

(19) World Intellectual Property Organization
International Bureau



(43) International Publication Date
15 September 2011 (15.09.2011)

(10) International Publication Number
WO 2011/112446 A1

(51) International Patent Classification:
B21B 45/04 (2006.01)

(21) International Application Number:
PCT/US2011/027174

(22) International Filing Date:
4 March 2011 (04.03.2011)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:
61/312,195 9 March 2010 (09.03.2010) US

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(81) Designated States (unless otherwise indicated, for every kind of national protection available): AE, AG, AL, AM, AO, AT, AU, AZ, BA, BB, BG, BH, BR, BW, BY, BZ,

CA, CH, CL, CN, CO, CR, CU, CZ, DE, DK, DM, DO, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN, HR, HU, ID, IL, IN, IS, JP, KE, KG, KM, KN, KP, KR, KZ, LA, LC, LK, LR, LS, LT, LU, LY, MA, MD, ME, MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ, OM, PE, PG, PH, PL, PT, RO, RS, RU, SC, SD, SE, SG, SK, SL, SM, ST, SV, SY, TH, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, ZA, ZM, ZW.

(84) Designated States (unless otherwise indicated, for every kind of regional protection available): ARIPO (BW, GH, GM, KE, LR, LS, MW, MZ, NA, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European (AL, AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HR, HU, IE, IS, IT, LT, LU, LV, MC, MK, MT, NL, NO, PL, PT, RO, RS, SE, SI, SK, SM, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

Declarations under Rule 4.17:

- as to the identity of the inventor (Rule 4.17(i))
- as to applicant's entitlement to apply for and be granted a patent (Rule 4.17(ii))

Published:

- with international search report (Art. 21(3))

(54) Title: CONE NUT DECOKING MACHINE

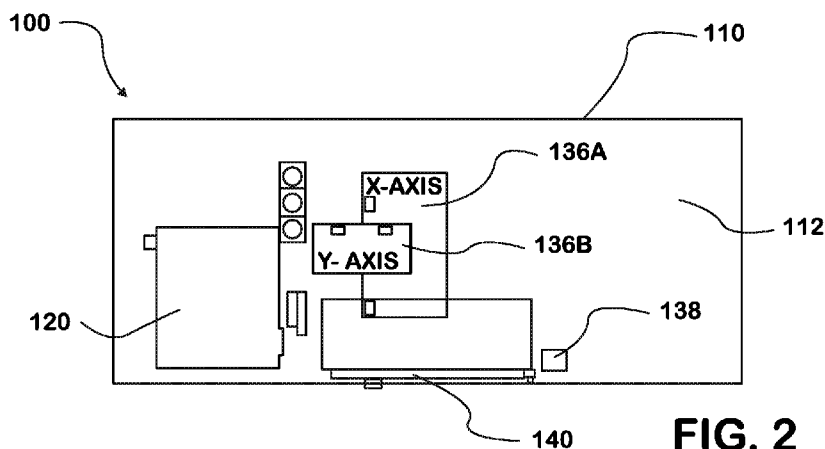


FIG. 2

(57) Abstract: A work station for cleaning a cone nut includes a work bench comprising a bench top, a lathe arranged on the bench top and configured to rotate a cone nut, and a cleaning unit arranged on the bench top adjacent to the lathe and configured to clean the cone nut.

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CONE NUT DECOKING MACHINE

CROSS REFERENCE TO PRIOR APPLICATIONS

[0001] This application claims the benefit from U.S. Provisional Application No. 61/312,195 filed on March 9, 2010, which is hereby incorporated herein by reference for all purposes as if fully set forth herein.

BACKGROUND OF THE DISCLOSURE

[0002] 1. Field of the Disclosure

[0003] This disclosure is directed to removing a scale or coking from a cone nut, and more particularly to an apparatus for removing a scale or coking from a cone nut.

[0004] 2. Related Art

[0005] When a used fuel injector is collected for remanufacturing, a scale or coking may be formed on an exterior surface of a cone nut. The scale or coking is typically removed manually using an abrasive pad. For example, a lathe may be used to rotate a cone nut at a speed of about 2500 RPM. An operator with an abrasive pad on his or her hand may manually place the pad on the rotating cone nut to clean the exterior surface of the cone nut. This may cause environmental, ergonomic and safety problems. Furthermore, depending on the operators' methods, some cone nuts may not be cleaned thoroughly for remanufacturing. Accordingly, there is a need for a new approach to effectively clean used cone nuts in a more consistent manner, that is safer, ergonomically improved and more environmentally friendly.

