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Chen

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(54) **HEXAGONAL WRENCH**

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(72) Inventor: **Joun-Jan Chen**, Taichung (TW)

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B25B 15/00 (2006.01)

(52) **U.S. Cl.**
CPC ***B25B 15/008*** (2013.01); ***B25B 15/005*** (2013.01)

(58) **Field of Classification Search**
CPC B25B 15/008; B25B 15/005; B25B 15/001
See application file for complete search history.

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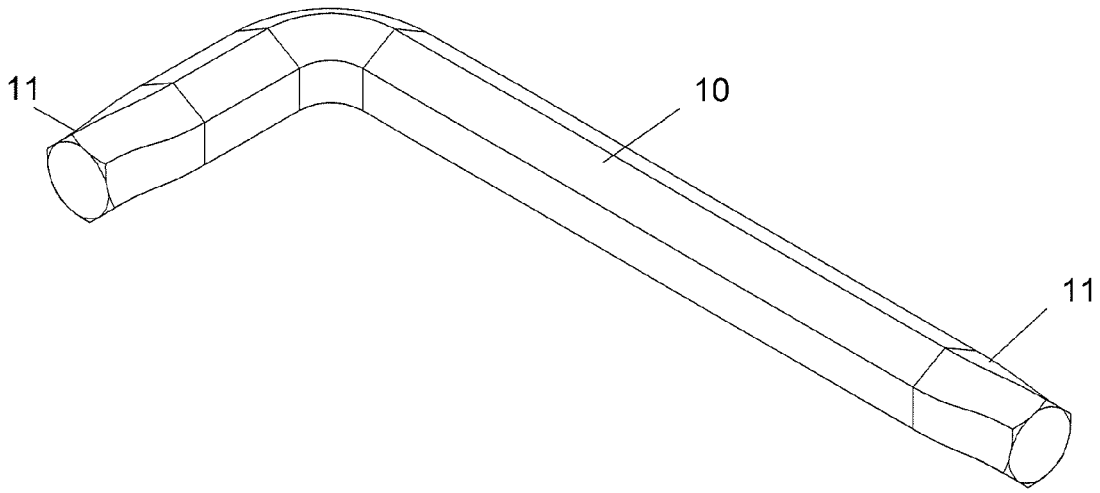
Primary Examiner — David B. Thomas

(57) **ABSTRACT**

A hexagonal wrench includes a body with at least one function end which is a twisted and equal-sided column. The twisted and equal-sided column includes a root section, an end section and a middle section which formed between the root section and the end section. A maximum twist angle is defined between the root section and the end section, and the maximum twist angle is equal to or less than 30 degrees. The root section has a first cross section and the end section has a second cross section. The first cross section is larger than second cross section.

