
  - wherein the first distal end and the second distal end comprise a distal length measured from the connection point to a terminal location at an end of the first and second distal ends;
  - wherein the first mandrel jaw extends almost entirely the distal length;
  - wherein the second mandrel jaw extends almost entirely the distal length;
  - wherein the connection point permits pivoting movement between said first mandrel jaw and said second mandrel jaw such that said first mandrel jaw and said second mandrel jaw are opposed and movable coplanarly with respect to each other in response to a squeezing force being applied to said first handle and said second handle,
  - wherein said first mandrel jaw has a first uniform cross-sectional area throughout its length and wherein said second mandrel jaw has a second uniform cross-sectional area throughout its length, and wherein said first mandrel jaw and said second mandrel jaw are for securely gripping said material placed there between upon the application of said squeezing force to said first handle and said second handle by a user.
2. The mandrel pliers of claim 1 wherein said first uniform cross-sectional area and said second uniform cross-sectional area have the same shape.
3. The mandrel pliers of claim 2 wherein said first uniform cross-sectional area is larger than said second uniform cross-sectional area.
4. The mandrel pliers of claim 1 wherein said first cross-sectional area is triangular and said second cross-sectional area is heart shaped and wherein said first mandrel jaw and said second mandrel jaw are

oriented such that a corner of said first mandrel jaw can mate with a cleft in said second mandrel jaw to allow a heart shaped piece to be formed with said pair of mandrel pliers.

5. The mandrel pliers of claim 1 wherein said first cross-sectional area is v-shaped and said second cross-sectional area is teardrop shaped and wherein said first mandrel jaw and said second mandrel jaw are oriented such that the inside of a v in the first mandrel jaw can mate with the bottom of a teardrop of the second mandrel jaw to allow a teardrop shaped piece to be formed with said pair of mandrel pliers.

6. The mandrel pliers of claim 2 wherein said first cross-sectional area is larger than a third cross-sectional area of a structure of said pair of mandrel pliers to which said first mandrel jaw is attached.

7. The mandrel pliers of claim 1 wherein said first uniform cross-sectional area is larger than said second uniform cross-sectional area.

8. The mandrel pliers of claims 1 or 7 wherein said first cross-sectional area has a shape of a square.

9. The mandrel pliers of claims 1 or 7 wherein said first cross-sectional area has a shape of a triangle.

10. The mandrel pliers of claims 1 or 7 wherein said first cross-sectional area has a shape of a rectangle.

11. The mandrel pliers of claims 1 or 7 wherein said first cross-sectional area has a shape of an oval.

12. The mandrel pliers of claims 1 or 7 wherein said first cross-sectional area has a shape of a circle.

13. The mandrel pliers of claim 1 wherein said first mandrel jaw is attached to said first member by welding.

14. A pair of mandrel pliers for forming a material during the manufacture of jewelry, said pair of mandrel pliers comprising:

a first member having a first handle on a first proximal end of said first member and a first mandrel jaw on a first distal end of said first member;

a second member having a second handle on a second proximal end of said second member and a second mandrel jaw on a second distal end of said second member;

wherein said first member and said second member are attached at a connection point that divides the first member into the first proximal end and the first distal end, and divides the second member into the second proximal end and the second distal end;

wherein the first distal end and the second distal end comprise a distal length measured from the connection point to a terminal location at an end of the first and second distal ends;

wherein the first mandrel jaw extends almost entirely the distal length;

wherein the second mandrel jaw extends almost entirely the distal length;

wherein the connection point permits pivoting movement between said first mandrel jaw and said second mandrel jaw such that said first mandrel jaw and said second mandrel jaw are opposed and movable with respect to each other in response to a squeezing force being applied to said first handle and said second handle;

wherein said first mandrel jaw and said second mandrel jaw are for securely gripping said material placed at a location between opposing surfaces of said first and said second mandrel jaws upon the application of said squeezing force to said first handle and said second handle by a user, wherein a first cross-sectional area of said first mandrel jaw at said location is different from a second cross-sectional area of said second mandrel jaw at said location.

15. The mandrel pliers of claim 14, wherein said first cross-sectional area is rectangular, said second cross-sectional area is rectangular, or a combination thereof.

16. The mandrel pliers of claim 14, wherein said first cross-sectional area is triangular, said second cross-sectional area is triangular, or a combination thereof.

