(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) Publication number: **0 673 720 A1**

(12) EUROPEAN PATENT APPLICATION

(21) Application number: **95103760.5**

(51) Int. Cl.[6]: **B25B 7/08**, B25B 7/06

(22) Date of filing: **15.03.95**

(30) Priority: **25.03.94 US 218513**

(43) Date of publication of application:
27.09.95 Bulletin 95/39

(84) Designated Contracting States:
DE FR IT

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(54) Hand tool with hinge joint.

(57) A precision hinge joint especially useful for dental and orthodontic hand tools (10) includes a threaded fastener (32) that pivotally couples arms (12, 16) of the tool together. An outer end of the fastener is riveted into a recess (30) formed on the side of the tool to form an enlarged end portion that substantially prevents the threaded fastener from loosening during use.

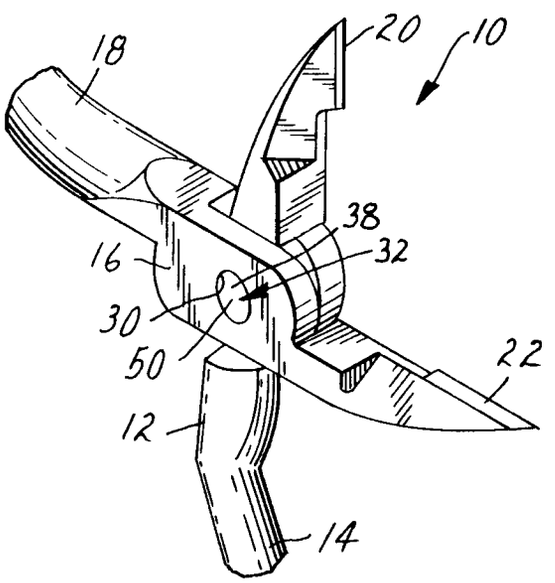

FIG.3

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This invention relates to a hand tool having a precision, essentially permanent hinge joint.

Many types of hand tools include a pair of arms that are pivotally connected to each other for swinging movement to accomplish a desired task. For example, common household pliers include a pair of arms having handle portions that are connected by a pivot for moving a pair of jaws located on the opposite end of the arms either toward or away from each other. Similarly, wire cutters, scissors and other hand tools also have handles that are pivotally coupled to each other.

Inexpensive tools are often provided with a pivotal coupling in the nature of a large rivet. The rivet is often considered a permanent coupling in that it normally does not permit arms of the tool to be detached from each other during ordinary use. The rivet is made by peening over outside ends of a section of cylindrical stock to form enlarged heads that contact outer sides of the arms.

Other types of hand tools employ a bolt for a fastener and pivotal connection. The bolt extends through bores in both arms, and is threaded into a nut. In order to avoid inadvertent loosening of the bolt from the nut, a thread locking compound is sometimes employed. Alternatively, other means, such as brazing or welding the nut to the bolt, may be used in an attempt to prevent the bolt from loosening from the nut.

A variety of precision hinged hand tools are used in orthodontic and dental offices daily and are also known as hand instruments. For example, pliers having small beaks may be used to hold dental or orthodontic attachments in the oral cavity. Pliers are also used to bend tiny loops or bends in an orthodontic archwire, or to adjust the position of a wing or hook of orthodontic brackets in order to optimize treatment. Hinged cutters are widely used by dentists and orthodontists to cut or trim archwire or other items as needed.

Preferably, the hinge joint of dental or orthodontic hand tools allows precise pivotal movement of the jaws of the tool in a smooth, nonwobbly arc toward or away from each other, while substantially preventing movement of the jaws in a lateral direction. Precise, smooth pivotal movement is especially important when bending orthodontic wires so that the bend or loop can be precisely formed with the proper radius and at the proper location along the wire as may be desired by the orthodontist. Precision hinge joints are also important in the use of cutting instruments such as during the trimming of orthodontic wire, inasmuch as the wire should be cleanly cut at the desired location without slippage of the tool or inadvertent bending of the wire.