14 Claims, 9 Drawing Sheets



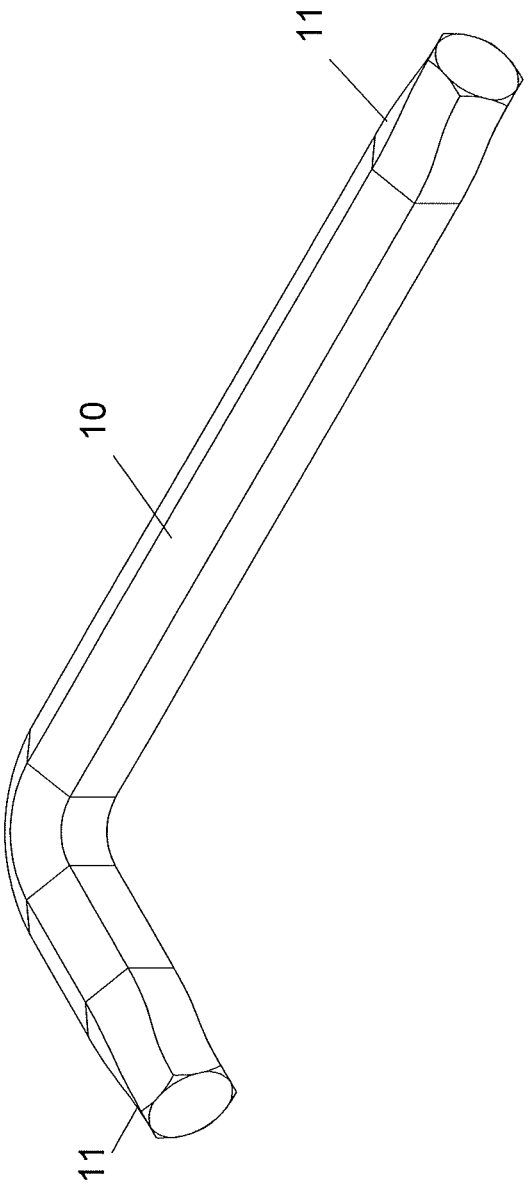


FIG.1

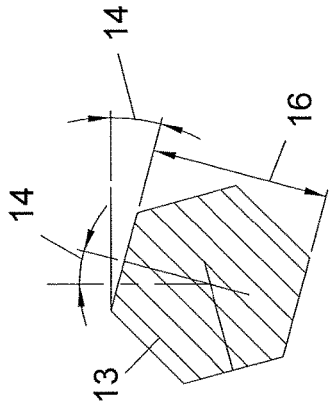


FIG.4

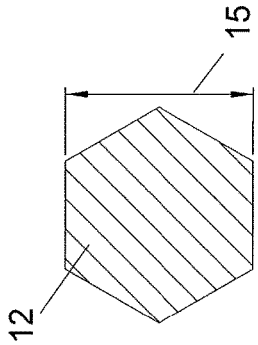


FIG.3

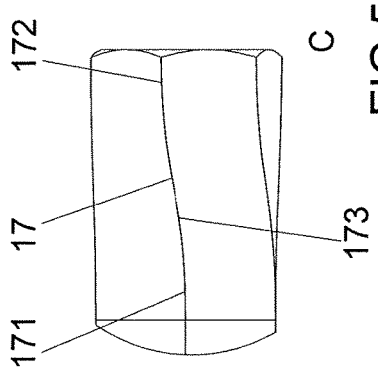


