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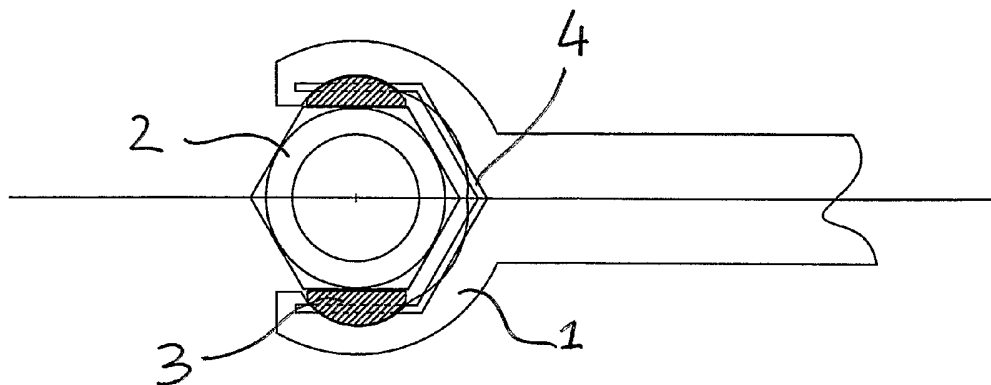
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(54) Title: TOOL FOR ENGAGEMENT WITH A POLYGONAL OBJECT



(57) Abstract: The invention provides a tool (1) configured for engagement with a polygonal object (2) requiring to be rotated about a rotational axis. The tool includes one or more supports for supporting contact faces (3) which engage with said polygonal object and two or more contact face portions having engagement surfaces in the form of contact faces for engaging complementary surfaces of the polygonal object, said contact faces being displaceably located for displacement relative to the supports and the object.

TOOL FOR ENGAGEMENT WITH A POLYGONAL OBJECT

Field of the Invention

- 5 The invention relates to a tool such as a spanner or the like.

Background to the Invention

10 Spanners are commonly used to tighten or loosen nuts and bolts. These nuts and bolts are popularly made with hexagonal heads, there are also nuts and bolts that are square. To grip shafts there are usually two parallel flat surfaces located opposite one another which can also be gripped by a spanner.

- 15 The inventor is aware of spanners made in a wide range of different types, e.g.
- flat open-ended spanners;
 - ring spanners;
 - socket spanners;
 - tube spanners; and

20 - adjustable spanners.

Flat open-ended spanners can be double-ended, or in combination with ring spanner at one end. Similarly, ring spanners can be double-ended or in a combination with a flat open end as above. Both these types can also be

25 single-ended with the other end rounded to form a tapered point known as a podger spanner. Socket spanners are popularly made in a "Double Hex" form which relies on the female hex corners to grip the male hex corners of the hex nut or bolt head. Impact sockets are identified by there being a perfect female hex of six sides. Sockets have square drive connections for connecting to

30 drives such as in the case of a power bar, ratchet, nut runner, torque wrench, crank handle, or an impact wrench.

Tube spanners resemble pieces of tubing (pipe) with a hex formed to both ends. There is as a consequence of deforming the tube wall both an inner

female hex and an outer male hex, their sizes differing by the wall thickness of the tube from which they were made. A hole is located transversely through the tube walls at either end near to the hex forms for the positioning of a drive bar for rotation.

5

Adjustable spanners are more commonly referred to as a shifting spanner. They are of the flat open-ended configuration, with one fixed jaw and one movable jaw for adjustment. There are numerous sizes even though they are adjustable within a range of sizes.

10

Flogging spanners are normally made with a single-ended ring form with the handle shortened and thickened to cope with heavy hammer blows, used for large nuts and bolts.

15 The inventor is aware of many instances when spanners, although correctly sized, do not engage the flats or corners of hexagonal nuts or bolt heads properly. This problem is believed to originate from:

- incorrect size, shape, or form of the nut or bolt head;
- comparatively soft steel of nut or bolt;
- 20 - previously subjected to over stress;
- previously subjected to the incorrect size of spanner;
- the contact surfaces of the nut or bolt heads have worn from repeated use;
- contact with other mechanical items that hook, snag or drag on, over
25 around nuts and bolt heads; or
- erosion or corrosion from the in situ environment, medium or application.

Furthermore, there are some incidents of so called near to correct size
30 between the Imperial and Metric sizes which leads to the use of the incorrect size of spanner. Taking into account the number of Imperial systems, including BSW, UNC, UNF, A'C, BA, and probably a few more, there is little chance that the correct size and type of spanner is available when needed. The only option would be to use the "near to correct" size which results in

damage to nuts and bolt heads. Each successive tightening or loosening brings about more deterioration and finally to a situation where the nut or bolt cannot be loosened or tightened. The consequence of this sequence of events is a replacement which in some cases may be quite expensive, with
5 other possible consequential losses.

Pliers are often used to grip hex or square nuts or bolt heads. In instances where rather large pliers with long handles are used to grip the nut or bolt head sufficient force can be applied to damage the flats or corners. When
10 self-locking pliers (vice grips) are used this is most certainly the case, and the damage can be severe. The geometry of all pliers is common in that the jaws are usually only parallel to one another at one point in the arc scribed by the movement about the centre pin. In every other position the jaws are out of parallel by varying degrees depending on the opening. Generally pliers are
15 made with the jaws parallel in the closed position. This makes pliers in general totally unsuited to a task for which they are so widely used. Because of their convenience to adapt so readily to a wide range of sizes has resulted in this situation.

