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

(11) **EP 4 171 880 B1**

(12) **EUROPEAN PATENT SPECIFICATION**

(45) Date of publication and mention of the grant of the patent:
13.11.2024 Bulletin 2024/46

(21) Application number: **20734728.7**

(22) Date of filing: **25.06.2020**

(51) International Patent Classification (IPC):
B25B 13/06 *(2006.01)* ***B25B 23/08*** *(2006.01)*
B25B 15/00 *(2006.01)*

(52) Cooperative Patent Classification (CPC):
B25B 13/06; B25B 15/004; B25B 23/08

(86) International application number:
PCT/EP2020/067775

(87) International publication number:
WO 2021/259480 (30.12.2021 Gazette 2021/52)

(54) **VACUUM NOZZLE AND A METHOD FOR MAKING SUCH A NOZZLE**

VAKUUMDÜSE UND VERFAHREN ZUR HERSTELLUNG EINER SOLCHEN DÜSE

BUSE D'ASPIRATION ET SON PROCÉDÉ DE FABRICATION

(84) Designated Contracting States:
AL AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HR HU IE IS IT LI LT LU LV MC MK MT NL NO PL PT RO RS SE SI SK SM TR

(43) Date of publication of application:
03.05.2023 Bulletin 2023/18

(73) Proprietor: **Atlas Copco Industrial Technique AB**
105 23 Stockholm (SE)

(72) Inventor: **BASIC, Mehmed**
11763 Stockholm (SE)

(74) Representative: **Atlas Copco Industrial Technique AB**
105 23 Stockholm (SE)

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Description

Technical field

[0001] The present invention generally relates to a vacuum nozzle for a tightening tool, more particularly to such a nozzle adapted to engage and apply a rotational tool to a fastening element.

Technical Background

[0002] Power tools for tightening are known to be used in various industries, where the size of the screws used naturally varies form very large to very small. For example, in the electronics industry, screws of a very small size are commonly utilized, such as M1 screws or smaller. These screws are often situated in tight spaces and are further to be tightened to a very low torque level.

[0003] Such small screws are difficult to handle by hand, and in order to facilitate handling it is known to use vacuum technique to pick up the screws. For example, so called vacuum adapters are known in the art. Such adapters are arranged at a front end of a tightening tool such that small screws can be picked up by means of this vacuum (i.e. sucked into position) and arranged at a bit or similar structure at the front end of the tool to be tightened. These adapters however tend to be somewhat bulky and may thus restrict access of the tool to certain hard to reach screw positions. Document WO 2007/140579 A1 discloses a vacuum nozzle according to the preamble of claim 1.

[0004] In order to alleviate some of these problems, attempts have been made to use smaller nozzles, for example tube shaped slim nozzles for providing better access to such screw positions. However, there are still problems remaining in achieving a sufficiently small size of such nozzles for certain applications as well as achieving a sufficient flow providing a desired vacuum at the front end of such nozzles and hence there exists a need for improvement in the field of vacuum nozzles.

Summary of the invention

[0005] Accordingly, it would be desirable to provide a vacuum nozzle for a tightening tool adapted to engage tightening elements having a small diameter. In particular, it would be desirable to provide such a nozzle where the channels providing the vacuum may be optimized for a certain application. To better address one or more of these concerns a vacuum nozzle and a method as defined in the independent claims are provided.

[0006] Preferred embodiments are defined in the dependent claims.

[0007] According to a first aspect of the present invention a vacuum nozzle according to claim 1 is provided.

[0008] According to the first aspect, the nozzle provides an inventive solution to the concerns described above by means of a design providing an integrated fluid connection between the end of the nozzle engaging the tool and the end engaging the fastening element, and further in that this nozzle is defined by a series of printed layers. This since the utilization of such printed layers during manufacturing allows for great freedom in the design of the geometry of the nozzle as such, including provision of small dimensions, and also for freedom of design of the at least one channels, also when using harder materials such as for example steel alloys. In one embodiment, this technique may be performed by means of a three-dimensional printer.

[0009] Hence the vacuum nozzle according to independent claim 1 cleverly solves the problem of achieving a sufficiently small size of sockets necessary for certain applications as well as achieving a sufficient flow to provide vacuum at the front end of the nozzle. The skilled person realizes that the vacuum nozzle may also be referred to as a bit or as a bit or nozzle having an integrated vacuum channel.