FIG.5

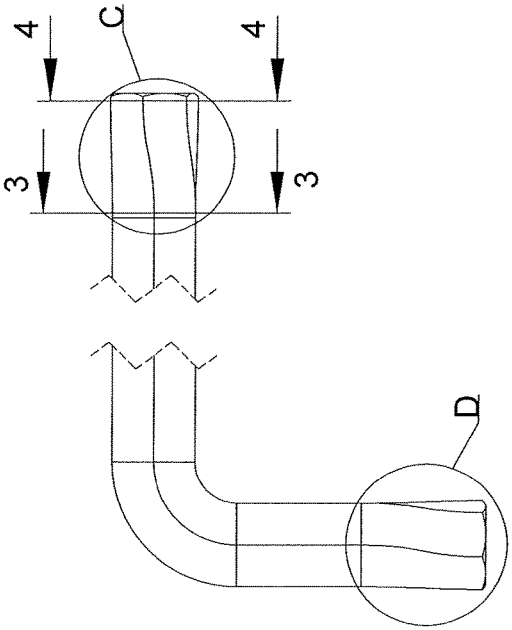


FIG.2

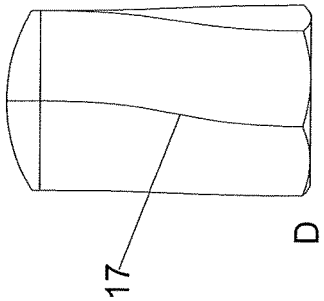


FIG.6

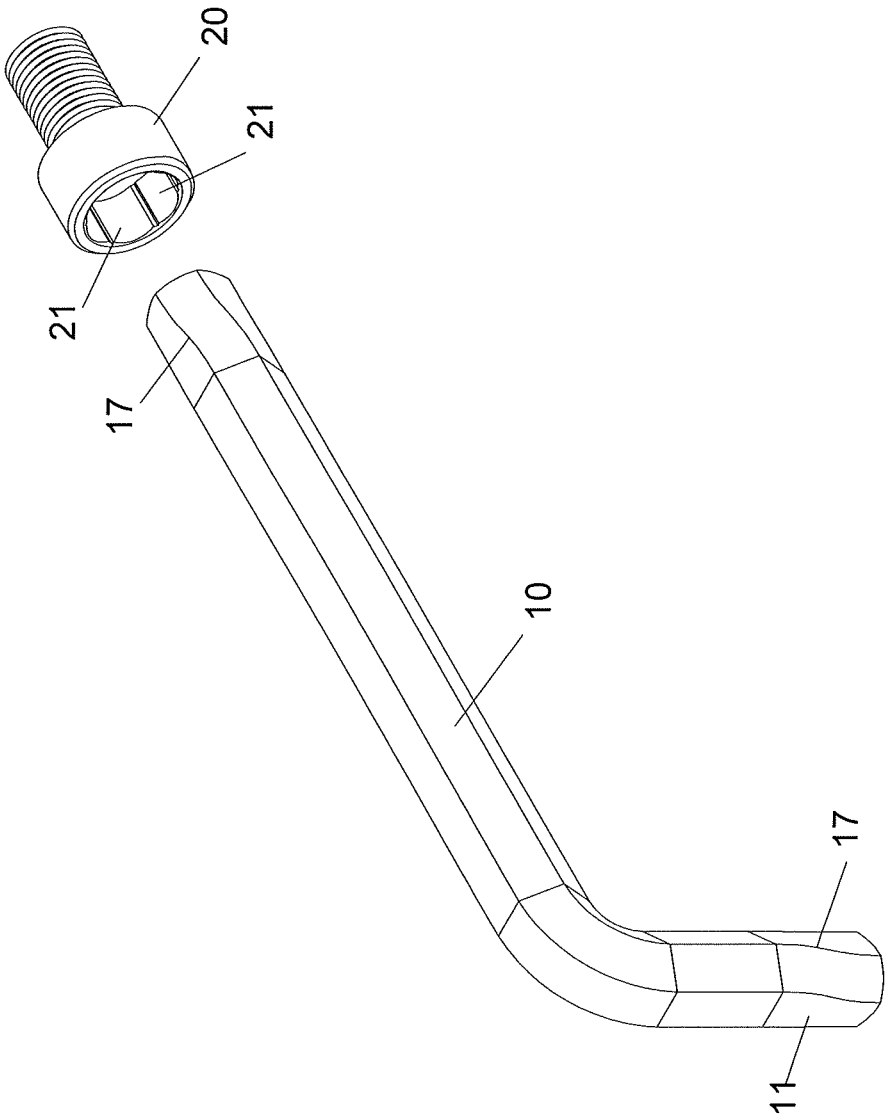


FIG.7

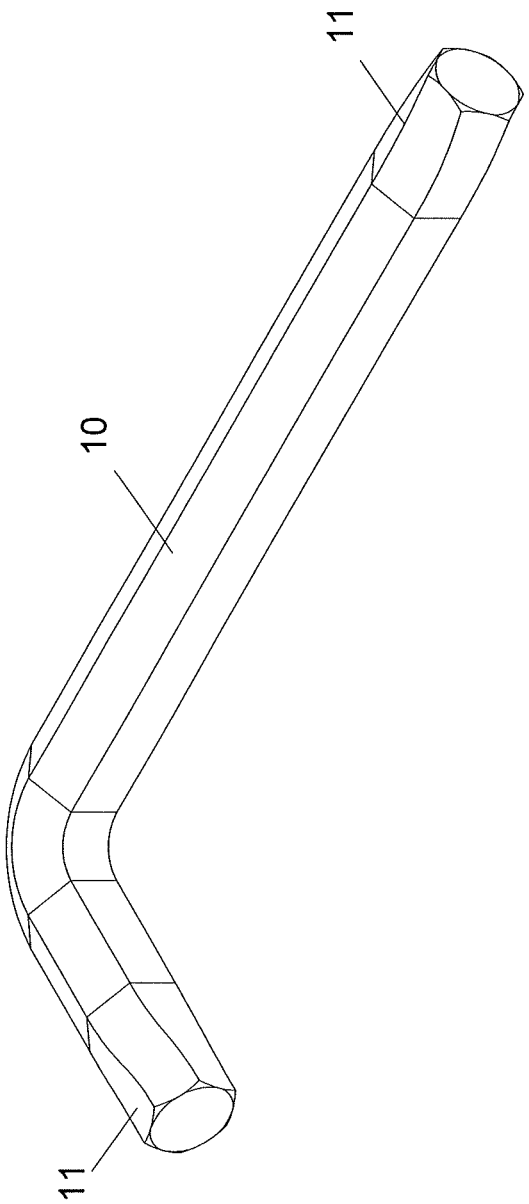


FIG.8