20 Furthermore, the inventor is also aware of numerous applications where square shafts or keys are driven by complementarily shaped square sockets. The consequences of incorrectly sized or precision of accuracy achieved in manufacture of both components leads to uneven point loading when torsional forces are applied, resulting in deformation or either or both the components.
25 Common applications of square drives are taps (internal threading) and valve spindle ends.

Likewise, in power transmission there is a great dependence on splined shafts and sleeves. To achieve good efficiency and long life, both the components
30 need to be accurately sized and finely machined which in turn, leads to increased production costs.

Object of the Invention

The inventor has identified a need for a means which will, as far as practical, ensure that the contact planes of the jaws of a tool such as a spanner or a plier are absolutely parallel.

5 The inventor has further identified a need for a means whereby the contact plane of said jaws will align with the flat faces of hex or square nuts and bolt heads, compensating for any inaccuracies of out of parallelness of the nut or bolt head faces.

10 Further, the need extends to, in the case of open-ended spanners, ring spanners, sockets and impact sockets that there be a range of sizes that will be automatically accommodated for every spanner size.

A further need is for a means to use square or hexagonal shafting in power
15 transmission, thus eliminating the expense of cutting internal and external splines, as is common practice at present.

Thus there is a further need for a self-aligning and compensating tool enabling differences of dimensional tolerance and angular alignment to be easily
20 accommodated. Torsional drive forces should be equally balanced over the whole area of each and every contact face, achieving the optimum drive efficiency. Furthermore, there is a need to accommodate axial misalignment between drive and driven components.

25

Summary of the Invention

According to a first aspect of the invention, there is provided a tool configured for engagement with a polygonal object requiring to be rotated about a
30 rotational axis, such as a nut, a bolt, a shaft, or a key, said tool including:

- one or more supports for supporting contact faces which engage with said polygonal object; and
- two or more contact face portions having engagement surfaces in the form of contact faces for engaging complementary surfaces of

the polygonal object, said contact faces being displaceably located for displacement relative to the supports and the object.

5 The contact faces may be loose inserts which are located into complimentary segmental compartments of a housing.

The number of inserts may be equivalent to the number of flat sides of the object to be rotated.

10 The inserts may be segmented in cross-section to allow them to swivel in the complimentary segmental compartments to individually align the contact faces with the faces of the object being driven.

15 To accommodate misalignment, the inserts may be spherical, which allows axial and transverse movement.

The supports may be arranged in opposed pairs.

20 The contact face portions may be pivotally mounted for pivotal displacement relative to the supports.

The tool may be a spanner, a plier, a shifting spanner, or the like.

25 The polygonal object may be a nut or a bolt having a hexagonal, square, or other shape. However, the polygonal object may be a shaft or a key provided, typically, with a square section.

30 This invention differs from conventional spanner and pliers designs in that it provides movable contact faces, which may be in the form of pads, which will engage the flat surfaces of square or hex nuts or bolt heads.

Rotation of the spanner may due to the geometry thereof bring these contact faces into firm contact with the nut or bolt head faces.

The swivel arrangement of the mounting of the contact faces to the spanner may result in substantially even force being transmitted along the entire length of the nut or bolt head faces.

- 5 Increasing torque may increase the force which the contact faces experience which improves the chance of perfect alignment and fit-up of the spanner or pliers to the hex or square nut or bolt head.

- 10 The contact faces may be mounted by means of a swivel pin, a ball and socket, a trunnion, or the like.

There may be provided a spring clip means to locate and keep the contact faces parallel in the maximum open position of the spanner or pliers.

- 15 There is perceived to be a need to keep the contact faces, such as pads, parallel when the spanner or pliers are in the free position so that a nut or bolt head can be engaged which is of the maximum spanner or pliers' size.

- 20 In the case of flat open-ended spanners and pliers, one contact face may be provided per jaw.

In the case of ring spanners and socket spanners six contact faces may be provided.

- 25 A spring clip centralizing and retaining mechanism may be used to maintain the contact faces a maximum distance apart in a required polygonal form complimentary to the object to be rotated.

- 30 It follows from the preceding that the range of sizes which a particular tool or spanner, be it flat open-ended, ring or socket, can handle will be from maximum in the free position downwards to the smaller size. This automatic sizing comes about by rotation about the nut or bolt head.

The geometric principles which work in one direction of rotation are equally applicable in the counter-direction of rotation. So, spanners and pliers incorporating this invention work with equal efficiency on tightening or loosening right hand or left hand threaded components.

5

In so far as pliers are concerned, the contact faces in their jaws may function as described above except over a wider range of sizes.

10

Because of the arc through which the jaws move about the centre pin, the contact faces will not maintain a parallel alignment to one another. This only comes about by contact pressure onto the nut or bolt head faces.

In the case of normal pliers rotational torque will not increase contact pressure of the contact faces only the grip force will do that.