17. The mandrel pliers of claim 14, wherein said first cross-sectional area is oval, said second cross-sectional area is oval, or a combination thereof.

18. The mandrel pliers of claim 14, wherein said first cross-sectional area is circular, said second cross-sectional area is circular, or a combination thereof.

19. The mandrel pliers of claim 14, wherein wrapping said material around said first mandrel jaw at said location forms a first loop enclosing a first area, and wherein wrapping said material around said

second mandrel jaw at said location forms a second loop enclosing a second area different than said first area.

20. The mandrel pliers of claim 14 wherein said second cross-sectional area is triangular and said first cross-sectional area is heart shaped and wherein said first mandrel jaw and said second mandrel jaw are oriented such that a corner of said second mandrel jaw can mate with a cleft in said first mandrel jaw to allow a heart shaped piece to be formed with said mandrel pliers.

21. The mandrel pliers of claim 14 wherein said second cross-sectional area is v-shaped and said first cross-sectional area is teardrop shaped and wherein said first mandrel jaw and said second mandrel jaw are oriented such that the inside of a v in the second mandrel jaw can mate with an acute angle of a teardrop of the first mandrel jaw to allow a teardrop shaped piece to be formed with the mandrel pliers.

22. The mandrel pliers of claim 14, wherein said first member and said first mandrel jaw are machined from a single piece of stock, said second member and said second mandrel jaw are machined from a single piece of stock, or a combination thereof.

23. The mandrel pliers of claim 14, wherein said first and second mandrel jaws are solid mandrel jaws.

24. A method of forming a material using a pair of mandrel pliers having a first member with a first handle on a first proximal end of said first member and a first mandrel jaw on a first distal end of said first member, and a second member with a second handle on a second proximal end of said second member and a second mandrel jaw on a second distal end of said second member, the method comprising:

a) placing said material between the first mandrel jaw and the second mandrel jaw of a pair of mandrel pliers,

wherein said first member and said second member are attached at a connection point that divides the first member into the first proximal end and the first distal end, and divides the second member into the second proximal end and the second distal end,

wherein the first distal end and the second distal end comprise a distal length measured from the connection point to a terminal location at an end of the first and second distal ends,

wherein the first mandrel jaw extends almost entirely the distal length,

wherein the second mandrel jaw extends almost entirely the distal length, and

wherein said first mandrel jaw has a first uniform cross-sectional area throughout a length of the first mandrel jaw and wherein said second mandrel jaw has a second uniform cross-sectional area throughout a length of the second mandrel jaw; and

b) bending said material at least partially around said first mandrel jaw by applying a squeezing force to a first handle and a second handle of said pair of mandrel pliers and pulling on said material while wrapping said material around said first mandrel jaw;

said first mandrel jaw has a first uniform cross-sectional area throughout its length and said second mandrel jaw has a second uniform cross-sectional area throughout its length, the second mandrel jaw being opposed to, the first mandrel jaw, said first mandrel jaw and said second mandrel jaw movable with respect to each other in response to the force being applied to said first handle and said second handle of said pair of mandrel pliers and wherein said first mandrel jaw and said second mandrel jaw are for securely gripping a wire placed between said first and second mandrel jaws upon the application of a squeezing force to a first handle and a second handle of said mandrel pliers by a user.

25. The method of claim 24 wherein said first uniform cross-sectional area and said second uniform cross-sectional area are the same shape.

26. The method of claim 25 wherein the first uniform cross-sectional area is larger than the second uniform cross-sectional area.

27. The method of claim 25 wherein said first cross-sectional area is substantially in the shape of a square.

28. The method of claim 27 wherein said material is a piece of wire such that performing the steps of the method results in the formation of at least one substantially square loop.

29. The method of claim 28 wherein a substantially square coil of wire is formed by repeating the steps of the method.

30. The method of claim 27 wherein said material is a rectangular piece of sheet metal such that performing the steps of the method results in the formation of a substantially square tube.

31. The method of claim 25 wherein said first cross-sectional area has the shape of a triangle.

32. The method of claim 25 wherein said first cross-sectional area is larger than a third cross-sectional area of a structure of the pliers to which said first mandrel jaw is attached.