[0010] The vacuum nozzle is hence adapted to both engage, by means of a vacuum provided at the first end of the nozzle by means of the fluid path, and apply a torque to a fastening element such as a screw. In order to provide this vacuum, the second end of the nozzle may also adapted to engage (or be coupled to) a vacuum source, such that the vacuum provided by this source may in turn be provided at the first end of the nozzle via the fluid path in order to suck a screw into position to be engaged. In one embodiment, a thread is provided at the second end of the nozzle to engage a corresponding thread of a tool in order to engage the tool and vacuum source.

[0011] The tightening tool with which the inventive nozzle may be used may be a tightening tool such as a screwdriver, such as a pneumatic an electrically powered screwdriver, possibly a battery driven tool. More particularly, the nozzle may depending on the application be suitable for use with a fixtured screwdriver or a handheld screwdriver.

[0012] According to the invention the body comprises an outer sleeve, a fastening element engaging structure arranged at the first end coaxially arranged with respect to the sleeve and adapted to engage a fastening element, and a solid body portion at the second end. Hereby, air may pass between the fastening element structure and the outer sleeve, i.e. the fluid path may in some embodiments be described as at least partly formed between said fastening engaging structure and said outer sleeve. Depending on the design of the outer sleeve, structural integrity of the nozzle may also be enhanced by means of the provision of such a sleeve.

[0013] According to the invention the at least one fluid path is at least partly formed by a fluid channel extending through the solid body portion between a first end of the solid body portion and a second end of the solid body, i.e. the at least one fluid path may extend at least partly through the solid body portion. Hereby, as the path followed by and shape of the at least one channel may be

chosen freely a possibility is provided to design channels having an optimized design for the application in question, depending on the desired flow characteristics. For example, the path followed may be a path comprising straight and/or curved portions, and the cross section of the channel may be constant or varying having any suitable shape.

[0014] Such a fluid channel may further in some embodiments be arranged to emerge from the solid portion at a position close or adjacent to the base of the fastener engaging structure. For example, in one embodiment, the radial distance between an opening of such a channel to the fastener engaging structure may be less that ¼ of the diameter of the opening, in some embodiments less than 1/5. Hereby a more compact design may be achieved.

[0015] Further, as mentioned above, the at least one fluid path may in some embodiments extend partly through the solid portion and partly be formed between the sleeve and the fastening element engaging structure.

[0016] According to one embodiment the fluid path is at least partly formed by a fluid channel extending through the fastening element engaging structure between a first end 12a of the fastening element engaging structure and a second end 12b of the fastening element engaging structure, i.e. the at least one fluid path may extends at least partly through the fastening element engaging structure. Hereby, the design of the channel may be adapted and optimized to an even higher degree in that a more complex geometry of the at least one channel may be used not only with regards to the part of the channel extending through the solid body portion, but also with regards to the portion of the channel extending through the fastening element engaging structure. In some embodiments however, the fastening element engaging structure may constitute or at least form part of the solid body portion and the channel in such an embodiment may be completely formed through the fastening element engaging structure.

[0017] According to the invention the vacuum nozzle comprises a plurality of channels, these channels extending at least between the first and the second end of the solid body portion and/or the first and second end of the fastening element engaging structure. Hereby a more efficient air flow may be achieved. For example, a suitable vacuum at the first end of the nozzle may be achieved faster using more than one channels. In one embodiment, the vacuum nozzle comprises three channels. Three channels may provide a proper balance between a good flow and hence a proper vacuum at the fastener engaging end of the nozzle and structural integrity and manufacturability of the nozzle.

[0018] According to one embodiment the at least one channel is defined between a first number of channel openings arranged at the first end of the channel, and a second number of channel openings at the second end of the channel, wherein the first number is different from the second number. I.e., the at least one channel may be a branched channel. For example, according to one embodiment, an exemplary vacuum nozzle may have a channel extending between a single channel opening at the second end, and more than one channel openings at the first end. I.e., the channel may be described as a single channel which divides, or splits, into more than one channel along the nozzle. This may be advantages for example in that an even more optimized flow of air may be obtained.

[0019] According to one embodiment, the at least one channel extends along a curved path between the first and second end(s) of the channel. By curved should in the context of the present specification be understood a path having one or more bends, or portions, having a suitable radius. Such a curved path may for example be curved in a plane normal to the axial direction, and/or in a plane perpendicular to this direction and/or in any other direction. In other embodiments, the at least one channel may follow a stepped path, i.e. a path making one or more steep or sharp turns (i.e. a path having sharp corners) between the first and second end.