15

In the case of "locking" pliers the contact pressure will increase with rotation as described in the case of the flat open-ended spanner.

20

Adjustable spanners (shifting spanners) work as described in the case of the flat open-ended spanners.

25

The inventor believes, that spanner and pliers geometry is such that rotational forces induce reciprocal clamping forces by the contact faces that are proportional to one another. This would mean the greater the torque the greater the clamping forces.

The spanners and pliers of this design would improve lifetime preservation of the nut and bolt head forms. For example, it is envisaged that the spanner sizes would be ranged :

30

- | | | |
|---|-----------------|------------------|
| - | open-ended flat | size 17 to 19 mm |
| - | ring spanner | size 30 to 33 mm |
| - | socket (impact) | size 24 to 26 mm |

It is believed to be another advantage of the invention that the number of spanners usually packed to form a set would be less. Furthermore that there would be only one set of spanners to do all Metric and Imperial size variations. These cost savings would cover the additional cost to incorporate this invention and still pass an advantage to the end user, or rather increase the commercial viability in achieving novelty demand pricing.

General Description of the Drawings

The invention will now be described, by way of non-limiting examples only, with reference to the accompanying drawings in which equivalent numbers indicate same or similar structural features:

Figure 1 shows an open-end flat spanner and/or adjustable spanner engaging nut or bolt head flats..

- 1 - Open-end flat spanner or adjustable spanner.
- 2 - Nut or bolt head.
- 3 - Pressure pad in trunnion swivel arrangement engaging nut flats.
- 4 - Retaining spring clip.

Figure 2 shows a ring and/or socket and/or tube spanner engaging bolt head or nut flats.

- 2 - Nut or bolt head.
- 3 - Pressure pad in trunnion swivel arrangement engaging nut flats.
- 4 - Retaining spring clip.
- 5 - Ring and/or socket and/or tube spanner.

Figure 3 shows an open-end flat spanner and/or adjustable spanner engaging nut or bolt head corners.

- 1 - Open-end flat spanner and/or adjustable spanner.
- 2 - Nut or bolt held.

3 - Pressure pads in trunnion swivel arrangement engaging nut or bolt head corners.

4 - Retaining spring clip.

5 Figure 4 shows a ring and/or socket and/or tube spanner engaging nut or bolt head corners.

2 - Nut or bolt head.

3 - Pressure pad in trunnion swivel arrangement engaging nut or bolt head corners.

4 - Retaining spring clip.

5 - Ring and/or socket and/or tube spanner.

Figure 5 shows pliers and/or self-locking pliers engaging nut or bolt head.

15

2 - Nut or bolt head.

3 - Pressure pad in trunnion swivel arrangement engaging nut or bolt head flats.

4 - Retaining spring clip.

20 6 - Pliers and/or self-locking pliers.

Figure 6 shows pliers and/or self-locking pliers engaging nut or bolt head corners.

25 2 - Nut or bolt head.

3 - Pressure pad in trunnion swivel arrangement engaging nut or bolt head corners.

4 - Retaining spring clip.

6 - Pliers and/or self-locking pliers.

30

Figure 7 shows alternate contact face with swivel pin arrangement, suitably shaped for engaging nut or bolt head flats and/or engaging nut or bolt head corners.

- 7 - Alternate pressure pad detail with swivel pin arrangement.

Figure 8 shows the geometric principle of the invention.

- 5 "A" a point in fixed position to lever "C" and equally spaced from centre line as "B".
 "B" a point in fixed position to lever "C" and equally spaced from centre line as "A".
 Lever with fixed position to points "A" and "B".
 10 Open position of "A" and "B" when "C" is normal to centre line.
 Closed relative position to "D" when "A", "B" and "C" move through arc C-C1, A-A1 and B-B1.

Figure 9 shows a cross-sectional arrangement of hexagonal shaft.

- 15
 8 - Driven or driving hexagonal shaft.
 9 - Segmental section inserts.
 10 - Retaining spring clip.
 11 - Outer sleeve or driving or driven socket.

20
 Figure 10 shows detail of a transmission and/or square drive in cross-sectional arrangement.

- 8 - Driven or driver square section.
 25 9 - Segmental section inserts.
 10 - Retaining spring clip.
 11 - Outer sleeve or driving or driven socket.

Specific Description of the Drawings

30
 With reference to Figure 8 showing the geometric principles of the invention, C represents a lever which has a fixed position to points A and B. As can be seen from the inset nut or bolt head, the points A and B are outside the nut or bolt head flats and are shown by dimension D. Rotation of C about the centre

of the nut or bolt head C1, causes A and B to travel through arcs A-A1 and B-B1, respectively.

- Positions A1 and B1 are shown relative to the nut or bolt head flats as dimension E. The right-angled platforms shown at A1 and B1 have clearly intersected the nut or bolt head flats. The practical application of this principle would have caused the right-angled platforms at points A1 and B1 to have engaged the hexagonal flats somewhere along the arcs A-A1 and B-B1. Importantly, this engagement would be a point of contact where the loci of the geometry intersect and the contact planes are no longer parallel. These principles in spanner design, and no matter how closely the spanner fits the hexagonal flats, any rotation will move the contact point and the contact faces at an angle to each other.
- 15 The principle of this invention is dependant on the aspects of the above geometry, that the rotation, as in A-A1, B-B1 and C-C1 will close the open dimension from D to E. Furthermore, the right-angled platforms at A1 and B1 are swivel-mounted to rotate so as to keep the contact faces in perfect parallel alignment and the torsional forces equally and evenly distributed between opposing pressure pads and contact faces.