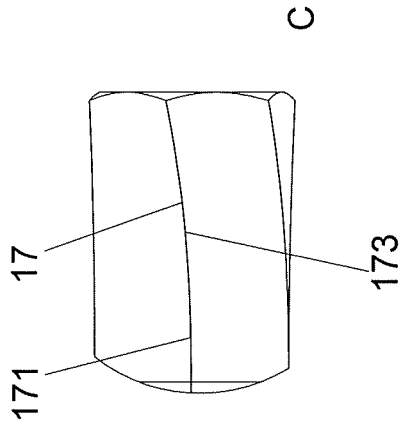


FIG.11

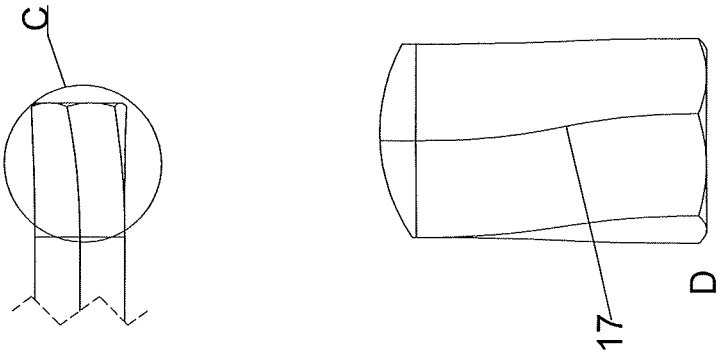


FIG.10

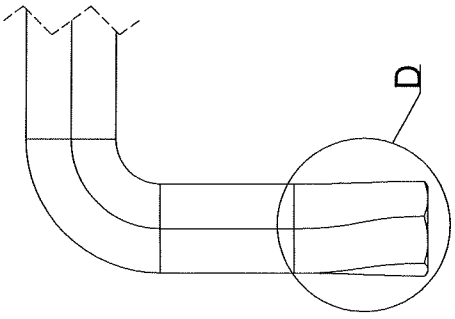


FIG.9

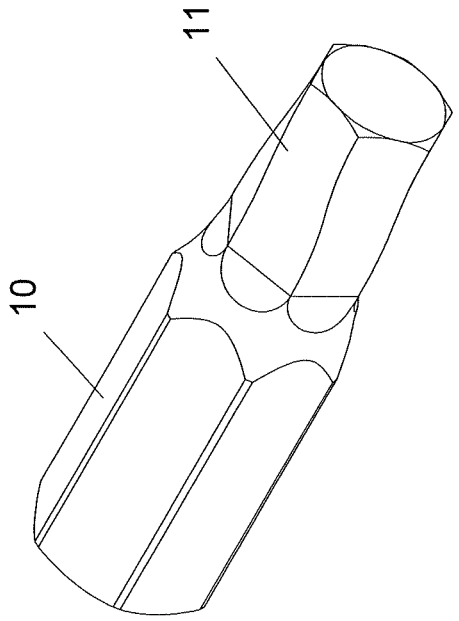


FIG.12