[0020] According to one embodiment, the outer sleeve and the solid body portion are integrally formed whereas according to another embodiment, the outer sleeve and the solid body portion are two separate bodies. Further, in some embodiment, the fastening element engaging structure is integrally formed with the solid body portion or, in some case, with the solid body and the outer sleeve as one unit. I.e., according to one embodiment, the outer sleeve, the solid body portion and the fastening element engaging structure are integrally formed. To provide such integrally formed components is achievable using an additive manufacturing technique according to the invention and is advantageous for example in terms of improved strength due to the absence of any interface between parts which may easily break as well as eliminating challenging requirements on tolerances between parts as may be the case when multiple bodies are used.

[0021] According to one embodiment the fastening element engaging structure is a screw driver bit adapted to engage a screw head. For example, such a screw driver bit may be a bit adapted to engage a recess in a screw head such as a hexagonal, Torx, square or triangle bit or any other common type such as slot, cross (also known as Philips) or square (also known as Robertsson). Other embodiments could involve a bit socket adapted to engage for example a hexagonal screw head.

[0022] According to one embodiment the fastening element engaging structure is a socket adapted to receive a fastening element. For example, a fastening element such as a nut or possibly a screw head such as the hexagonal screw head mentioned above.

[0023] In general, due to the thin walled structures achievable using an additive manufacturing technique used according to the invention, the cross sectional area of the at least one fluid path may be close to the cross sectional area of the solid body and/or of the fastener engaging structure through which it extends.

[0024] For example, in one exemplary embodiment where at least one channel extends through the solid body portion and comprises a substantially circular opening adjacent to said fastener engaging structure, the diameter of said opening is at least 70% of the radial distance between the outer surface of the bit engaging structure and the inner surface of the tubular body portion, in some embodiments up to 80%. Hereby, a large fluid flow may be achieved in an advantageously compact manner.

[0025] For example, according to one embodiment, an outer diameter of the outer sleeve lies in the range 3-5 mm. In one embodiment, an inner diameter of the outer sleeve lies in the range 2-4 mm.

[0026] According to one embodiment, the total length of the vacuum nozzle lies in the range 1-10 mm, sometimes in the range 2-5 mm. According to one embodiment, the length of the second engaging structure lies in the range 0.5-3 mm, sometimes 1-2 mm. For example, in one embodiment, the distance from the center of the bit to the end of the outer sleeve may be less or equal to 3mm, possibly 2 mm. Such a small distance may be of particular importance when performing tightening of very small screws, such as M08-M1 screws, to very low torque values such as 2-3 N-cm. The nozzle may hence in some embodiments be a nozzle adapted for tightening of screws of dimensions lying in the range M05-M2, in some embodiments M08-M1 and the equivalent sizes using any other non-metric scale. The nozzle may further in some embodiment be a nozzle adapted for tightening of screws to a torque lying in the range 1-4 N-cm, in some embodiments 2-3 N-cm.

[0027] The channel(s) formed in the solid body portion and/or the fastening element engaging structure may have any suitable cross section. In one embodiment, the cross section is a circular cross section.

[0028] In one embodiment, the diameter of such a circular channel lies in the range 0,5-2 mm, in other embodiments in the range 0,5-1,25mm. As mentioned above, the diameter may be very close to the distance between the fastener engaging structure and sleeve, or similarly to the diameter of the fastener engaging structure in cases where the channel extends there through. Suitable materials for the nozzle includes metal, i.e. metal alloys such as steel, stainless steel, aluminum, titanium etc. For some embodiments, plastic could however also be a suitable material.

[0029] There exists a method for producing, or making, a nozzle according to any of the embodiments described above is provided, said method being an additive manufacturing method. According to one embodiment of the second aspect, the additive manufacturing method is performed by means of a three-dimensional printer.

[0030] The method is a method for making a vacuum nozzle, method being characterized by the use of an additive layer manufacturing method to build the nozzle from a plurality of layers such that the vacuum nozzle includes a body extending in an axial direction and having a first end adapted to receive and engage said fastening element and a second end adapted to engage a rotating output axle of a tool, and comprises an outer sleeve, a fastening element engaging structure arranged at said first end, coaxially arranged with respect to said sleeve and adapted to engage a fastening element; and a solid body portion arranged at said second end, such that the outer sleeve, fastening element engaging structure and solid body portion are integrally formed.

[0031] The method further comprises the step of creating a computer assisted design file which, when executed by a three-dimensional printer, creates a nozzle according to any of the embodiments described above.

[0032] There is provided a computer assisted design file which comprises digital information for the implementation of the method according to the embodiments described above when loaded onto a three-dimensional printer is provided. In an alternative embodiment, a computer assisted design file which comprises digital information which, when executed by a three-dimensional printer, creates a nozzle according to any of the embodiments described above is provided.