The basic geometry and principle apply equally to the adaptation of the invention to the following types of spanners:

- flat open-end spanner;
- 25 - adjustable open-end spanner (shifting spanner);
- ring spanner;
- socket spanner;
- tube spanner;
- flogging spanner;
- 30 - pliers;
- pliers, self-locking; and
- Stillson pipe wrenches.

Figures 1 and 3

Arrangement of open-end flat spanner and/or adjustable spanner showing pressure pads engaging hexagonal flat in Figure 1 and hexagonal corners in Figure 3. According to the principles of the invention, rotation in relation to the hexagon will bring about a clamping force of the pressure pads and the swivel arrangement, whether by trunnion or by pin, will allow perfect alignment and equal and even distribution of the forces to the contact faces. Rotation in either clockwise or anti-clockwise direction has the same and equal result.

10 Figures 2 and 4

Arrangement of circular assemblies applicable to ring, socket and tube spanners. Pressure pad and hexagonal flat engagement in Figure 2 and corner engagement in Figure 4. According to the principles of the invention, the same actions have the same result except threefold as compared to the description for Figures 1 and 3.

Figures 5 and 6

20 Arrangement of pliers and/or self-locking pliers with hexagonal flat engagement in Figure 5, and corner engagement in Figure 6. According to the principles of the invention, the same actions have the same result as described for Figures 1 and 3.

25 The above examples provide a spanner and/or pliers where the contact faces automatically align to the nut or bolt head faces. Furthermore, the forces are balanced and equal over opposing faces and evenly distributed over the contact surfaces and the proportional clamping forces are relative to the applied torque, is achieved.

30

With reference to Figures 9 and 10

The inner component (no. 8) is manufactured in a fixed stationary position and the outer component (no. 11) is permitted to rotate about the inner (no. 8).

Then the dimensional spacing between the opposing segmental hosing reduces in relation to the fixed flats of the inner component. (See Figure 8 for geometric principle). This results in a clamping force being induced on the segmental inserts. The radius of the outer segment will swivel before the flat face of the segmental insert is perfectly aligned with the flat face of the inner component. In this manner, equal torsional forces are shared between all the contact faces.

The figures form an integral part of the disclosure of the invention and any feature shown in the figures but not described is included in the specification by reference and is intended to illustrate the general concept to which it relates.

Further, to the extent that the priority documents supplement the present specification and do not conflict therewith, the contents of the priority documents are to form an integral part of the disclosure as if specifically reproduced here.

CLAIMS:

1. A tool configured for engagement with a polygonal object requiring to
5 be rotated about a rotational axis, said tool including:
- one or more supports for supporting contact faces which engage with said polygonal object; and
 - two or more contact face portions having engagement surfaces in the form of contact faces for engaging complementary surfaces of
10 the polygonal object, said contact faces being displaceably located for displacement relative to the supports and the object.
2. A tool as claimed in claim 1, wherein the contact faces are loose inserts which are located into complimentary segmental compartments of a housing.
15
3. A tool as claimed in claim 2, wherein the number of inserts is equivalent to the number of flat sides of the object to be rotated.
4. A tool as claimed in claim 2 or claim 3, wherein the inserts are
20 segmented in cross-section to allow them to swivel in the complimentary segmental compartments to individually align the contact faces with the faces of the object being driven.
5. A tool as claimed in any one of claims 2 to 4, wherein to accommodate
25 misalignment, the inserts are spherical, which allows axial and transverse movement.
6. A tool as claimed in any one of the preceding claims, wherein the supports are arranged in opposed pairs.
30
7. A tool as claimed in any one of the preceding claims, wherein the contact face portions are pivotally mounted for pivotal displacement relative to the supports.

8. A tool as claimed in claim 7, wherein the contact faces are mounted by means of a swivel pin, a ball and socket, or a trunnion.

9. A tool as claimed in any one of the preceding claims, wherein there is provided a spring clip means to keep the contact faces parallel.

10. A tool as claimed in claim 9, wherein a spring clip centralizing and retaining mechanism is used to maintain the contact faces a maximum distance apart in a required polygonal form complimentary to the object to be rotated.

11. A tool as claimed in any one of the preceding claims, wherein the tool is a spanner.

12. A tool as claimed in any one of claims 1 to 10, wherein the tool is a plier.

13. A tool as claimed in claim 11 or claim 12, wherein the contact faces engage with the flat surfaces of a nut or bolt head.

14. A tool as claimed in claim 11 or claim 12, wherein the contact faces engage with the corners of a nut or bolt.

15. A tool as claimed in any one of claims 1 to 10, wherein the tool is a power transmission spanner.

16. A tool as claimed in any one of the preceding claims, wherein the tool is configured to be driven by square cross-sectional shaft or spindle.