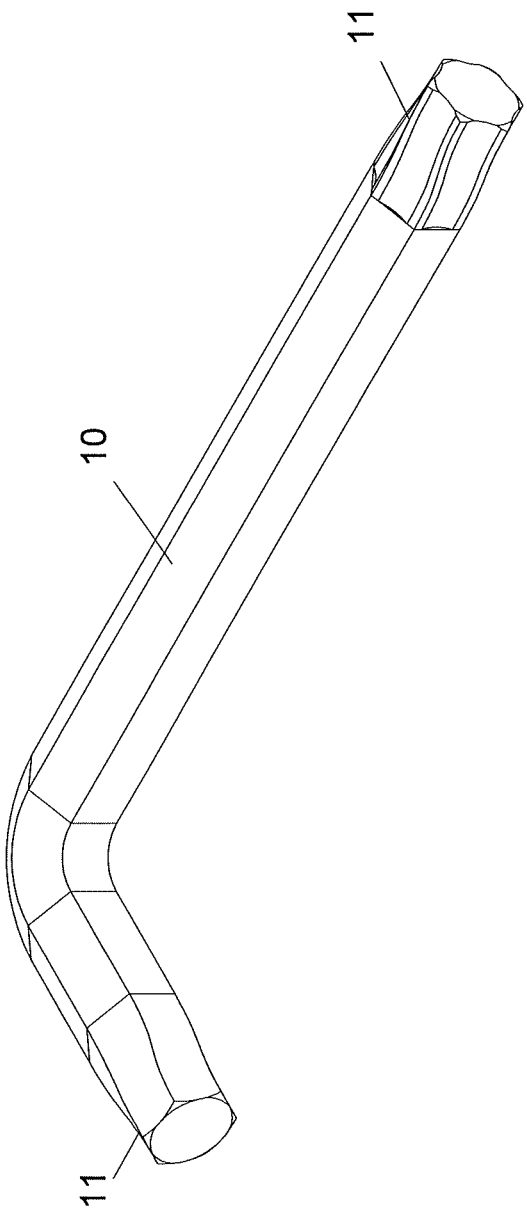


FIG.13

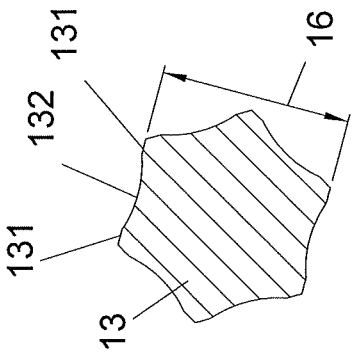


FIG.16

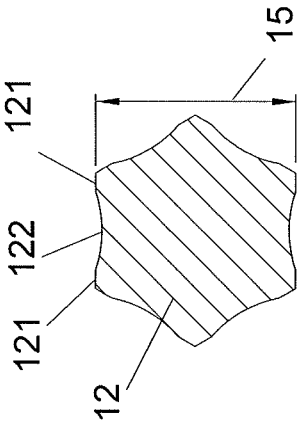


FIG.15

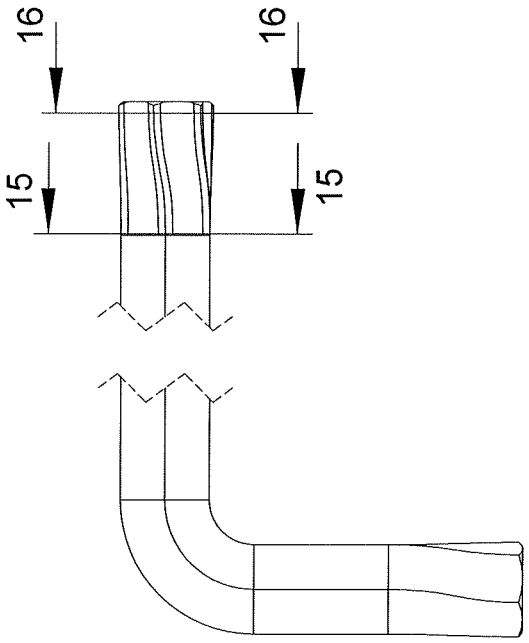
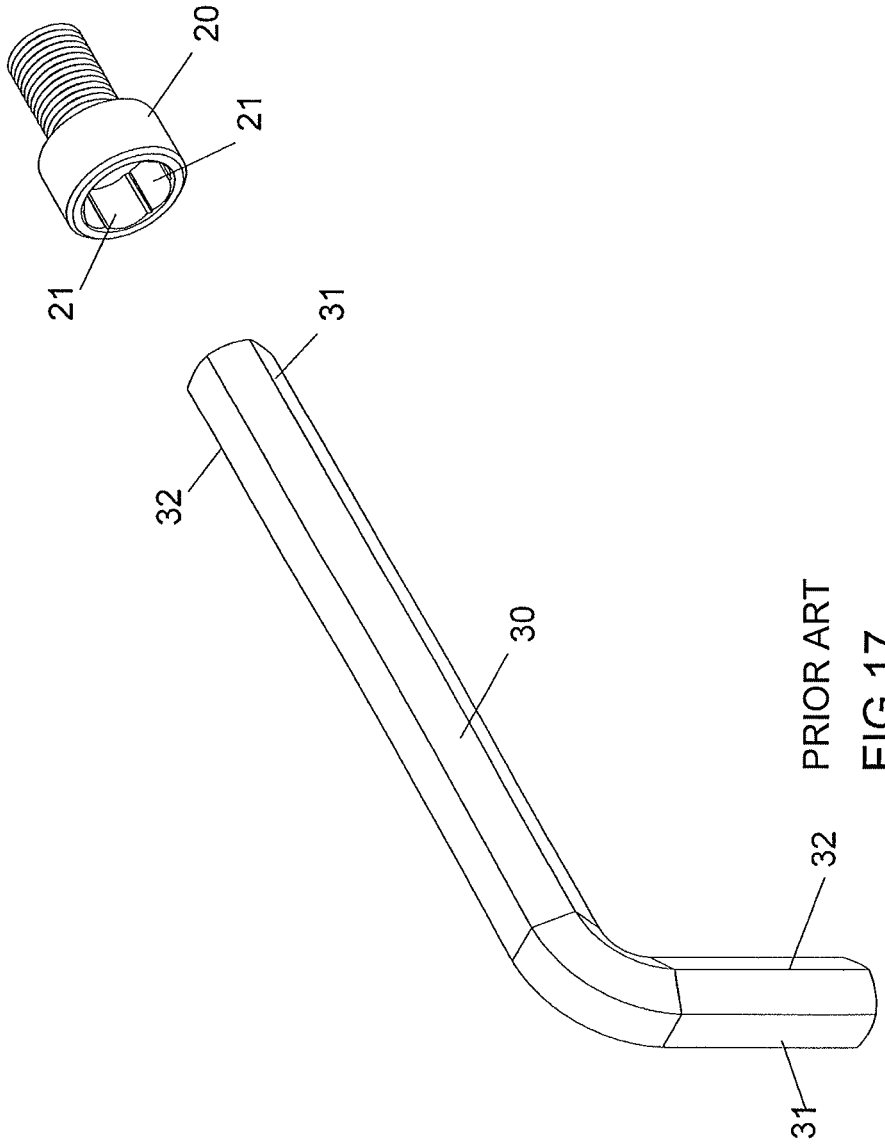