[0033] There is also provided a computer program that, when executed by a dimensional printer, performs the method described above as well as a computer program that, when executed by a three dimensional printer, creates a vacuum nozzle according to any of the embodiments described above is provided.

[0034] Objectives, advantages and features conceivable within the scope of the second and third aspect of the invention are readily understood by the foregoing discussion referring to the first aspect of the invention.

[0035] Further objectives of, features of and advantages of the present invention will become apparent when studying the following detailed disclosure, the drawings and the appended claims.

Brief description of the drawings

[0036] The invention will be described in the following illustrative and non-limiting detailed description of exemplary embodiments, with reference to the appended drawing, on which

Figure 1a is a perspective view of an exemplary vacuum nozzle according to a first embodiment.

Figure 1b is a cross sectional view of an exemplary vacuum nozzle according to a first embodiment.

Figure 1c is a front view of an exemplary vacuum nozzle according to a first embodiment.

Figure 2a is a perspective view of an exemplary vacuum nozzle according to a second embodiment.

Figure 2b is a cross sectional view of an exemplary vacuum nozzle according to a second embodiment.

Figure 2c is a front view of an exemplary vacuum nozzle according to a second embodiment.

[0037] All figures are schematic, not necessarily to scale and generally only show parts which are necessary in order to elucidate the invention, wherein other parts may be omitted or merely suggested.

Detailed description

[0038] An exemplary vacuum nozzle 1 according to a first embodiment is shown in perspective view in Figure 1a and in cross sectional view in fig. 1b. The nozzle comprising a body 10 extending in an axial direction A-A and having a first end 10a adapted to receive and engage a fastening element, such as a screw, and a second end 10b adapted to engage a rotating output axle of a tool (not shown). A fluid path 20 is arranged to provide a fluid connection between the first end 10a and the second end 10b of the nozzle 1.

[0039] The nozzle 1 is hence adapted to engage, by means of a vacuum provided at the first end 10a by means of the fluid path 20, and apply a torque to a fastening element such as a screw. In order to provide this functionality, the illustrated embodiment of the nozzle comprises an outer sleeve 11, a fastening element engaging structure 12 arranged at the first end 10a and coaxially arranged with respect to the sleeve and adapted to engage a fastening element, in the illustrated embodiment is a hexagonal screw driver bit 12 adapted to engage a screw head having a hexagonal recess, and a solid body portion 13 at the second end 10b. Further, the fluid path 20 is in the illustrated embodiment formed by three channels 20a, 20b, 20c extending through this solid body portion 13 and the space formed between an inner surface 11b of the sleeve 11 and the screw driver bit 12. In the illustrated embodiment, the outer sleeve 11, the solid body portion 13 and the fastening element engaging structure 12 are integrally formed.

[0040] A thread 14, shown in fig. 1b, is provided at the second end 10b of the nozzle to engage a corresponding thread of a tool in order to engage the axle of the tool. Further, the second end 10b is also adapted to engage a vacuum source, such that a vacuum may be provided at the first end of the nozzle 10a via the fluid path 20 in order to suck a screw into position to be engaged by the bit 12.

[0041] As mentioned above, the nozzle 1 shown in fig. 1a comprises three channels 20a, 20b, 20c extending through the solid body 13. One of these channels 20a is shown in the cross section of fig 1b, extending through the solid body portion 13 between a first and a second end 13a, 13b thereof. The channel 20a of the illustrated embodiment has a substantially straight shape. The cross sectional shape, as may be seen also in figures 1a and 1c, of the three channels 20a, 20b, 20c is circular. Further, the respective channel openings are equally spaced along an imaginary circle on the end surface 13b of the solid portion, i.e. as may be seen in figure 1c. As may be seen from fig. 1c, the diameter of the circular openings is close to the radial extension of the space formed between the outer surface of the fastener engaging structure 12 and the inner diameter D1 of the outer sleeve 11.

[0042] For the illustrated embodiment, the outer diameter D is approximately 4 mm whereas the inner diameter D1 is approximately 3.4 mm. The distance L between the end of the screw driver bit 12 and the first end 10a of the nozzle is approximately 2 mm.

[0043] Turning to figures 2a-2c, another exemplary vacuum nozzle 1' according to a second embodiment is shown. The nozzle 1', as the previous embodiment described above, comprises a body 10' having a first end 10a' adapted to receive and engage a fastening element, such as a screw, and a second end 10b' adapted to engage a rotating output axle of a tool. A fluid path 20' is arranged to provide a fluid connection between the first end 10a' and the second end 10b'. Likewise, the nozzle 1' is adapted to engage, by means of a vacuum provided at the first end 10a by means of the fluid path 20', and apply a torque to, a fastening element such as a screw and therefore comprises an outer sleeve 11', a fastening element engaging structure 12' arranged at the first end 10a and coaxially arranged with respect to the sleeve 12' and adapted to engage a fastening element, as may be seen from figures 2a and 2c a hexagonal screw driver bit 12' adapted to engage a screw head having a hexagonal recess, and a solid body portion 13' at the second end 10b'.