33. A method for forming a material using a pair of mandrel pliers having a first member with a first handle on a first proximal end of said first member and a first mandrel jaw on a first distal end of said first member, and a second member with a second handle on a second proximal end of said second member and a second mandrel jaw on a second distal end of said second member, the method comprising:

placing said material at a location between the first mandrel jaw and the second mandrel jaw, wherein said first member and said second member are attached at a connection point that divides the first member into the first proximal end and the first distal end, and divides the second member into the second proximal end and the second distal end,

wherein the first distal end and the second distal end comprise a distal length measured from the connection point to a terminal location at an end of the first and second distal ends,

wherein the first mandrel jaw extends almost entirely the distal length,

wherein the second mandrel jaw extends almost entirely the distal length;

applying a squeezing force to a first handle and a second handle to securely grip the material at the location between said first mandrel jaw and said second mandrel jaw;

selecting between forming a first loop at least partially enclosing a first area or forming a second loop at least partially enclosing a second area different than said first area;

pulling on said material while wrapping said material at least partially around said first mandrel jaw to form said first loop or pulling on said material while wrapping said material at least partially around said second mandrel jaw to form said second loop; and

wherein said first mandrel jaw is substantially opposed to said second mandrel jaw, wherein said first mandrel jaw and said second mandrel jaw are movable with respect to each other in response to the squeezing force being applied to a first handle and a second handle of said pair of mandrel pliers, and wherein said first mandrel jaw and said second mandrel jaw are for securely gripping said material placed between said first and second mandrel jaws upon the application of the squeezing force to a first handle and a second handle of said mandrel pliers by a user.

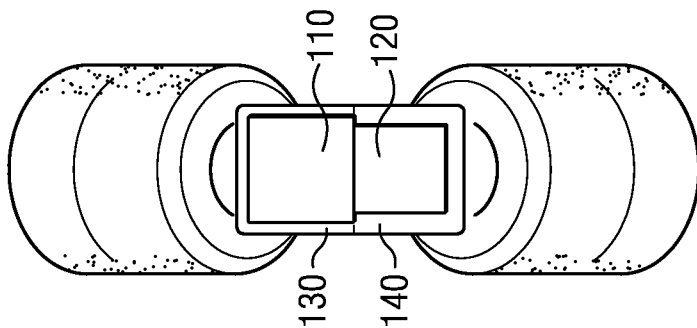
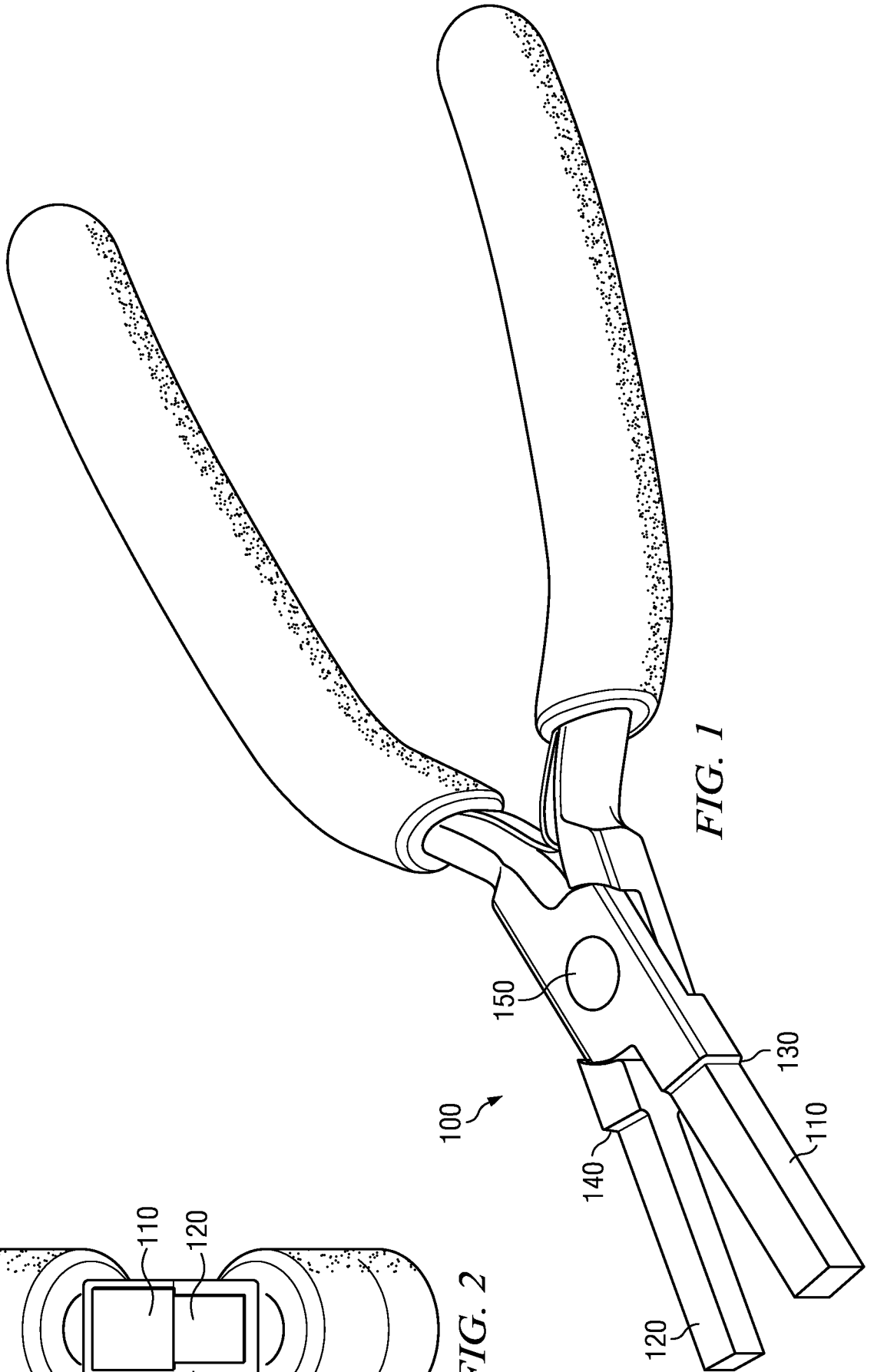
34. The method of claim 33 further comprising:

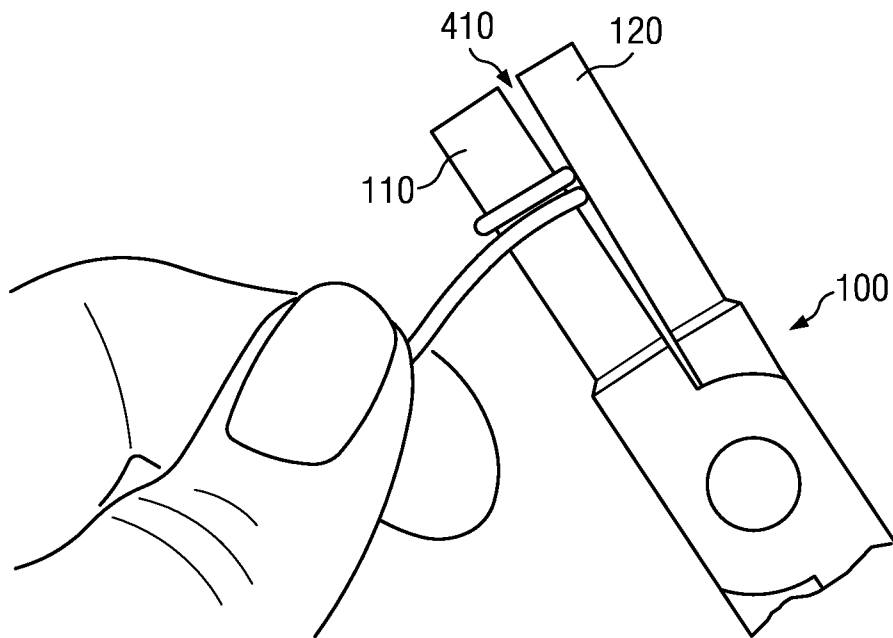
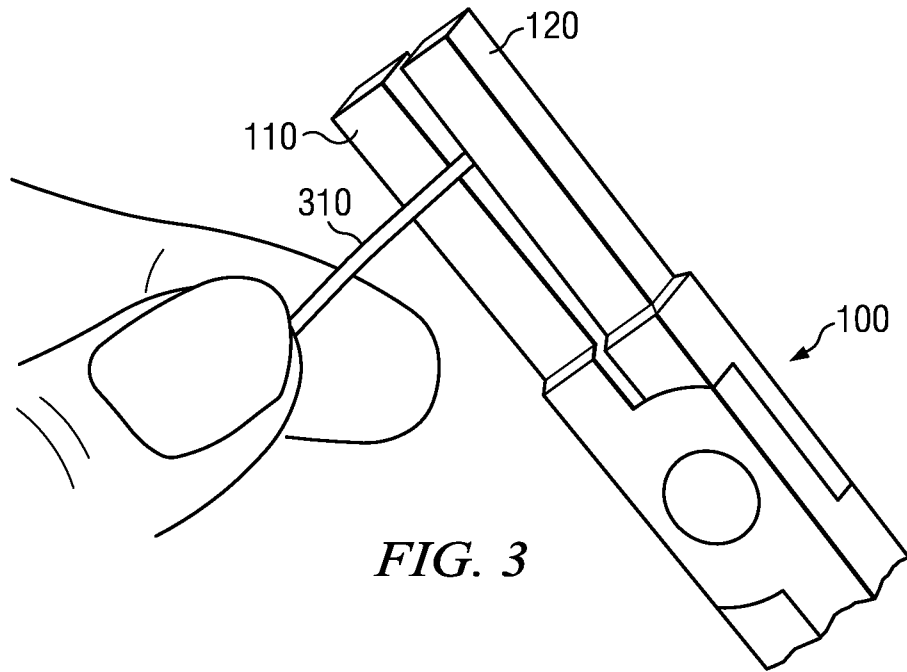
releasing said squeezing force to separate said first mandrel jaw and said second mandrel jaw;