FIG.14



PRIOR ART
FIG.17

HEXAGONAL WRENCH

BACKGROUND OF THE INVENTION

1. Fields of the Invention

The present invention relates to a hexagonal wrench, and more particularly, to a hexagonal wrench having a function end which is twisted an angle relative to the axis of the body.

2. Descriptions of Related Art

The conventional hexagonal wrench is disclosed in FIG. **17** and comprises a body **30** having at least one function end **31** which has a hexagonal cross section. The function end **31** includes six straight ridges **32** which are parallel to each other. Nevertheless, when the function end **31** is used to rotate an object **20** having a recess composed of six sides **21**, the function end **31** cannot be tightly in contact with the six sides **21**. Each straight ridge **32** contacts one of the six sides **21** at only one point. When rotating the function end **31**, the object **20** may not be successfully rotated. Assume that each straight ridge **32** contacts multiple points on the side **21** corresponding thereto, the multiple points are located along a straight line. In this case, the object **20** may not be successfully rotated.

Another conventional hexagonal wrench is disclosed in U.S. Pat. No. 5,105,690 and comprises a body **10** with a function end which has a cross section that has an even size. The function end includes a first driving portion and a second driving portion, and both driving portions have a hexagonal cross section. The first driving portion has an inclination angle. The first driving portion has substantially the same structure as the function end so that the first driving portion has multiple contact point with each of the six sides of the object, these contact points are located along a straight line.

The present invention intends to provide a hexagonal wrench which improves the shortcomings mentioned above.

SUMMARY OF THE INVENTION

The present invention relates to a hexagonal wrench and comprises a body with at least one function end which is a twisted and equal-sided column. The twisted and equal-sided column includes a root section, an end section and a middle section which formed between the root section and the end section. A maximum twist angle is defined between the root section and the end section, and the maximum twist angle is equal to or less than 30 degrees. The root section has a first cross section and the end section has a second cross section. The first cross section is larger than second cross section.

The primary object of the present invention is to provide a hexagonal wrench wherein there are multiple points between the function end and the recess of an object so as to improve the problems happened to the conventional hexagonal wrenches. When the object is rotated, every side of the recess may not be deformed in the same way, so that the spiral function end has high possibility of multiple contact points with each side of the recess of the object.