[0044] However, the fluid path 20' is in the illustrated embodiment of figures 2a and b formed by a single channel 20a' extending through the fastening element engaging structure 12', i.e. the screw driver bit 12'. Further, in figures 2a and b, the outer sleeve 11' and the solid body portion 13' are two separate bodies. More particularly, the solid body portion 13' is integrally formed with (or may even be described as formed by) the fastening element engaging structure 12'

[0045] The thread (not shown) provided at the second end 10b' of the nozzle may hence also be described as being provided at the second end of the fastening element engaging structure 12'. The single channel 20' forming the fluid path 20' through the nozzle in this second embodiment extends along a substantially straight path through the screw driver bit 12' also forming in a sense the solid body portion 13' in this embodiment. This channel 20' is shown in the cross section of fig 2b and has a substantially circular cross section, as may be seen also in fig 2a and fig 2c. Further, as may be seen from fig. 2c, the diameter of the circular opening is quite close to the radial extension of the fastener engaging structure 12'. I.e. the fastener engaging structure 12' in this case is rather thin walled.

[0046] For the embodiment shown in figures 2a-c, the outer diameter is approximately 4 mm whereas the inner diameter is approximately 3.7 mm. The distance between

the end of the screw driver bit 12 and the first end 10a of the nozzle is approximately 2 mm.

[0047] As described above, during operation of the nozzle, the nozzle is attached to a tool and a vacuum source by means of the thread 14', such that a rotational torque as well as a vacuum may be provided at the first end 10a' of the nozzle 1'.

[0048] The inventive design of the nozzle 1 shown in figures 1a-c and 2a-c is enabled by the manufacturing method of the nozzle, i.e. that the respective nozzle is defined by a series of additive manufactured layers built on each other and printed using an additive manufacturing technique. More particularly, the illustrated embodiments of the nozzle have been built up using an additive manufacturing method performed by means of a three-dimensional printer, also known as 3D-printinq.

[0049] While the invention has been illustrated and described in detail in the drawings and foregoing description, such illustration and description are to be considered illustrative or exemplary and not restrictive; the invention is not limited to the disclosed embodiments. The skilled person understands that many modifications, variations and alterations are conceivable within the scope as defined in the appended claims.

[0050] In the claims, the word "comprising" does not exclude other elements or steps and the indefinite article "a" or "an" does not exclude a plurality.

[0051] Any reference signs in the claims should not be construed as limiting the scope of the claims.

Claims

1. A vacuum nozzle (1) for a tightening tool adapted to engage and apply a torque to a fastening element, said nozzle comprising

a body (10) extending in an axial direction and having a first end (10a) adapted to receive and engage said fastening element and a second end (10b) adapted to engage a rotating output axle of a tool
wherein at least one fluid path (20) is arranged to provide a fluid connection between said first end and said second end of said nozzle, and
wherein the vacuum nozzle is defined by a series of additive manufactured layers built on each other and printed using an additive manufacturing technique.
wherein said body comprises;
an outer sleeve (11),
a fastening element engaging structure (12) arranged at said first end, coaxially arranged with respect to said sleeve and adapted to engage a fastening element; and
a solid body portion (13) arranged at said second end
characterised in that
said at least one fluid path is at least partly formed by a fluid channel extending through said solid body portion between a first end (13a) of said solid body portion and a second end (13b) of said solid body, and
wherein said vacuum nozzle comprises a plurality of fluid channels.

2. A vacuum nozzle for a rotating tool according to claim 1, wherein said fluid channel is arranged to emerge from said solid portion at said first end at a position adjacent to the base of the fastener engaging structure.

3. A vacuum nozzle for a rotating tool according to claim 1 or 2, wherein said fluid path is at least partly formed by a fluid channel extending through said fastening element engaging structure between a first end (12a) of said fastening element engaging structure and a second end (12b) of said fastening element engaging structure.

4. A vacuum nozzle for a rotating tool according to any of the preceding claims 1-3, wherein said solid body portion and said fastening element engaging structure (12) are integrally formed.

5. A vacuum nozzle for a rotating tool according to claim 4, wherein said outer sleeve, said solid body portion and said fastening element engaging structure (12) are integrally formed.