SUMMARY OF THE DISCLOSURE

[0006] According to an aspect of the disclosure, a work station is disclosed for cleaning a cone nut. The work station comprises a work bench including a bench top, a lathe arranged on the bench top and configured to rotate a cone nut, and a cleaning unit arranged on the bench top adjacent to the lathe and configured to clean the cone nut.

[0007] The work station may further include a door arranged on a front side of the bench top. The door may be configured to be automatically locked when the lathe and the cleaning unit are turned on.

[0008] The cleaning unit may include a slide arranged on the bench top, a motor mounted on the slide, and an abrasive pad rotated by the motor. The work station may further include a control unit for controlling the lathe and the cleaning unit. The lathe and the cleaning unit may be powered by at least one of electrical power and pneumatic power.

[0009] The slide may include an X axis slide for moving the motor to a first direction, and a Y axis slide for moving the motor to a second direction, which may be substantially perpendicular to the first direction. The X axis slide may move from a home position to a work position to move the abrasive pad toward the cone nut when the cleaning unit is turned on. The Y axis slide may move from a home position to a work position to form a contact between the abrasive pad and the cone nut when the cleaning unit is turned on. The Y axis slide may repeat moving between a home position and the work position when the cleaning unit is turned on. The Y axis slide may repeat this movement, for example, three times.

[0010] The lathe may include a clamping collet and an unclamp for the clamping collet. The work station may further include an enclosure arranged over the work bench for collecting debris from the cone nut.

[0011] According to another aspect of the disclosure, a method of operating the work station may include fixing the cone nut to the lathe, activating the lathe to rotate the cone nut, activating the motor to rotate the abrasive pad, and moving the motor toward the lathe such that the abrasive pad contacts the cone nut.

[0012] The fixing the cone nut to the lathe may include activating the unclamp, placing the cone nut on the clamping collet, and deactivating the unclamp.

[0013] The moving the motor may include automatically moving the motor. The automatically moving the motor may include automatically moving the X axis slide from the home position to the work position, and automatically moving the Y axis slide from the home position to the work position. The automatically moving the Y axis slide may include automatically moving the Y axis slide between the home position and the work position three times.

[0014] The method may further include automatically moving the X axis slide and the Y axis slide to the home positions after the Y axis slide is automatically moved between the home position and the work position three times.

[0015] The method may further include manually moving the motor. The method may further include collecting debris from the cone nut.

[0016] Additional features, advantages, and embodiments of the disclosure may be set forth or apparent from consideration of the following detailed description, drawings, and claims. Moreover, it is to be understood that both the foregoing summary of the disclosure and the following detailed description are exemplary and intended to provide further explanation without limiting the scope of the disclosure as claimed.

BRIEF DESCRIPTION OF THE DRAWINGS

[0017] The accompanying drawings, which are included to provide a further understanding of the disclosure, are incorporated in and constitute a part of this specification, illustrate embodiments of the disclosure and together with the detailed description serve to explain the principles of the disclosure. No attempt is made to show structural details of the disclosure in more detail than may be necessary for a fundamental understanding of the disclosure and the various ways in which it may be practiced. In the drawings:

[0018] Fig. 1 shows a front view of a work station for cleaning a cone nut, constructed according to the principles of the disclosure;

[0019] Fig. 2 shows a top view of the work station shown in Fig. 1; and

[0020] Fig. 3 shows a flowchart of a process for cleaning a cone nut using the work station shown in Figs. 1 and 2 according to the principles of the disclosure.

