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(71) Applicant: **Universidade de Aveiro**
3810-193 Aveiro (PT)

(72) Inventors:
- **DAVIM TAVARES DA SILVA, João Paulo**
  3800-428 Aveiro (PT)
- **LAURO, Carlos Henrique**
  3800-182 Aveiro (PT)
- **FONSECA FESTAS, António José**
  3800-147 Aveiro (PT)

(74) Representative: **Patentree**
Edificio Net
Rua de Salazares, 842
4149-002 Porto (PT)

(54) MULTI-OPERATION FRICTION DRILLING TOOL

(57) Multioperation friction drilling tool allowing three different final operations to be performed in the same drilling: drilling, calibration and threading. The friction drilling tool of the present disclosure has a friction self-piercing segment, a calibration segment, a thread-opening segment and a stop segment. The calibration segment allows calibrated holes to be obtained, if that is the final objective, or preparing the hole for a thread-opening operation in the material drained on the walls of the already-calibrated hole, depending on the user's choice. An embodiment of the friction drilling multioperation tool sequentially comprises a plurality of distinct axial segments: a support segment, a thread-opening segment, a calibration segment of predetermined diameter and a friction self-piercing segment, which may comprise a cylindrical stop-spacer segment.

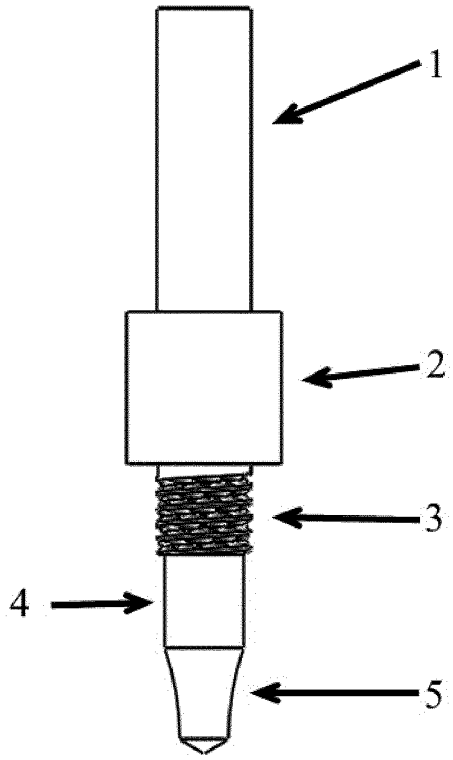

Fig. 1

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Description

Technical Domain

[0001] The present disclosure relates to a friction drilling multioperation tool allowing three different final operations to be performed in the same drilling: drilling, calibration and threading.

[0002] The friction drilling tool of the present disclosure has, in one embodiment, a drilling or self-piercing segment, a calibration segment, a thread-opening segment and a stop segment. The calibration segment allows calibrated holes to be obtained, if that is the final objective, or preparing the hole for a thread-opening operation in the material drained on the walls of the already-calibrated hole, depending on the user's choice.

Background art

[0003] CN265257 discloses a friction drilling tool, however it is limited to drilling holes by friction. US2017106430 discloses a friction drilling tool which is a bolt using the friction drilling method for drilling and threading. In general, existing tools mainly drill and/or thread.

[0004] Friction drilling is a method that uses a hardened conical tipped cylindrical tool which, when pressed under rotation against the workpiece, the friction generated between the workpiece and the tool allows generating the necessary heat to reduce the mechanical strength of the metal material, allowing the conformation thereof by draining.

[0005] Friction drilling is applied to thin plates, pipes or workpieces of reduced thickness mainly of aluminium and steel. This technology makes it possible to substantially reduce the manufacturing time in an ecological way since not producing chips.

[0006] These facts are described in order to illustrate the technical problem solved by the embodiments of the present document.

General Description

[0007] The present disclosure relates to a friction drilling method which uses a hardened conical tipped cylindrical tool pressed under rotation against the workpiece. The friction generated between the workpiece and the tool allows generating the necessary heat to reduce the mechanical strength of the metal material, allowing the conformation thereof by draining. The present description presents a cylindrical friction drilling tool containing a friction drilling or self-piercing segment, a calibration segment, a thread-opening segment and optionally a stop segment.