6. A vacuum nozzle for a rotating tool according to any of claims 1-5, wherein said at least one channel is defined between a first number of channel openings at a first end of said channel, and a second number of channel openings at said second end of said channel, and wherein said first number is different from said second number.

7. A vacuum nozzle for a rotating tool according to any of claims 1-6, comprising a channel defined between a single opening at said second end, and more than one channel openings at said first end.

8. A vacuum nozzle for a rotating tool according to any of the preceding claims 1-7, wherein said at least one channel extends along a curved path between said first and second end of said channel.

9. A vacuum nozzle for a rotating tool according to any of the preceding claims, wherein said fastening element engaging structure is a screw driver bit adapted to engage a screw head.

Patentansprüche

1. Vakuumdüse (1) für ein Anziehwerkzeug, die angepasst ist, um ein Befestigungselement in Eingriff zu nehmen und ein Drehmoment auf dieses auszuüben, die Düse umfassend

   einen Körper (10), der sich in einer axialen Richtung erstreckt und ein erstes Ende (10a), das angepasst ist, um das Befestigungselement aufzunehmen und in Eingriff zu nehmen, und ein zweites Ende (10b) aufweist, das angepasst ist, um eine rotierende Ausgangsachse eines Werkzeugs in Eingriff zu nehmen,
   wobei mindestens ein Fluidweg (20) angeordnet ist, um eine Fluidverbindung zwischen dem ersten Ende und dem zweiten Ende der Düse bereitzustellen, und
   wobei die Vakuumdüse durch eine Reihe von additiv gefertigten Schichten definiert ist, die aufeinander aufgebaut und unter Verwendung einer additiven Fertigungstechnik gedruckt sind.
   wobei der Körper umfasst;
   eine Außenhülse (11),
   eine Befestigungselementeingriffsstruktur (12), die an dem ersten Ende angeordnet, in Bezug auf die Hülse koaxial angeordnet und angepasst ist, um ein Befestigungselement in Eingriff zu nehmen; und
   einen Festkörperabschnitt (13), der an dem zweiten Ende angeordnet ist, **dadurch gekennzeichnet, dass** der mindestens eine Fluidweg mindestens teilweise durch einen Fluidkanal ausgebildet ist, der sich durch den Festkörperabschnitt zwischen einem ersten Ende (13a) des Festkörperabschnitts und einem zweiten Ende (13b) des Festkörpers hindurch erstreckt, und
   wobei die Vakuumdüse eine Vielzahl von Fluidkanälen umfasst.

2. Vakuumdüse für ein rotierendes Werkzeug nach Anspruch 1, wobei der Fluidkanal angeordnet ist, um aus dem Festabschnitt an dem ersten Ende an einer Position angrenzend an die Basis der Befestigungselementeingriffsstruktur auszutreten.

3. Vakuumdüse für ein rotierendes Werkzeug nach Anspruch 1 oder 2, wobei der Fluidweg mindestens teilweise durch einen Fluidkanal ausgebildet ist, der sich durch die Befestigungselementeingriffsstruktur zwischen einem ersten Ende (12a) der Befestigungselementeingriffsstruktur und einem zweiten Ende (12b) der Befestigungselementeingriffsstruktur hindurch erstreckt.

4. Vakuumdüse für ein rotierendes Werkzeug nach einem der vorstehenden Ansprüche 1 bis 3, wobei der Festkörperabschnitt und die Befestigungselementeingriffsstruktur (12) einstückig ausgebildet sind.

5. Vakuumdüse für ein rotierendes Werkzeug nach Anspruch 4, wobei die Außenhülse, der Festkörperabschnitt und die Befestigungselementeingriffsstruktur (12) einstückig ausgebildet sind.

6. Vakuumdüse für ein rotierendes Werkzeug nach einem der Ansprüche 1 bis 5, wobei der mindestens eine Kanal zwischen einer ersten Anzahl von Kanalöffnungen an einem ersten Ende des Kanals und einer zweiten Anzahl von Kanalöffnungen an dem zweiten Ende des Kanals definiert ist und wobei die erste Anzahl von der zweiten Anzahl verschieden ist.

7. Vakuumdüse für ein rotierendes Werkzeug nach einem der Ansprüche 1 bis 6, umfassend einen Kanal, der zwischen einer einzelnen Öffnung an dem zweiten Ende und mehr als einer Kanalöffnung an dem ersten Ende definiert ist.

8. Vakuumdüse für ein rotierendes Werkzeug nach einem der vorstehenden Ansprüche 1 bis 7, wobei sich der mindestens eine Kanal entlang eines gekrümmten Wegs zwischen dem ersten und dem zweiten Ende des Kanals erstreckt.