17. A tool as claimed in any one of claims 1 to 16, whenever applied to a coupling in a transmission system.

18. A tool as claimed in any one of claims 1 to 16, whenever applied to valve spindles.

19. A tool as claimed in any one of claims 1 to 16, whenever applied to a square drive extension bar of a socket spanner set.

5 20. A tool as claimed in any one claims 1 to 16, in the form of a tap wrench.

21. A tool as claimed in any one of claims 1 to 16, whenever used in relation to a motor driven tapping head.

10 22. A spanner, pliers, tap wrench, coupling and/or drive mechanism to obviate splined inner and outer components as described herein.

23. A new tool substantially as herein described.

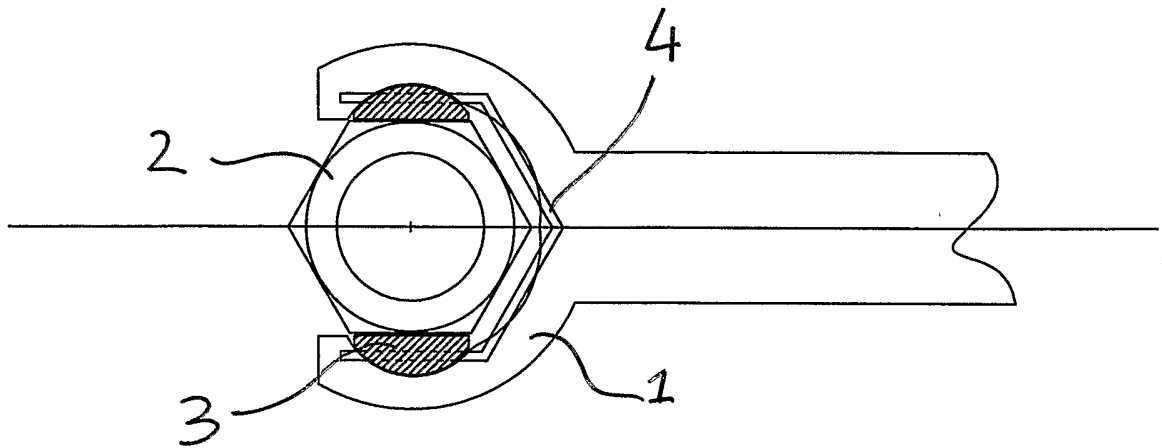


Fig 1

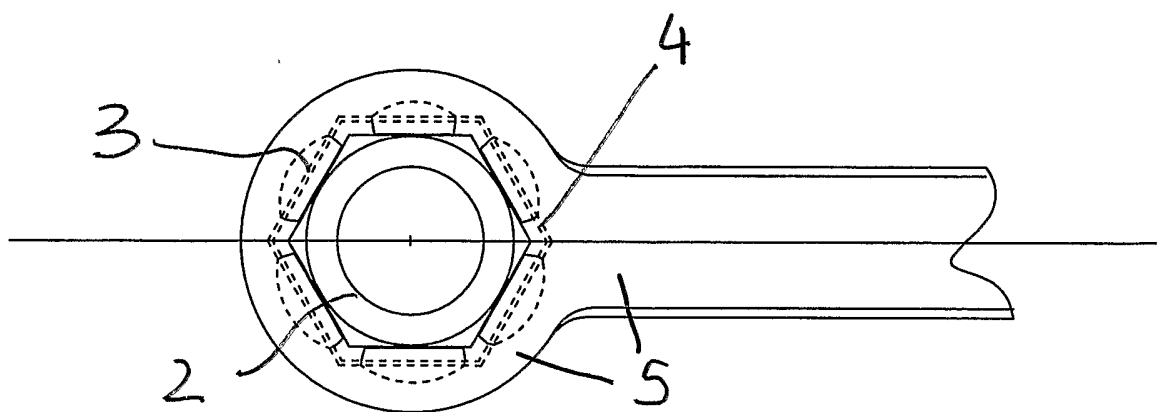


Fig 2

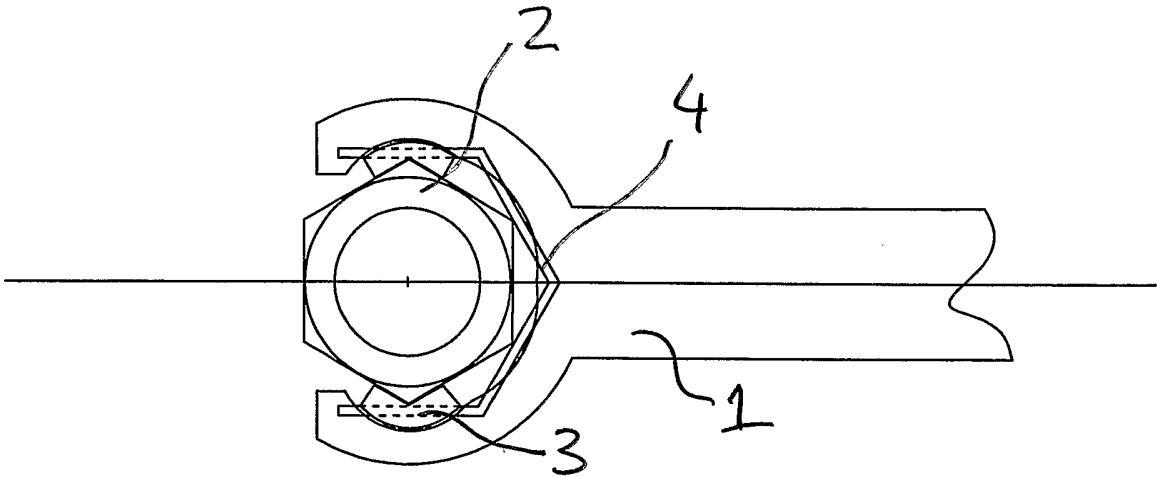


Fig 3

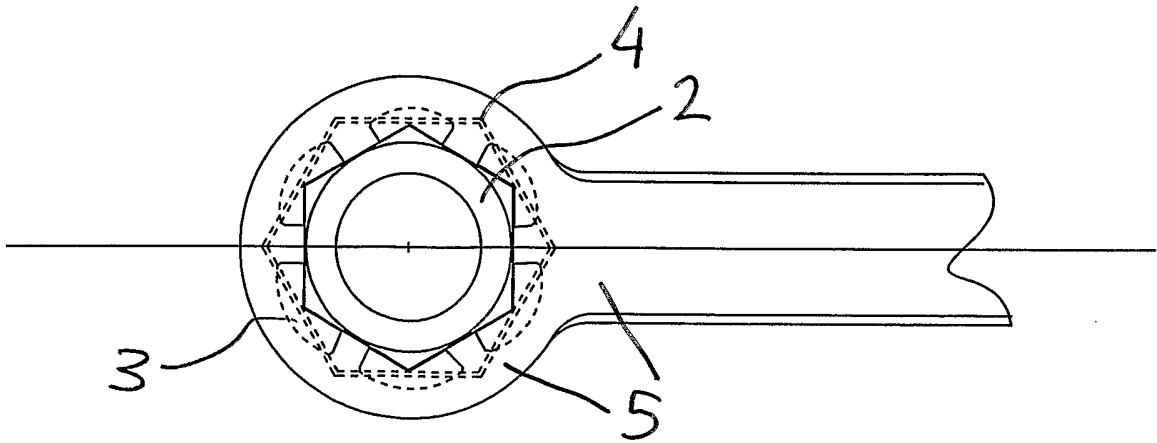


Fig 4