[0008] The friction drilling is applied to thin plates, pipes or workpieces of reduced thickness mainly of aluminium and steel. This technology makes it possible to substantially reduce the manufacturing time in an ecological way since not producing chips. This technology can be applied to CNC machines, possibly with appropriate variations.

[0009] The present description relates to a multioperation friction drilling tool characterized in that it can use three active functions, drilling, calibration and threading. The calibration segment allows calibrated holes to be obtained, if that is the final objective, or preparing the hole for a final threading operation in the material drained on the walls of the already-calibrated hole, depending on the user's choice on the depth of operation of the tool, respectively the depth corresponding to the calibration and drilling segments and the depth corresponding to the thread-opening, calibration and drilling segments.

[0010] With the present tool there is no longer need to change tools in order to calibrate or thread the hole - if calibration is intended, one mainly has to finish the operation after calibrating and before reaching the threading segment; if threading is intended, one mainly has to finish the operation, then calibrate and thread in the respective segments.

[0011] A multioperation friction drilling tool is described which sequentially comprises a support body or segment, a thread-opening segment, a calibration segment of predetermined diameter and a friction drilling or self-piercing segment.

[0012] One embodiment comprises a cylindrical stop-spacer segment having a diameter larger than those of the other segments.

[0013] In one embodiment, the friction drilling or self-piercing segment has a pointed shape, in particular a tip with a particularly double-conical configuration.

[0014] In one embodiment, the friction self-piercing segment has a conical tip or a rounded crown tip.

[0015] In one embodiment, the friction self-piercing segment has a tip and, adjacent to said tip, a substantially frustoconical, substantially hyperboloid or substantially trumpet-shaped subsegment.

[0016] In one embodiment, said subsegment is substantially hyperboloid.

[0017] In one embodiment, the calibration segment has a length of at least twice the diameter of the calibration.

[0018] In one embodiment, the length of the drilling or self-piercing segment is identical to the length of the calibration segment.

[0019] In one embodiment, the length of the thread-opening segment is identical to the length of the calibration segment.

[0020] One embodiment comprises, immediately following one another, i.e. adjacent and sequentially, the thread-opening segment, the calibration segment and the friction drilling (or self-piercing) segment.

[0021] One embodiment comprises, immediately following one another, i.e. adjacent and sequentially, the stop-spacer segment, the thread-opening segment, the calibration segment and the friction drilling segment.

Brief Description of the Figures

[0022] For an easier understanding, figures are herein attached, which represent preferred embodiments which are not intended to limit the object of the present description.

[0023] Figure 1 shows the schematic representation of a multioperation friction drilling tool, wherein:

1. represents the support body or segment or rod;
2. represents the stop segment (spacer);
3. represents the thread-opening segment;
4. represents the calibration segment;
5. represents the drilling, or self-piercing segment (tip).

[0024] Figure 2 shows the representation of a multioperation friction drilling tool application.

Detail Description

[0025] The present disclosure relates to a multioperation friction drilling tool allowing three different final operations to be performed in the same drilling: drilling, calibration and threading.

[0026] The friction drilling tool of the present disclosure has a drilling segment, a calibration segment, a thread-opening segment and a stop segment. The calibration segment allows calibrated holes to be obtained, if that is the final objective, or preparing the hole for a thread-opening operation in the material drained on the walls of the already-calibrated hole.

[0027] In one embodiment, **Figure 1** shows the schematic representation of the multioperation friction drilling tool consisting of a cylindrical support body or segment **1,** a pointy drilling segment **5** with hardened double-tapered tip which, when pressed under rotation against the relevant material, creates sufficient friction for performing drilling, a cylindrical calibration segment **4** containing a specific diameter to ensure calibration of the hole, a thread-opening segment **3** of the specific shape for opening a thread in the previously drilled and calibrated material and a cylindrical stop or spacer segment **2** having a diameter larger than the other segments.