9. Vakuumdüse für ein rotierendes Werkzeug nach einem der vorstehenden Ansprüche, wobei die Befestigungselementeingriffsstruktur ein Schraubendrehereinsatz ist, der angepasst ist, um einen Schraubenkopf in Eingriff zu nehmen.

Revendications

1. Buse d'aspiration (1) pour un outil de serrage adapté pour mettre en prise et appliquer un couple à un élément de fixation, ladite buse comprenant

   un corps (10) s'étendant dans une direction axiale et ayant une première extrémité (10a) adaptée pour recevoir et mettre en prise ledit élément de fixation et une seconde extrémité (10b) adaptée pour mettre en prise un axe de sortie rotatif d'un outil
   dans laquelle au moins un trajet de fluide (20) est agencé pour fournir une connexion de fluide entre ladite première extrémité et ladite seconde extrémité de ladite buse, et
   dans laquelle la buse d'aspiration est définie par une série de couches de fabrication additive, construites les unes sur les autres et imprimées à l'aide d'une technique de fabrication additive.
   dans laquelle ledit corps comprend ;
   un manchon extérieur (11),

une structure de mise en prise de l'élément de fixation (12) agencée à ladite première extrémité, agencée coaxialement par rapport audit manchon et adaptée à la mise en prise d'un élément de fixation ; et
une partie du corps solide (13) agencée à ladite seconde extrémité **caractérisée en ce que** ledit au moins un trajet de fluide est au moins partiellement formé par une voie de canalisation des fluides s'étendant à travers ladite partie du corps solide entre une première extrémité (13a) de ladite partie du corps solide et une seconde extrémité (13b) dudit corps solide, et
dans laquelle ladite buse d'aspiration comprend une pluralité de canaux de fluides.

2. Buse d'aspiration pour un outil rotatif selon la revendication 1, dans laquelle ladite voie de canalisation des fluides est agencée pour émerger de ladite partie solide à ladite première extrémité à une position adjacente à la base de la structure de mise en prise de la fixation.

3. Buse d'aspiration pour un outil rotatif selon la revendication 1 ou 2, dans laquelle ledit trajet de fluide est au moins partiellement formé par une voie de canalisation des fluides s'étendant à travers ladite structure de mise en prise de l'élément de fixation entre une première extrémité (12a) de ladite structure de mise en prise de l'élément de fixation et une seconde extrémité (12b) de ladite structure de mise en prise de l'élément de fixation.

4. Buse d'aspiration pour un outil rotatif selon l'une quelconque des revendications 1 à 3 précédentes, dans laquelle la partie du corps solide et la structure de mise en prise de l'élément de fixation (12) sont formées d'un seul tenant.

5. Buse d'aspiration pour un outil rotatif selon la revendication 4, dans laquelle ledit manchon extérieur, ladite partie du corps solide et ladite structure de mise en prise de l'élément de fixation (12) sont formés d'un seul tenant.

6. Buse d'aspiration pour un outil rotatif selon l'une quelconque des revendications 1 à 5, dans laquelle ledit au moins un canal est défini entre un premier nombre d'ouvertures de canal à une première extrémité dudit canal, et un second nombre d'ouvertures de canal à une seconde extrémité dudit canal, et dans laquelle ledit premier nombre est différent dudit second nombre.

7. Buse d'aspiration pour un outil rotatif selon l'une quelconque des revendications 1 à 6, comprenant un canal défini entre une ouverture unique à ladite seconde extrémité et plusieurs ouvertures de canal à ladite première extrémité.

8. Buse d'aspiration pour un outil rotatif selon l'une quelconque des revendications 1 à 7 précédentes, dans laquelle ledit au moins un canal s'étend le long d'une trajectoire incurvée entre lesdites première et seconde extrémités dudit canal.

9. Buse d'aspiration pour un outil rotatif selon l'une quelconque des revendications précédentes, dans laquelle la structure de mise en prise de l'élément de fixation est un embout de tournevis adapté à la mise en prise d'une tête de vis.