DETAILED DESCRIPTION OF THE DISCLOSURE

[0021] The embodiments of the disclosure and the various features and advantageous details thereof are explained more fully with reference to the non-limiting embodiments and examples that are described and/or illustrated in the accompanying drawings and detailed in the following description. It should be noted that the features illustrated in the drawings are not necessarily drawn to scale, and features of one embodiment may be employed with other embodiments as the skilled artisan would recognize, even if not explicitly stated herein. Descriptions of well-known components and processing techniques may be omitted so as not to unnecessarily obscure the embodiments of the disclosure. The examples used herein are intended merely to facilitate an understanding of ways in which the disclosure may be practiced

and to further enable those of skill in the art to practice the embodiments of the disclosure. Accordingly, the examples and embodiments herein should not be construed as limiting the scope of the disclosure, which is defined solely by the appended claims and applicable law. Moreover, it is noted that like reference numerals represent similar parts throughout the several views of the drawings.

[0022] Fig. 1 shows a front view of a work station 100 for cleaning a cone nut constructed according to the principles of the disclosure. Fig. 2 shows a top view of the work station 100 shown in Fig. 1. Referring Figs. 1 and 2 concurrently, the work station 100 may include a work bench 110, a lathe 120, a cleaning unit 130 and a door 140. Optionally, the work station 100 may further include an enclosure (not shown) located over the work bench 100, which may be connected to a dust collection system (not shown) for collecting debris (*e.g.*, wheel and scale debris) from the work station 100. The lathe 120, the cleaning unit 130 and the door 140 may be arranged on a bench top 112 of the work bench 110 to provide an ergonomically improved work environment for operators. The cleaning unit 130 may be arranged adjacent to the lathe 120. The door 140 may be arranged at a front portion of the bench top 112. The work station 100 may use pneumatic power, electrical power or a combination of pneumatic power and electrical power.

[0023] The lathe 120 may include a clamping collet (not shown) for securing a cone nut via a spring close/air off condition and an unclamp (not shown) for opening and closing the clamping collet. The cone nut may be placed on an inside diameter of the lathe 120 where the clamping collet is located. The cleaning unit 130 may include an abrasive wheel motor 132, an abrasive pad 134 and a slide 136. The abrasive pad 134 may be connected to an axle of the abrasive wheel motor 132 for rotational movement. The abrasive pad 134 may be a multi-

layered abrasive pad from, *e.g.*, Scotch Brite™. The abrasive wheel motor 132 may be mounted on the slide 136, which may include an X-axis slide 136A and a Y-axis slide 136B as shown in Fig. 2. The slides 136A, 136B may be pneumatic slides, such as, *e.g.*, pneumatic mini sliders from Festo™.

[0024] The lathe 120, the abrasive wheel motor 132 and the slides 136A, 136B may be automatically controlled by using a control unit (not shown), such as, *e.g.*, Siemens Logic PLC™. The cleaning unit 130 may further include a cycle start switch 138 for activating and deactivating an automatic cleaning operation of the work station 100. While the lathe 120, the abrasive wheel motor 132 and the slides 136A, 136B may be automatically controlled, the operator may manually adjust placement and movement of the abrasive pad 134 as needed because, depending on conditions, some used cone nuts may need more cleaning than others.

[0025] Fig. 3 shows a flowchart of a process 300 for cleaning a cone nut using the work station 100 shown in Figs. 1 and 2 according to the principles of the disclosure. Upon starting the process 300 (at 302), the operator may open the door 140 (at 304), activate an unclamp (not shown) of the clamping collet (at 304), place a used cone nut on the clamping collet (at 308), deactivate the unclamp of the clamping collet (at 310) to fix the cone nut to the lathe 120 and close the door (at 312). Then, the operator may activate the cycle start switch 138 (at 314) to start an automatic cleaning of the cone nut. Upon activating the cycle start switch 138 (at 314), a safety switch (not shown) for the door 140 may be activated to lock the door 140. Upon detecting the activation of the cycle start switch 138, the control unit may control the pneumatic circuit and/or the electronic circuit to operate the lathe 120, the abrasive wheel motor 132 and the slides 136A, 136B to carry out the cleaning operation.