continuing to wrap said material around either said first mandrel jaw or said second mandrel jaw to complete said first loop or said second loop.

35. The method of claim 34, further comprising:  
repeating the steps of the method to form a plurality of loops.
36. The method of claim 34, further comprising:  
hammering said first loop or said second loop to sharpen corners of said first loop or said second loop.
37. The method of claim 33, wherein said first area is rectangular, said second area is rectangular, or a combination thereof.
38. The method of claim 33, wherein said first area is triangular, said second area is triangular, or a combination thereof.
39. The method of claim 33, wherein said first area is oval, said second area is oval, or a combination thereof.
40. The method of claim 33, wherein said first area is circular, said second area is circular, or a combination thereof.
41. The method of claim 33, wherein said first member and said first mandrel jaw are machined from a single piece of stock, said second member and said second mandrel jaw are machined from a single piece of stock, or a combination thereof.
42. The method of claim 33, wherein said first and second mandrel jaws are solid mandrel jaws.

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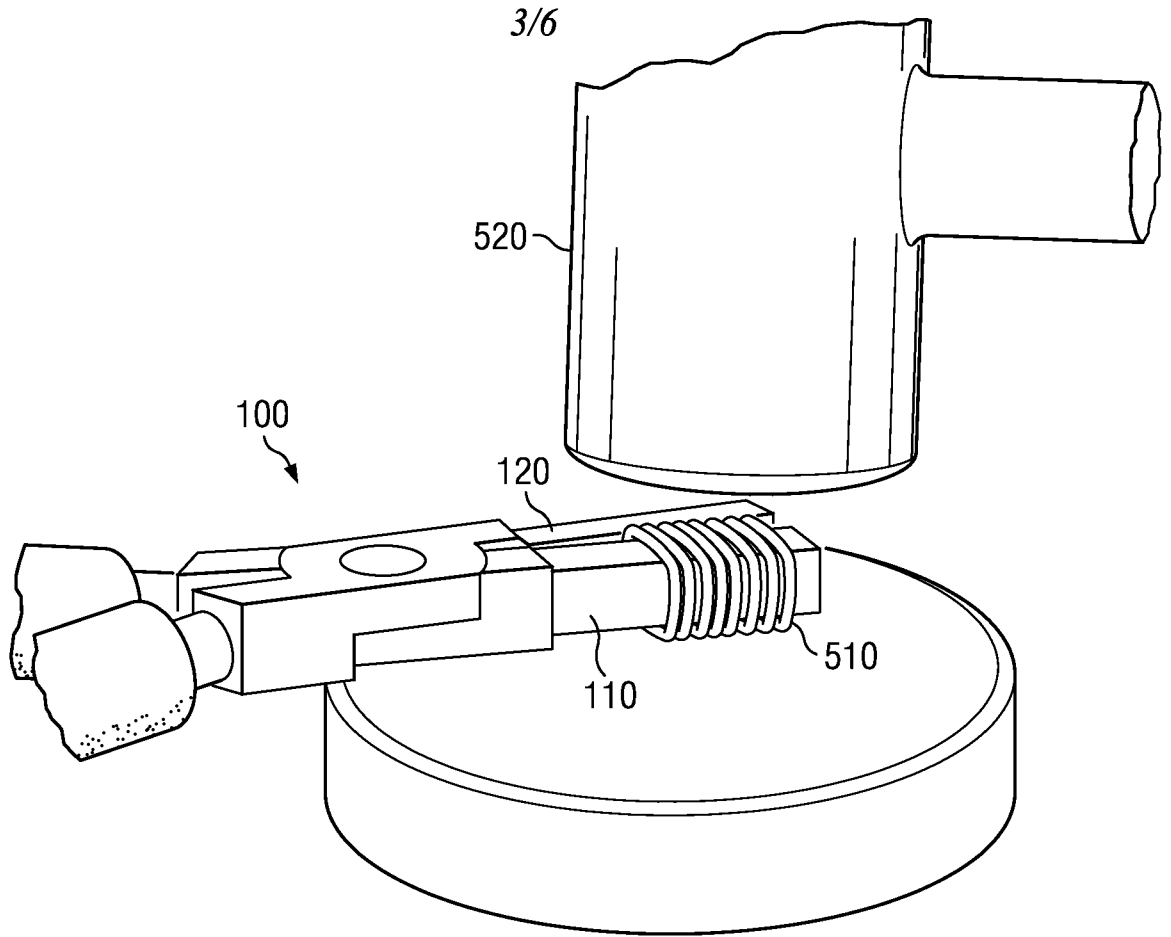