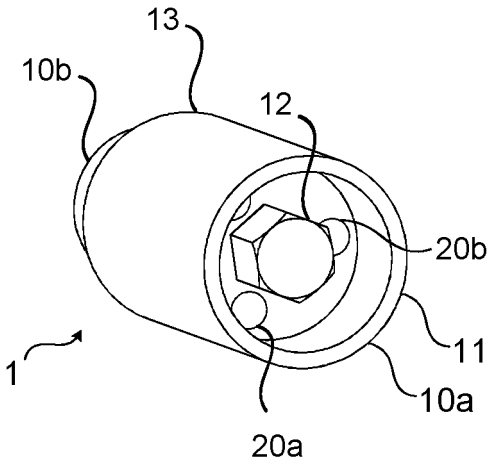


Fig. 1a

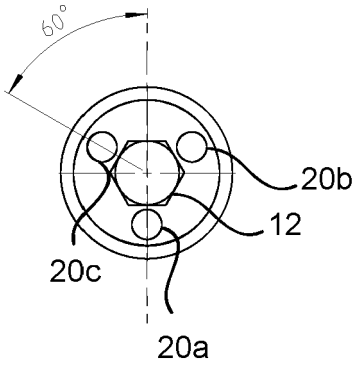


Fig. 1c

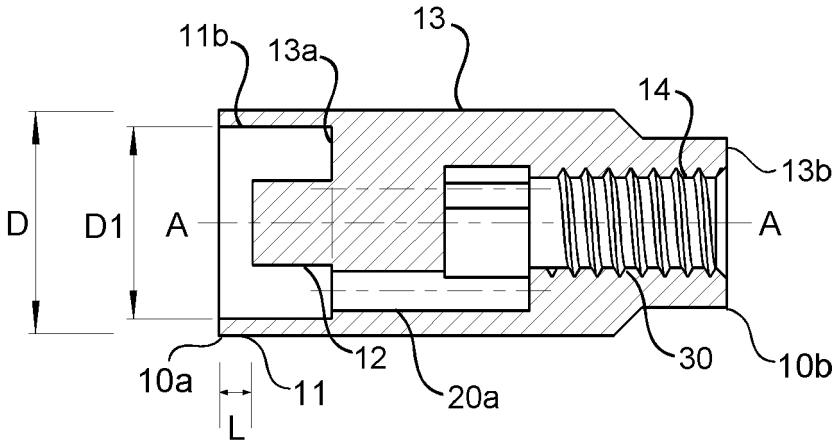


Fig. 1b

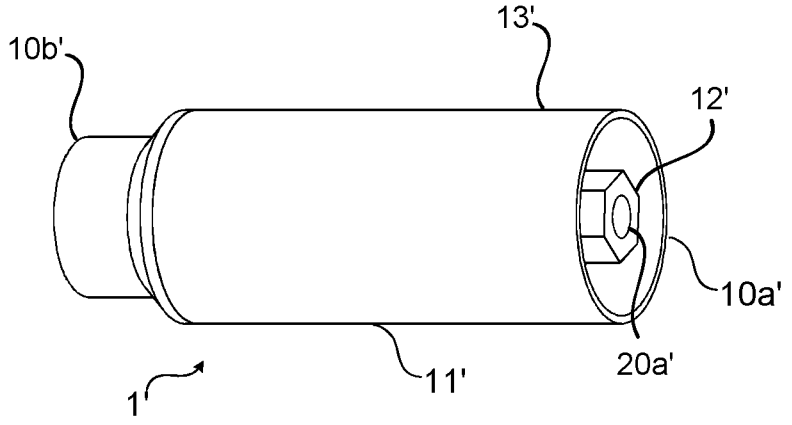


Fig. 2a

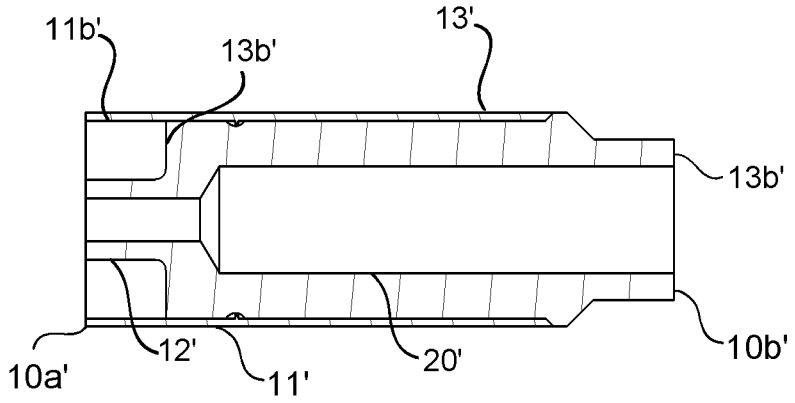


Fig. 2b

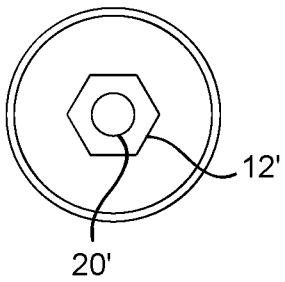


Fig. 2c

REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

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