The hinge joint of dental and orthodontic hand tools has received considerable attention over the years. Clearly, a joint that comes apart or otherwise loosens over a period of time is unacceptable. Moreover, the joint should not corrode or otherwise degrade after repeated sterilizations.

Flush joints for dental and orthodontic hand tools are particularly advantageous, in that the fastener presents less exposed surface area and therefore may be more effectively or efficiently sterilized than a comparable fastener having a protruding head. Additionally, the flush joint is sometimes beneficial when the hand tool is used in the limited space of the oral cavity since it does not obstruct the practitioner's view of the work operation.

Certain orthodontic hand tools having a hinge joint are made with a bolt-type fastener that is threaded into a threaded section of one arm of the tool. The fastener is ground flush with both sides of the tool once the fastener is tightened in place. In some instances, a thread locking compound is applied to the threads of the fastener before assembly to reduce the likelihood of inadvertent loosening of the fastener.

However, use of the thread locking compound is not entirely satisfactory, and occasionally bolt-type fasteners with such locking compounds have inadvertently loosened, causing an inconvenience to the practitioner. It has been suggested that conventional thread locking compounds may degrade over a period of time as the tool is subjected to repeated sterilizations. Moreover, once the tool has been assembled, it is difficult to confirm that the thread locking compound has been applied to the threads in the proper amount and at a correct location during manufacture.

The present invention is directed toward a hinge joint hand tool that comprises a first arm having a first handle portion and a first bore, and a second arm having a second handle portion and a second bore. The second bore has a central reference axis and a threaded section. The tool also includes a fastener that extends in the first bore and the second bore and pivotally couples the first arm to the second arm. The fastener includes a head located next to the first arm. The fastener includes a shank connected to the head and having a threaded section in threaded engagement with the threaded section of the second bore. The second bore includes a recess remote from the first arm, and the recess has a cross-sectional area larger than the threaded section of the second bore in directions perpendicular to the reference axis. The shank includes an outer end portion in contact with the recess.

The threaded section of the fastener is useful for retaining the first arm and the second arm in precise, proper spatial relation to each other during the expected lifetime of the tool. Advantageously, the outer end portion of the shank, in contact with

the recess of the second arm, substantially prevents inadvertent loosening of the fastener from the second arm. The invention is especially satisfactory when both ends of the fastener are machined flush with outer sides of the first arm and the second arm, so that a substantially permanent, yet aesthetically pleasing hinge joint is attained.

The present invention also concerns a method of making a hinge joint hand tool that comprises the steps of aligning a bore of a first arm of the hand tool with a bore of a second arm of the hand tool, and placing a threaded fastener at least partially in the bore of the first arm. The method also includes the steps of rotating the fastener to thread the fastener into a threaded section of the bore of the second arm, and moving an outer end portion of the fastener into a recess of the second arm next to the threaded section in order to retain the fastener in place. The invention will be further described in connection with the drawings, in which:

Fig. 1 is fragmentary perspective view of a hand tool according to the invention during an intermediate step in manufacture of the tool;

Fig. 2 is an enlarged cross-sectional view through a hinge joint of the tool shown in Fig. 1 except that jaws of the tool are shown in a closed orientation;

Fig. 3 is a view somewhat similar to Fig. 1 except that the tool is illustrated as it appears after manufacturing has been completed;

Fig. 4 is an enlarged cross-sectional view through the hinge joint of the tool shown in Fig. 3 except that jaws of the tool are shown in a closed orientation; and

Fig. 5 is an elevational view of a riveting tool used in manufacture of the hinge joint shown in Figs. 1-4.

A hinge joint hand tool constructed in accordance with the invention is shown in Figs. 1-4 and is broadly designated by the numeral 10. The hand tool 10 illustrated in the drawings is a hand cutter or cutting pliers, although it should be understood in this regard that the invention is equally suitable for other hand tools or instruments such as wire bending pliers or orthodontic band seating pliers, and can be advantageously used in any tool where an aesthetic, non-obtrusive, substantially permanent precision pivotal coupling is desired.

The hand tool 10 includes a first lever arm 12 having a first handle portion 14. The hand tool 10 also includes a second lever arm 16 having a second handle portion 18. The handle portions 14, 18 are only partially shown in the drawings (Figs. 1 and 3), but are curved to comfortably fit within the hand of the user during use.