The present invention will become more obvious from the following description when taken in connection with the accompanying drawings which show, for purposes of illustration only, a preferred embodiment in accordance with the present invention.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is a perspective view to show the hexagonal wrench of the present invention;

FIG. **2** is a top view of the hexagonal wrench of the present invention;

FIG. **3** is a cross sectional view, taken along line **3-3** in FIG. **2**;

FIG. **4** is a cross sectional view, taken along line **4-4** in FIG. **2**;

FIG. **5** is an enlarged view of the circled "C" in FIG. **2**;

FIG. **6** is an enlarged view of the circled "D" in FIG. **2**;

FIG. **7** shows the hexagonal wrench of the present invention and a bolt;

FIG. **8** is a perspective view to show the second embodiment of the hexagonal wrench of the present invention;

FIG. **9** is a top view to show the second embodiment of the hexagonal wrench of the present invention;

FIG. **10** is an enlarged view of the circled "C" in FIG. **9**;

FIG. **11** is an enlarged view of the circled "D" in FIG. **9**;

FIG. **12** is a perspective view to show the third embodiment of the hexagonal wrench of the present invention;

FIG. **13** is a perspective view to show the fourth embodiment of the hexagonal wrench of the present invention;

FIG. **14** is a top view to show the fourth embodiment of the hexagonal wrench of the present invention;

FIG. **15** is a cross sectional view, taken along line **15-15** in FIG. **14**;

FIG. **16** is a cross sectional view, taken along line **16-16** in FIG. **14**, and

FIG. **17** shows a conventional hexagonal wrench and a bolt.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring to FIGS. **1** to **4**, the hexagonal wrench of the present invention comprises a body **10** having a function end **11** formed on each of two ends of the body **10**. The body **10** is a hexagonal column and is an L-shaped body. The two respective axes of the two function ends **11** are perpendicular to each other.

Each function end **11** is a twisted and equal-sided column, and the twisted and equal-sided column includes a root section **110**, an end section **111** and a middle section **112** which formed between the root section **110** and the end section **111**. A maximum twist angle **14** between the root section **110** and the end section **111** is equal to or less than 30 degrees. Preferably, the maximum twist angle **14** is between 10 to 15 degrees.

The root section **110** having a first cross section **12** which has a first shortest distance **15** between two opposite sides thereof. The end section **111** has a second cross section **13** which has a second shortest distance **16** between two opposite sides thereof. The second shortest distance **16** is smaller than the first shortest distance **15**. In other words, the first cross section **12** is larger than second cross section **13**. The second shortest distance **16** is more than 0.8 time of the first shortest distance **15**. Preferably, the second shortest distance **16** is more than 0.9 or 0.95 time of the first shortest distance **15**.

As shown in FIGS. **5** and **6**, each point of each of the cross sections along with the root section **110** forms a first section **171**. Each point of each of the cross sections along with the end section **111** forms a second section **172**. Each point of each of the cross sections along with the middle section **112** forms a third section **173**. The first section **171** is perpen-

dicular to the first cross section **12**. The second section **172** is perpendicular to the second cross section **13**. The third section **173** is a spiral line whose two ends are tangent to the first and second sections **171**, **172**. The two function ends **11** twist in opposite directions. The angle that the two function ends **11** twist is the same.

The function ends **11** are manufactured by way of cutting. That is, a knife is moved along the spiral line **17** so that the knife repeatedly cut the column six times to form the function end **11**.

As shown in FIG. **7**, the object **20** such as the bolt as disclosed includes a hexagonal recess which includes side sides **21** which are in contact with the function end **11**.

As shown in FIGS. **8** to **11**, the two function ends **11** twist in the same direction. The second section **172** and the third section **173** extend along a common spiral line, and one end of the third section **173** is tangent to the first section **171**. The first section **171** is perpendicular to the first cross section **12**.

FIG. **12** shows that the body **10** is hexagonal column and made to be screwdriver bit. The function end **11** tilts toward the distal end thereof, and has the function end **11** on one end thereof.

FIG. **13** shows that the function end **11** is a hexagonal column which has a star-shaped cross section.

As shown in FIGS. **14** to **16**, the function end **11** of the body **10** has a first cross section **12** which is a star-shaped cross section. Each side of the first cross section **12** includes two first straight sections **121** and a first curved section **122**. The center of the first curved section **122** is located outside the body **10** and located between the two first straight sections **121**. The two first straight sections **121** are located symmetrically to the first curved section **122**. The second cross section **13** is substantially star-shaped and each side of the second cross section **13** includes two second straight sections **131** and a second curved section **132**. The center of the second curved section **132** is located outside the body **10** and located between the two second straight sections **131**. The two second straight sections **131** are located symmetrically to the second curved section **132**.

Each side of the first cross section **12** of the function end **11** of the present invention is parallel to the horizontal plane, and the maximum twist angle between each side of the second cross section **13** of the function end **11** is 14 degrees.