FIG. 5

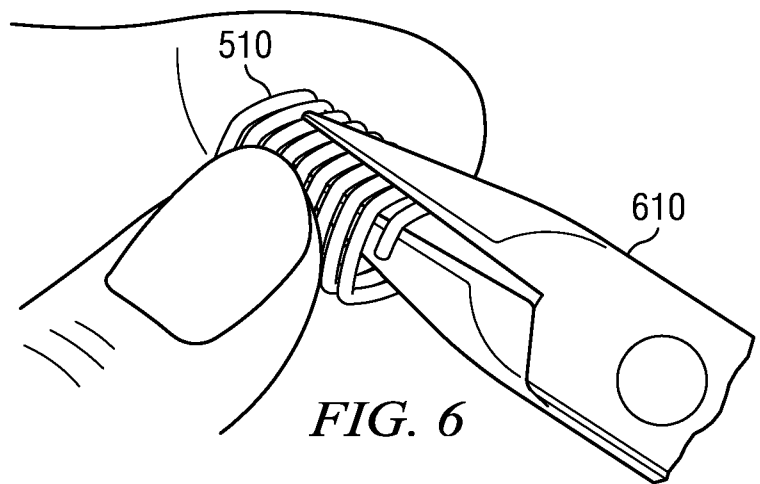


FIG. 6

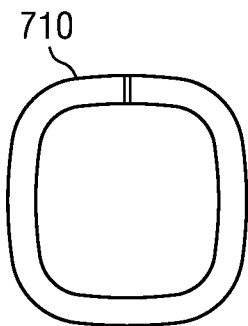


FIG. 7

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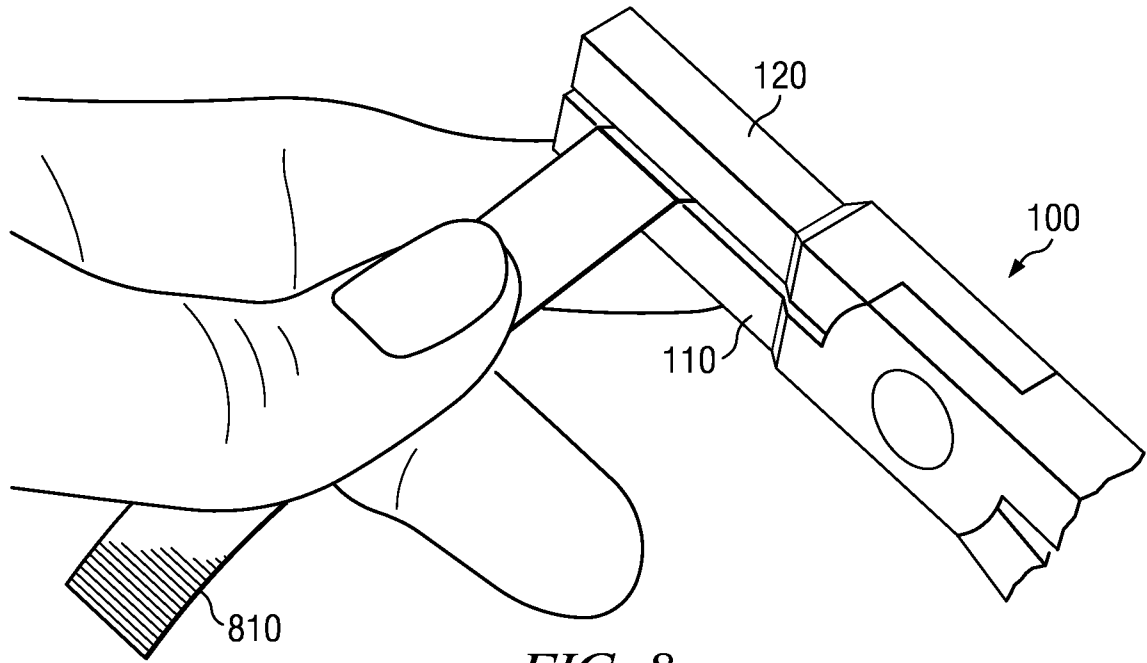