The first arm 12 has a jaw that includes a cutting tip 20 remote from the first handle portion 14, and the second arm 16 has a jaw that includes a cutting tip 22 remote from the second handle portion 18. The first arm 12 has a first bore 24 (Figs. 2 and 4) located between the first handle portion 14 and the cutting tip 20, and the second arm 16 has a second bore 26 located between the second handle portion 18 and the cutting tip 22.

The first bore 24 includes an inner cylindrical cavity that is next to the second arm 16, and an outer cylindrical cavity that faces outwardly and away from the second arm 16. The two cylindrical cavities of the first bore 24 are concentric and aligned along a central reference axis that also extends along the longitudinal axis of the second bore 26.

The second bore 26 includes a threaded section 28 that begins at the inner side of the second bore 26 next to the first arm 12, and extends in a direction away from the first arm 12. The threaded section 28 preferably conforms to the screw thread data set out in the unified and American standards, No. 0 through 2 inch, of the National Bureau of Standards handbook. For the hand tool 10 that is illustrated in Figs. 1-4, an example of a suitable thread size is 10-32 UNF 2B and a suitable pitch is 32 threads per inch (13 threads per cm).

The second bore 26 also includes an outer recess 30 that is remote from the first arm 12. The recess 30 extends from the outer end of the threaded section 28 to the outer side of the second arm 16. The recess 30 is chamfered and has the shape of a truncated cone. An example of a suitable dimension for the recess 30 of the hand tool 10 shown in the drawings is 0.025 in. (0.6 mm) deep (i.e., in a direction along the longitudinal central reference axis of the second bore 26), with the angle of the chamfer being 45 degrees from the reference axis.

A fastener 32 extends through the first bore 24 and the second bore 26 and pivotally couples the first arm 12 to the second arm 16. As shown in Figs. 2 and 4, the fastener 32 includes an enlarged cylindrical head 34 that is received in the outer cylindrical cavity of the first bore 24. The fastener 32 also includes a cylindrical body 36 that complementally fits within the inner cylindrical cavity of the first bore 24.

The fastener 32 is provided with a shank 38 that extends outwardly from the cylindrical body 36 and passes through the second bore 26. The shank 38 includes a threaded section 40 that is in mating, threaded engagement with the threaded section 28 of the second bore 26. Initially, the shank 38 has sufficient length to extend just beyond the outer side of the second arm 16 and project past the recess 30 as is shown in Figs. 1 and 2.

The fastener 32 also initially includes a stem 42 that is illustrated in Figs. 1 and 2. The stem 42

extends in a direction away from the shank 38 and has an internal, elongated channel that is shown by the dashed lines in Figs. 1 and 2. The internal channel has a hexagonal shape in transverse section and is adapted to matingly receive an allen wrench having a size of 1/8 in. (3.2 mm).

The shank 38 also includes a chamfered portion 44 that is located between the cylindrical body 36 and the threaded section 40. The chamfered portion 44 is surrounded by an annular shim or spacer 46 that is located within the inner cylindrical cavity of the first bore 24 and in contact with the inner side of the second arm 16.

To assemble the hand tool 10, the first arm 12 is placed next to the second arm 16 such that the first bore 24 is in alignment with the second bore 26. Next, the spacer 46 is placed onto the shank 38 of the fastener 32 in surrounding relation to the chamfered portion 44. Optionally, a quantity of thread locking compound (Loctite, No. 272) is applied to the threaded section 40. The fastener 32 is then placed in the first bore 24, and an allen wrench is inserted in the channel of the stem 42 in order to rotate the fastener 32 under force.

The fastener 32 is turned by the allen wrench until the threaded section 40 of the shank 38 is fully threaded into the threaded section 28 of the second bore 26. The allen wrench applies a seating torque of about 70 in-lb ± 2 in-lb (80 cm-kg ± 2 cm-kg) to the fastener 32. At such time, the head 34 of the fastener 32 is located completely within the first bore 24, with only the stem 42 protruding outwardly from the first arm 12 as shown in Fig. 2. When the shank 38 is fully seated and tightened to the aforementioned torque in the second bore 26, an outer end portion 50 of the shank 38 protrudes past the recess 30 as shown in Figs. 1 and 2.