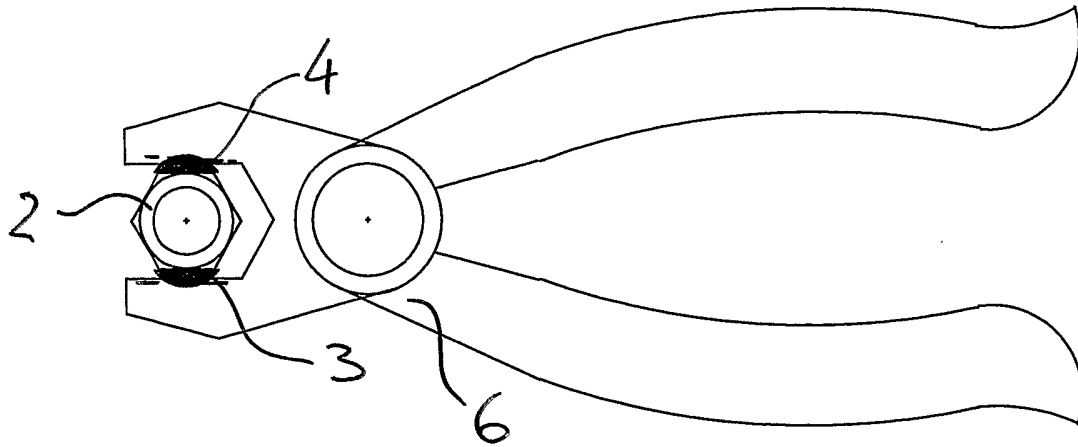


Fig 5

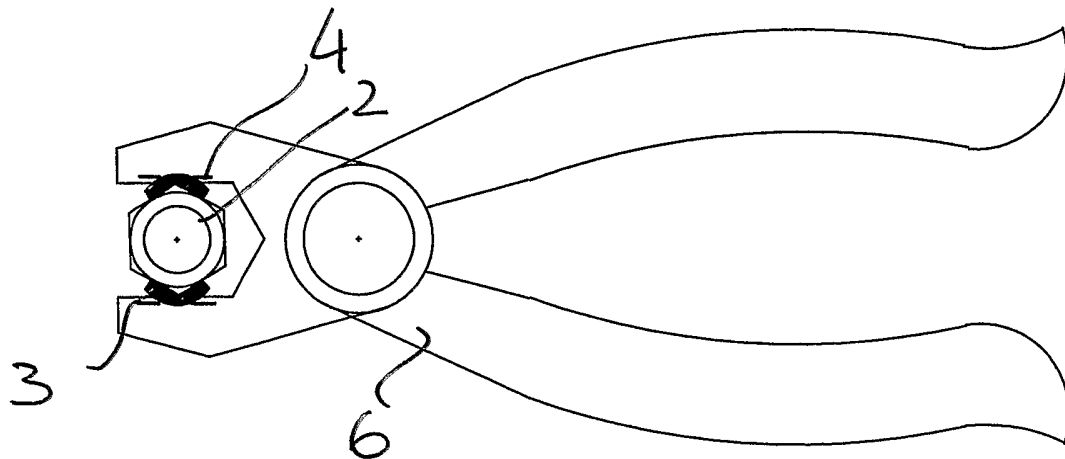


Fig 6

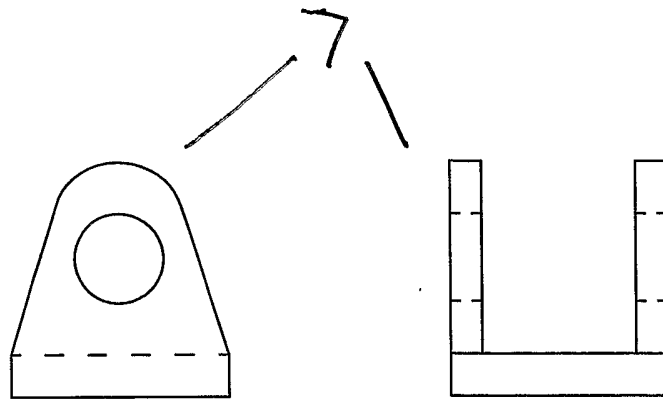


Fig 7

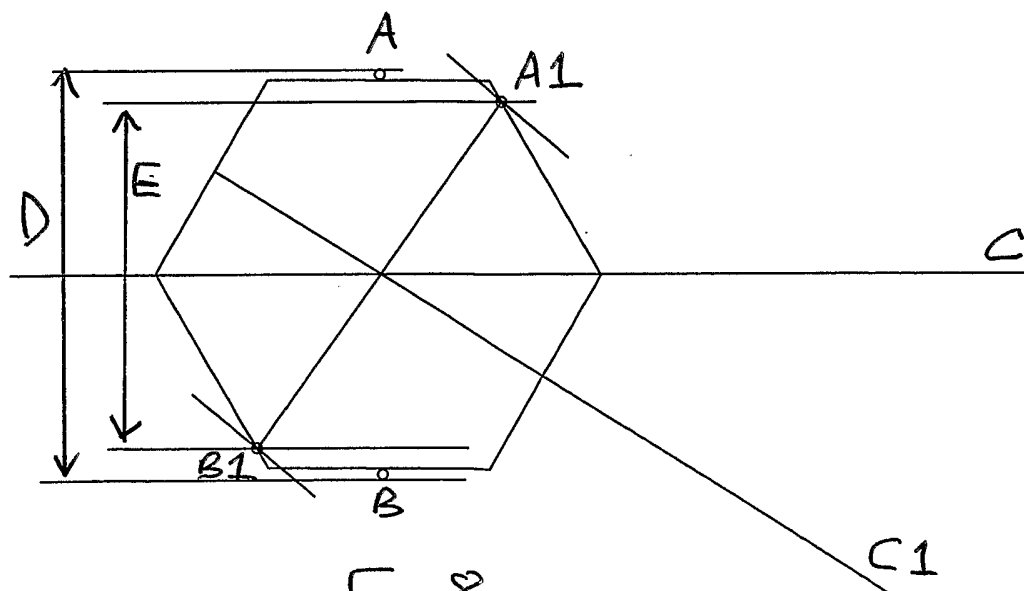


Fig 8

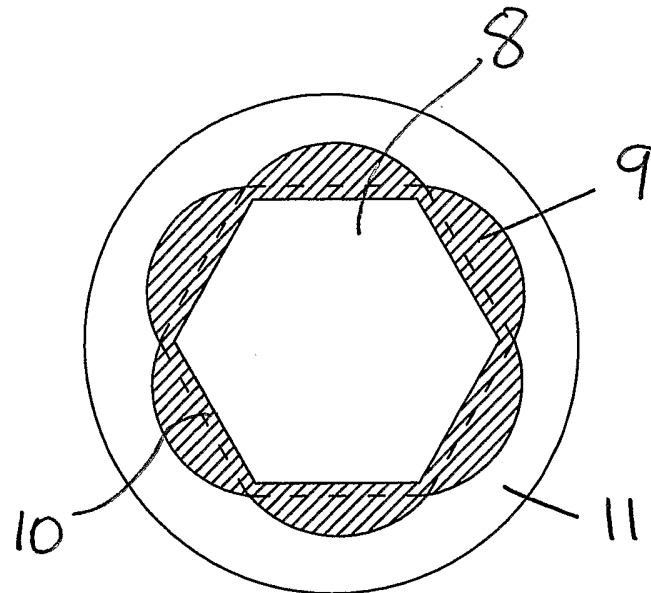


Fig 9

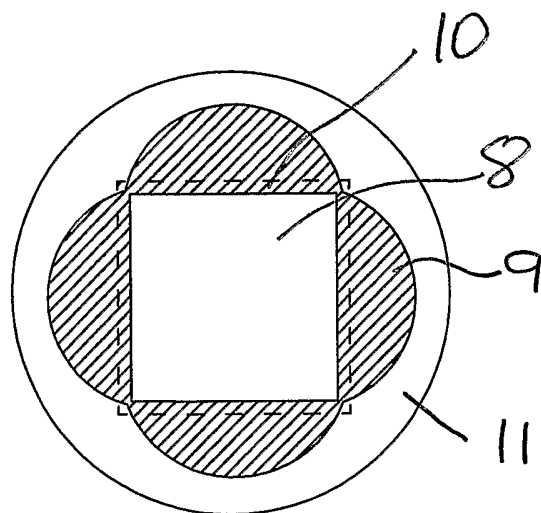


Fig 10

INTERNATIONAL SEARCH REPORT

 International Application No
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A. CLASSIFICATION OF SUBJECT MATTER