[0028] In one embodiment, **Figure 2** illustrates the sequential representation of a possible application of a multioperation friction drilling tool, where the beginning of the friction drilling by the drilling segment **(A), (B)** and **(C)** is observed. Subsequently and due to the existence of the calibration segment, the hole calibration **(D)** is undertaken. If desired at this stage, the tool can be removed thus leaving a calibrated hole without a thread as shown **(E).** If a calibrated and threaded hole **(G)** is desired, the tool continues until the thread-opening segment **(F)** is reached. The stop or spacer segment limits the stroke of the tool **(F).**

[0029] The calibration zone allows calibrated holes to be obtained, if that is the final objective, or preparing the hole for a final threading operation.

[0030] In one embodiment, the multioperation friction drilling tool begins to drill the hole using the double-tapered special tip. The friction generated between the workpiece and the tool allows generating the necessary heat to reduce the mechanical strength of the material, allowing the conformation by draining the hole. The calibration segment is then operable to obtain calibrated holes, if that is the final objective, or to prepare the hole for an operation **4,** and thereafter, if so desired, operates the final threading segment **3** in the material drained on the walls of the already-calibrated hole. Optionally, the operation can continue until the stop-spacer segment **2** is reached.

[0031] The drilling tool described in the present disclosure can be used for drilling/calibration/threading thin plates, pipes, thin workpieces made of metal material (aluminium, steels, etc.), in particular in drilling/calibration/threading operations in aluminium thin plates.

[0032] In one embodiment, the drilling tool described in the present disclosure has advantages both at the manufacturing time and at an ecological level, as it does not produce chips or outer burr, allowing a calibrated or threaded hole to be undertaken more efficiently.

[0033] One embodiment of the friction drilling multioperation tool sequentially comprises a plurality of distinct axial segments: a support segment **1,** a thread-opening segment **3,** a calibration segment **4** of predetermined diameter and a friction self-piercing segment **5.**

[0034] One embodiment comprises a cylindrical stop-spacer segment **2** having a diameter larger than those of the other segments **3, 4, 5** of the tool.

[0035] In one embodiment, the friction self-piercing segment **5** has a conical tip or a rounded crown tip.

[0036] In one embodiment, the friction self-piercing segment **5** has a tip and, adjacent to said tip, a substantially frustoconical, substantially hyperboloid or substantially trumpet-shaped subsegment.

[0037] In one embodiment, said subsegment is substantially hyperboloid.

[0038] In one embodiment, the calibration segment **4** has a length of at least twice the diameter of the calibration segment.

[0039] In one embodiment, the length of the friction self-piercing segment **5** is identical to the length of the calibration segment **4.**

[0040] In one embodiment, the length of the thread-opening segment **3** is identical to the length of the calibration segment **4.**

[0041] One embodiment comprises, adjacent and sequentially: the thread-opening segment **3,** the calibration segment **4** and the friction self-piercing segment **5.**

[0042] One embodiment comprises, adjacent and sequentially: the stop-spacer segment **2,** the thread-opening segment **3,** the calibration segment **4** and the friction self-piercing segment **5.**

[0043] The present disclosure is of course in no way restricted to the embodiments presented herein and a

person of ordinary skill in the art may provide many possibilities of modifying it and replacing technical features with equivalents thereof. The following claims define additional embodiments of the present description .

Claims

1. Friction drilling multioperation tool sequentially comprising a plurality of distinct axial segments: a support segment, a thread-opening segment, a calibration segment of predetermined diameter and a friction self-piercing segment.

2. Friction drilling multioperation tool according to the previous claim comprising a cylindrical stop-spacer segment having a diameter larger than the other tool segments.

3. Friction drilling multioperation tool according to any of the previous claims wherein the friction self-piercing segment has a conical tip.

4. Friction drilling multioperation tool according to any of the previous claims wherein the friction self-piercing segment has a tip and, adjacent to said tip, a substantially frustoconical, substantially hyperboloid or substantially trumpet-shaped subsegment.

5. Friction drilling multioperation tool according to the previous claim wherein said subsegment is substantially hyperboloid.

6. Friction drilling multioperation tool according to any of the previous claims wherein the calibration segment has a length of at least twice the diameter of the calibration segment.

7. Friction drilling multioperation tool according to any of the previous claims wherein the length of the friction self-piercing segment is identical to the length of the calibration segment.

8. Friction drilling multioperation tool according to any of the previous claims wherein the length of the thread-opening segment is identical to the length of the calibration segment.