Next, a riveting tool such as the riveting tool 48 illustrated in Fig. 5 is brought into engagement with the outer end portion 50 of the shank 38 as the hand tool 10 is held in a jig. The hexagonal channel previously occupied by the allen wrench now temporarily receives a locator stud that serves to locate the riveting tool 48 to the outer end portion 50 and resist the force applied by the riveting tool 48.

The riveting tool 48 has a circular flat end surface 52 having a diameter of 0.31 in. (7 mm), although a tool with a convex head may also be employed. As the flat end surface 52 is brought into contact with the outer end portion 50 of the shank 38, the riveting tool 48 is moved in an orbital path to cause the outer end portion 50 to deform in lateral directions. Operation of the riveting tool 48 is suspended once the end portion 50 fills the recess 30 and has a chamfered shape complementally matching the shape of the recess 30.

Next, the stem 42 is removed in a grinding operation, leaving the head 34 flush with the outer side of the first arm 12. Advantageously, use of a hexagonal inner channel on the stem 42 reduces the amount of material that must be removed during grinding of the stem 42.

In addition, the outer end portion 50 is ground to a flat configuration flush with the outer side of the second arm 16 and the outer end of the recess 30. Preferably, the length of the shank 38 is selected such that little, if any, grinding is needed in order to minimize the time and expense of the grinding operation.

The outer end portion 50 of the shank 38 in the finished tool 10 has a cross-sectional area (i.e., an area in a reference plane perpendicular to the central reference axis of the bore 26) that is larger than the threaded section 28 of the second bore 26. The deformed outer end portion 50 extends laterally beyond the threaded section 28 (i.e., extends beyond the shank 28 in a direction perpendicular to the central reference axis of the second bore 26). As a result, the outer end portion 50 retains the fastener 32 in place in essentially permanent fashion.

The hinge joint has substantial strength because both the riveted outer end portion 50 as well as the threaded section 40 of the shank 38 resist lateral movement of the second arm 16 away from the first arm 12 and together serve to retain the hand tool 10 in assembled relation. However, the hand tool 10 may be readily disassembled when desired, as may occasionally occur during overhauling of the hand tool 10. The fastener 32 is removed by selecting a drill bit having a diameter slightly less than the smallest diameter (i.e., the root diameter) of the threaded section 40, and then using the drill bit to drill a hole through the outer end portion 50 and the shank 38 without contacting the threaded section 28. A screw extractor is inserted into the hole to turn the fastener 32, at which time the remaining segments of the outer end portion 50 readily break away.

Preferably, a small amount of lubricant grease is placed on the two cylindrical surfaces of the head 34 as well as the lateral annular surface joining the two cylindrical surfaces. Grease may also be placed on both sides of the spacer 46. The cylindrical surfaces of the head 34 and the intermediate annular surface are in sliding, bearing contact with adjacent surfaces of the first arm 12 during use of the hand tool 10. Preferably, the spacer 46 is relatively thin or optionally eliminated, in order to further increase the area of the cylindrical surface of the head 34 that is in rotational sliding contact with adjacent surfaces of the first arm 12.

Finishing of the hand tool 10 preferably includes buffing and polishing of the exposed ends of the fastener 32 in order to provide an aesthetically pleasing and corrosion resistant hinge joint. Suitable materials for the fastener 32 include type 416L hardened stainless steel, while the arms 12, 16 may be made of a 400 series stainless steel such as type 410 or 420.