IPC 7 B25B13/10 B25B13/58

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC 7 B25B

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

EPO-Internal

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 1 646 350 A (DE HERTELENDY ANDOR) 18 October 1927 (1927-10-18)	1-4, 6-8, 11-13, 15-21
Y	page 1, line 104 - page 2, line 23 figures 1,2,6	14
X	US 1 483 906 A (MILLER WALTER F) 19 February 1924 (1924-02-19) the whole document	1-3, 6-21
X	US 5 579 667 A (KIM KWANG-MOO) 3 December 1996 (1996-12-03) column 3, line 23 - column 5, line 5 figure 4	1-4, 6, 11-21
X	US 6 116 118 A (WESCH JR WILLIAM E) 12 September 2000 (2000-09-12) figure 1b	1, 2, 6-8, 12, 15-21
	----- -/-	

☒ Further documents are listed in the continuation of box C.☒ Patent family members are listed in annex.

* Special categories of cited documents:

- *A* document defining the general state of the art which is not considered to be of particular relevance
- *E* earlier document but published on or after the international filing date
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- *Y* document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.
- *&* document member of the same patent family

Date of the actual completion of the international search

13 October 2004

Date of mailing of the international search report

22/10/2004

Name and mailing address of the ISA

 European Patent Office, P.B. 5818 Patentlaan 2
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INTERNATIONAL SEARCH REPORT

International Application No
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C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	DE 87 08 338 U (LIOU, IN JYE) 20 August 1987 (1987-08-20) figure 5	14
A	FR 2 814 101 A (MUSCIO MICHEL) 22 March 2002 (2002-03-22) column 8, line 14 - line 27 figures 10-12	9,10

FURTHER INFORMATION CONTINUED FROM PCT/ISA/ 210

Continuation of Box II.2

Claims Nos.: 22 23

Present independent claim 22 relates to an apparatus defined by reference to a desirable characteristic or property, namely a mechanism to obviate splined inner and outer components.

The claim covers all apparatus having this characteristic or property, whereas the application provides support within the meaning of Article 6 PCT and/or disclosure within the meaning of Article 5 PCT for only a very limited number of such apparatus. In the present case, the claim so lacks support, and the application so lacks disclosure, that a meaningful search over the whole of the claimed scope is impossible.

Independent of the above reasoning, the claim also lacks clarity (Article 6 PCT). An attempt is made to define the apparatus by reference to a result to be achieved. Again, this lack of clarity in the present case is such as to render a meaningful search over the whole of the claimed scope impossible.

Independent claim 23 does not meet the requirements of Article 6 PCT in that the matter for which protection is sought is not defined. This lack of clarity in the present case is such as to render a meaningful search over the whole of the claimed scope impossible.

The applicant's attention is drawn to the fact that claims relating to inventions in respect of which no international search report has been established need not be the subject of an international preliminary examination (Rule 66.1(e) PCT). The applicant is advised that the EPO policy when acting as an International Preliminary Examining Authority is normally not to carry out a preliminary examination on matter which has not been searched. This is the case irrespective of whether or not the claims are amended following receipt of the search report or during any Chapter II procedure. If the application proceeds into the regional phase before the EPO, the applicant is reminded that a search may be carried out during examination before the EPO (see EPO Guideline C-VI, 8.5), should the problems which led to the Article 17(2) declaration be overcome.

INTERNATIONAL SEARCH REPORT

International application No.
PCT/ZA2004/000070

Box II Observations where certain claims were found unsearchable (Continuation of item 2 of first sheet)

This International Search Report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. ☐ Claims Nos.:
because they relate to subject matter not required to be searched by this Authority, namely:
2. ☒ Claims Nos.: 22 23
because they relate to parts of the International Application that do not comply with the prescribed requirements to such an extent that no meaningful International Search can be carried out, specifically:
see FURTHER INFORMATION sheet PCT/ISA/210
3. ☐ Claims Nos.:
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

Box III Observations where unity of invention is lacking (Continuation of item 3 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:

1. ☐ As all required additional search fees were timely paid by the applicant, this International Search Report covers all searchable claims.
2. ☐ As all searchable claims could be searched without effort justifying an additional fee, this Authority did not invite payment of any additional fee.
3. ☐ As only some of the required additional search fees were timely paid by the applicant, this International Search Report covers only those claims for which fees were paid, specifically claims Nos.:
4. ☐ No required additional search fees were timely paid by the applicant. Consequently, this International Search Report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:

Remark on Protest

- ☐ The additional search fees were accompanied by the applicant's protest.
- ☐ No protest accompanied the payment of additional search fees.

INTERNATIONAL SEARCH REPORT

International Application No
PCT/ZA2004/000070

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