The root section **110** having a first cross section **12** which has a first shortest distance **15** between two opposite sides thereof. The end section **111** has a second cross section **13** which has a second shortest distance **16** between two opposite sides thereof. The second shortest distance **16** is smaller than the first shortest distance **15**. In other words, the first cross section **12** is larger than second cross section **13**.

The spiral line **17** is formed between the first and second cross sections **12**, **13**. The spiral line **17** includes a first section **171**, a second section **172** and a third section **173**. The first section **171** is perpendicular to the first cross section **12**. The second section **172** is perpendicular to the second cross section **13**. The third section **173** is tangent to the first section **171** and the second section **172**.

The advantages of the present invention are that the maximum twist angle **14** is defined between the first and second cross sections **12**, **13**. The second cross section **13** is smaller than the first cross section **12**.

The function end **11** twists along the spiral line **17**. When the function end **11** is engaged with the six-sided recess of the object **20**, each spiral line **17** of the function end **11** contacts each of the six sides **21** at one or more than one point so as to form multiple planes, and the function end **11** is able to effectively drive the object **20**.

When the object **20** is rotated, every side **21** of the recess may not be deformed in the same way, so that the spiral function end **11** has multiple contact points with each side **21** of the recess of the object **20**. In other words, the function end **11** of the present invention is more efficient than the conventional function end to drive the object **20**.

The maximum twist angle **14** of the spiral line **17** of the function end **11** is positive angle, so that when the object **20** needs to be rotated clockwise, the function end **11** provides more torque to drive the object **20**.

While we have shown and described the embodiment in accordance with the present invention, it should be clear to those skilled in the art that further embodiments may be made without departing from the scope of the present invention.

What is claimed is:

1. A hexagonal wrench comprising:

a body having at least one function end which is a twisted and equal-sided column, the twisted and equal-sided column including a root section, an end section and a middle section which formed between the root section and the end section, a maximum twist angle between the root section and the end section being equal to or less than 30 degrees, the root section having a first cross section which has a first shortest distance between two opposite sides thereof, the end section having a second cross section which has a second shortest distance between two opposite sides thereof, the second shortest distance being smaller than the first shortest distance, the first cross section being larger than second cross section, the second shortest distance being more than 0.8 time of the first shortest distance.

2. The hexagonal wrench as claimed in claim **1**, wherein each point of each of the cross sections along with the root section forms a first section, each point of each of the cross sections along with the end section forms a second section, each point of each of the cross sections along with the middle section forms a third section, the first section is perpendicular to the first cross section, the second section is perpendicular to the second cross section, the third section is a spiral line whose two ends are tangent to the first and second sections.

3. The hexagonal wrench as claimed in claim **1**, wherein the maximum twist angle is less than 20 degrees.

4. The hexagonal wrench as claimed in claim **1**, wherein the maximum twist angle is less than 15 degrees.

5. The hexagonal wrench as claimed in claim **1**, wherein the maximum twist angle is between 10 to 15 degrees.

6. The hexagonal wrench as claimed in claim **1**, wherein the second shortest distance is more than 0.9 time of the first shortest distance.

7. The hexagonal wrench as claimed in claim **1**, wherein the second shortest distance is more than 0.95 time of the first shortest distance.

8. The hexagonal wrench as claimed in claim **1**, wherein the body is a hexagonal column and bent to be an L-shape body, each of two ends of the L-shaped column has the function end.

9. The hexagonal wrench as claimed in claim **8**, wherein the two function ends twist in opposite directions.

10. The hexagonal wrench as claimed in claim **8**, wherein the two function ends twist in the same direction.

11. The hexagonal wrench as claimed in claim **1**, wherein each point of each of the cross sections along with the root section form a first section, each point of each of the cross sections along with the end section form a second section, each point of each of the cross sections along with the

middle section form a third section, the first section is perpendicular to the first cross section, the second section and the third section extend along a common spiral line, one end of the third section is tangent to the first section.

12. The hexagonal wrench as claimed in claim **1**, wherein the body is a screwdriver bit, the body is a hexagonal column and has the function end on one end thereof.

13. The hexagonal wrench as claimed in claim **1**, wherein the function end is a hexagonal column which has a star-shaped cross section.

14. The hexagonal wrench as claimed in claim **1**, wherein the function end is a spiral and hexagonal equal-sided column.

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