Claims

1. A hand tool (10) with a hinge joint comprising a first arm (12) having a first handle portion (14) and a first bore (24), a second arm (16) having a second handle portion (18) and a second bore (26), said second bore (26) having a central reference axis and a threaded section (28), and a fastener (32) extending in said first bore (24) and said second bore (26) and pivotally coupling said first arm (12) to said second arm (16), said fastener (32) including a head (34) located next to said first arm (12), said fastener (32) including a shank (38) connected to said head (34);

   characterized in that said fastener (32) includes a threaded section (40) in threaded engagement with said threaded section (28) of said second bore (26), said second bore (26) includes a recess (30) remote from said first arm (12), said recess (30) has a cross-sectional area larger than said threaded section (28) of said second bore (26) in directions perpendicular to said reference axis, and said shank (38) includes an outer end portion (50) in contact with said recess (30).

2. The hand tool (10) of claim 1, wherein said end portion (50) has a shape complemental to said recess (30).

3. The hand tool (10) of claim 1 or 2, wherein said end portion (50) is riveted into said recess (30).

4. The hand tool (10) of any of claims 1 to 3, wherein said recess (30) is chamfered.

5. The hand tool (10) of any of claims 1 to 4, wherein said end portion (50) has an outer end, and wherein said recess (30) has an outer end that is flush with said outer end of said end portion (50).

6. The hand tool of any of claims 1 to 5, wherein said first bore (24) has an outer end, and wherein said head (34) includes an outer end that is flush with said outer end of said first bore (24).

7. A method of making a hinge joint hand tool (10) comprising the steps of:

   aligning a bore (24) of a first arm (12) of the hand tool (10) with a bore (26) of a second arm (16) of the hand tool (10);

   placing a threaded fastener (32) at least partially in the bore (24) of the first arm (12);

   rotating the fastener (32) to thread the fastener (32) into a threaded section (28) of the bore (26) of the second arm (16); and

   moving an outer end portion (50) of the fastener (32) into a recess (30) of the second arm (16) next to the threaded section (28) in order to retain the fastener (32) in place.

8. The method of claim 7, wherein the step of moving the end portion (50) of the fastener (32) into the recess (30) includes the step of contacting a riveting tool (48) with the end portion (50) while moving the riveting tool (48) in an orbital path.

9. The method of claim 7 or 8, including the step of removing excess material from the end portion (50) of the fastener (32) in order to provide a substantially flush joint.