FIG. 8

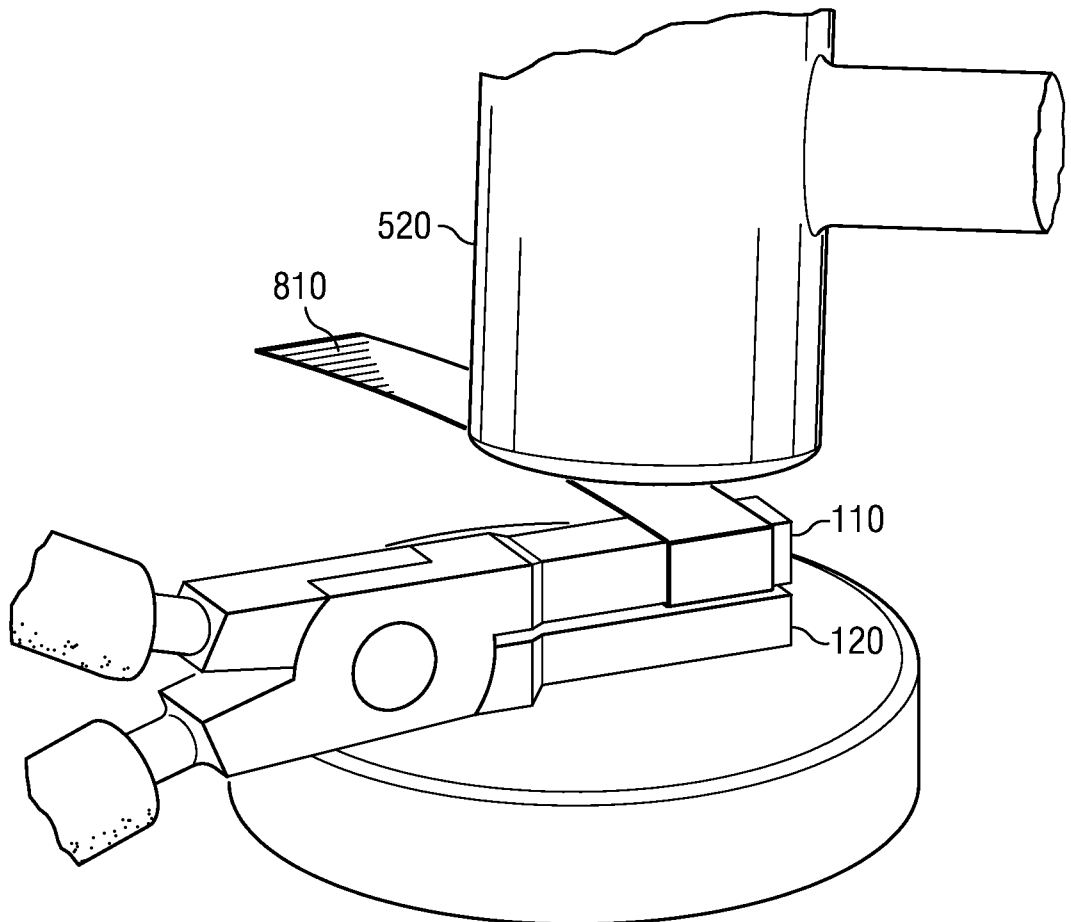


FIG. 9