9. Friction drilling multioperation tool according to any of the previous claims comprising, adjacent and sequentially: the thread-opening segment, the calibration segment and the friction self-piercing segment.

10. Friction drilling multioperation tool according to the previous claim comprising, adjacent and sequentially: the stop-spacer segment, the thread-opening segment, the calibration segment and the friction self-piercing segment.

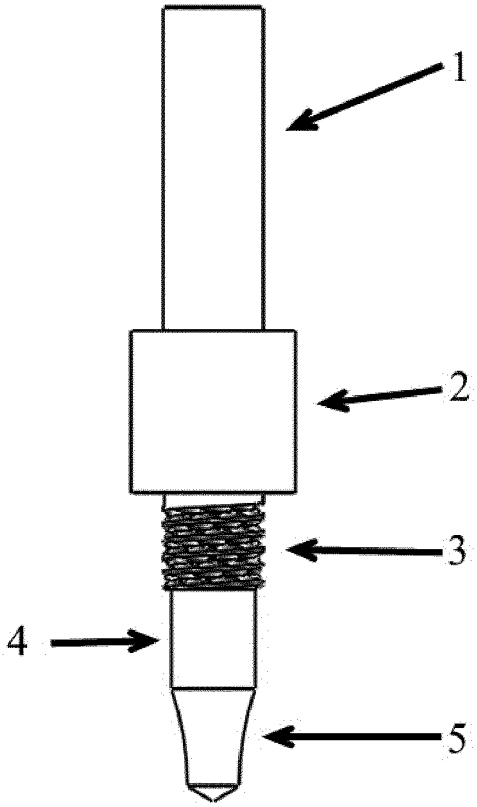

Fig. 1

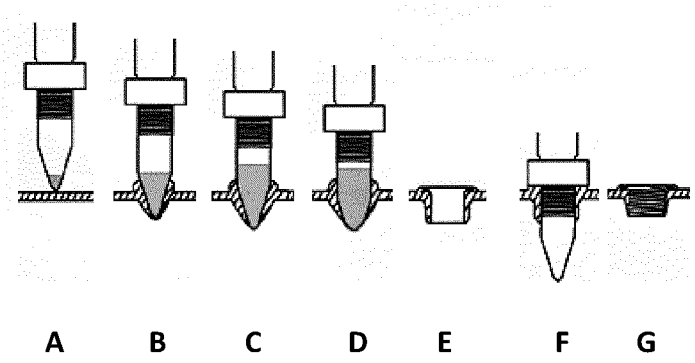

Fig. 2

INTERNATIONAL SEARCH REPORT

International application No
PCT/IB2018/056842

A. CLASSIFICATION OF SUBJECT MATTER
INV. B21J5/06
ADD.

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)
B21J

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 practicable, search terms used)
EPO-Internal, WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 3 429 171 A (FEHER JOSEPH J) 25 February 1969 (1969-02-25) page 1, column 1, lines 24-57; figures 1,2,4, 10, 11 page 2, column 2, lines 53-59 page 2, column 3, lines 8-13	1-10
X	WO 2005/089973 A1 (GUEHRING JOERG [DE]; GRUENER JOSEF [DE]) 29 September 2005 (2005-09-29) page 26, lines 4-22; figures 1-2	1-5,9,10
A	DE 10 2012 216302 A1 (FEDERAL MOGUL SEALING SYS SPA [DE]) 13 March 2014 (2014-03-13) paragraph [0061]; figure 9	1

☐ Further documents are listed in the continuation of Box C.

☒ See patent family annex.

* Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance

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"P" document published prior to the international filing date but later than the priority date claimed

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"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"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	Date of mailing of the international search report
27 November 2018	05/12/2018

Name and mailing address of the ISA/	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Fax: (+31-70) 340-3016	Augé, Marc

Form PCT/ISA/210 (second sheet) (April 2005)

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No
PCT/IB2018/056842

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 3429171 A	25-02-1969	NONE	
WO 2005089973 A1	29-09-2005	DE 102004013640 A1	06-10-2005
		WO 2005089973 A1	29-09-2005
DE 102012216302 A1	13-03-2014	NONE	

Form PCT/ISA/210 (patent family annex) (April 2005)

REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- CN 265257 **[0003]**
- US 2017106430 A **[0003]**