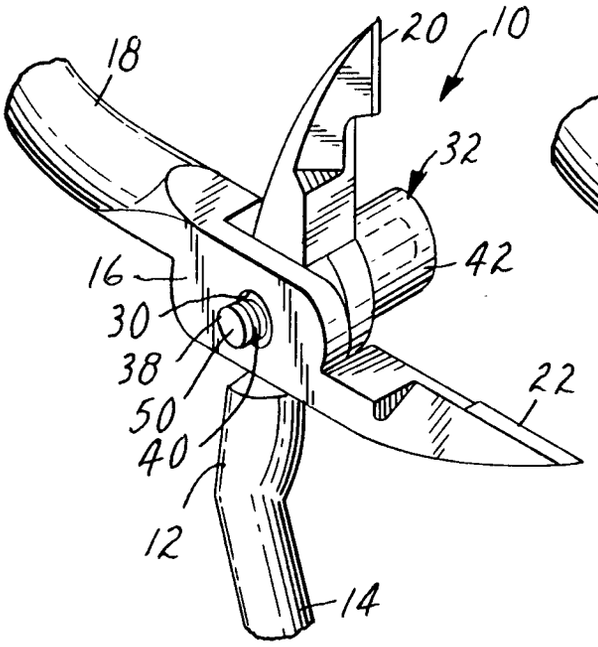

FIG. 1

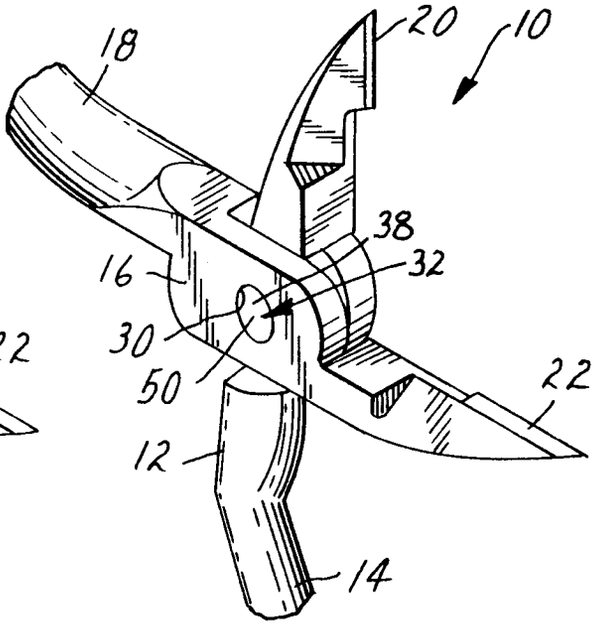

FIG. 3

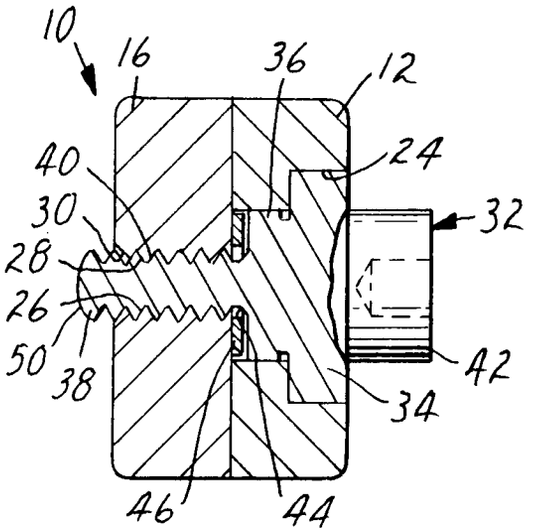

FIG. 2

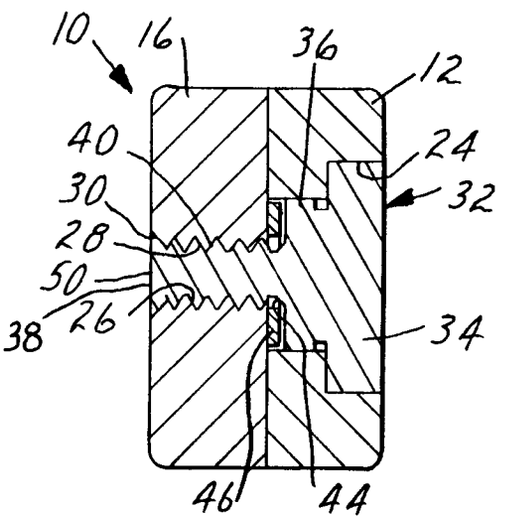

FIG. 4

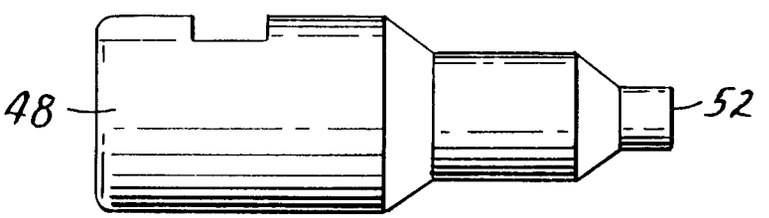

FIG. 5

European Patent Office

EUROPEAN SEARCH REPORT

Application Number
EP 95 10 3760

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.6)
X Y	US-A-2 939 215 (K.PUTSCH ET AL.) * the whole document * ---	1-5,7,9 6	B25B7/08 B25B7/06
X	DE-A-30 26 151 (W.HEIMANN) * page 4, line 11 - line 26; figure 2 * ---	1,2,4-7	
Y A	US-A-3 648 550 (W.J.ROZMUS) * column 7, line 33 - line 46; figure 10 * ---	6 1	
A	US-A-4 843 927 (B.GULISTAN) * abstract; figures 2-4 * ---	1,5,6	
A	US-A-3 602 074 (E.F.SMITH) * abstract; figures 6,11 * ---	1,5,6	
A	CH-A-573 288 (EREM S.A.) * the whole document * -----	1,6	

TECHNICAL FIELDS SEARCHED (Int.Cl.6)

B25B
A61C

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	5 July 1995	Majerus, H

CATEGORY OF CITED DOCUMENTS

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