[0026] For example, a spindle of the lathe 120 and the abrasive wheel motor 132 may be turned on (at 314), the X axis slide 136A may move from a home position to a work position, and the Y axis slide 136B may oscillate between a home position and a work position to make a contact between the abrasive pad 134 and the cone unit rotated by the lathe 120 (at 316). The Y axis slide 136B may oscillate between the home position and the work position for, *e.g.*, three cycles (at 318), and there may be a dwell time at the end of each cycle. If necessary, the operator may manually manipulate the slider 136 to move the abrasive pad 134 closer to the cone unit to apply greater cleaning pressure to the cone nut. Once the Y axis slide 136B completes, *e.g.*, the three cleaning cycles, the X axis slide 136A and Y axis slide 136B may return to their respective home positions (at 320), and the lathe 120 and the abrasive wheel motor 132 may be turned off (at 322). The safety switch of the door 140 may be deactivated at this time and the process 300 may be terminated (at 324). Thus, according to the disclosure, used cone nuts may be effectively cleaned in a more consistent manner while providing safer, ergonomically improved and more environmentally friendly working conditions for operators.

[0027] While the disclosure has been described in terms of exemplary embodiments, those skilled in the art will recognize that the disclosure can be practiced with modifications in the spirit and scope of the appended claims. These examples given above are merely illustrative and are not meant to be an exhaustive list of all possible designs, embodiments, applications or modifications of the disclosure.

WHAT IS CLAIMED IS:

1. A work station for cleaning a cone nut comprising:
a work bench comprising a bench top;
a lathe arranged on the bench top and configured to rotate a cone nut; and
a cleaning unit arranged on the bench top adjacent to the lathe and configured to clean the
cone nut.
2. The work station of claim 1, further comprising a door arranged on a front side of
the bench top.
3. The work station of claim 2, wherein the door is configured to be automatically
locked when the lathe and the cleaning unit are turned on.
4. The work station of claim 1, wherein the cleaning unit comprises:
a slide arranged on the bench top;
a motor mounted on the slide; and
an abrasive pad rotated by the motor.
5. The work station of claim 1, further comprising a control unit for controlling the
lathe and the cleaning unit.

6. The work station of claim 5, wherein the lathe and the cleaning unit are powered by at least one of electrical power and pneumatic power.

7. The work station of claim 1,
wherein the cleaning unit comprises:

a slide arranged on the bench top;

a motor mounted on the slide; and

an abrasive pad rotated by the motor; and

wherein the slide comprises:

an X axis slide for moving the motor to a first direction; and

a Y axis slide for moving the motor to a second direction, which is substantially perpendicular to the first direction.

8. The work station of claim 7, wherein the X axis slide moves from a home position to a work position to move the abrasive pad toward the lathe when the cleaning unit is turned on.

9. The work station of claim 7, wherein the Y axis slide moves from a home position to a work position to form a contact between the abrasive pad and the cone nut when the cleaning unit is turned on.

10. The work station of claim 9, wherein the Y axis slide repeats moving between a home position and the work position three times when the cleaning unit is turned on.

11. The work station of claim 10, wherein the lathe comprises:
a clamping collet; and
an unclamp for the clamping collet.
12. The work station of claim 1, further comprising an enclosure arranged over the work bench for collecting debris from the cone nut.
13. A method of operating a work station that includes a work bench having a bench top, a lathe arranged on the bench top and configured to rotate a cone nut, and a cleaning unit arranged on the bench top adjacent to the lathe and configured to clean the cone nut, the method comprising:
fixing the cone nut to the lathe;
activating the lathe to rotate the cone nut;
activating a motor to rotate an abrasive pad; and
moving the motor toward the lathe such that the abrasive pad contacts the cone nut.
14. The method of claim 13, wherein the fixing the cone nut to the lathe comprises:
activating an unclamp;
placing the cone nut on a clamping collet; and
deactivating the unclamp.
15. The method of claim 13, wherein the moving the motor comprises automatically moving the motor.

16. The method of claim 15, wherein the automatically moving the motor comprises: automatically moving an X axis slide from a home position to a work position; and automatically moving a Y axis slide from a home position to a work position.

17. The method of claim 16, wherein automatically moving the Y axis slide comprises automatically moving the Y axis slide between the home position and the work position three times.

18. The method of claim 17, further comprising automatically moving the X axis slide and the Y axis slide to the home positions after the Y axis slide is automatically moved between the home position and the work position three times.

19. The method of claim 13, further comprising manually moving the motor.

20. The method of claim 13, further comprising collecting debris from the cone nut.

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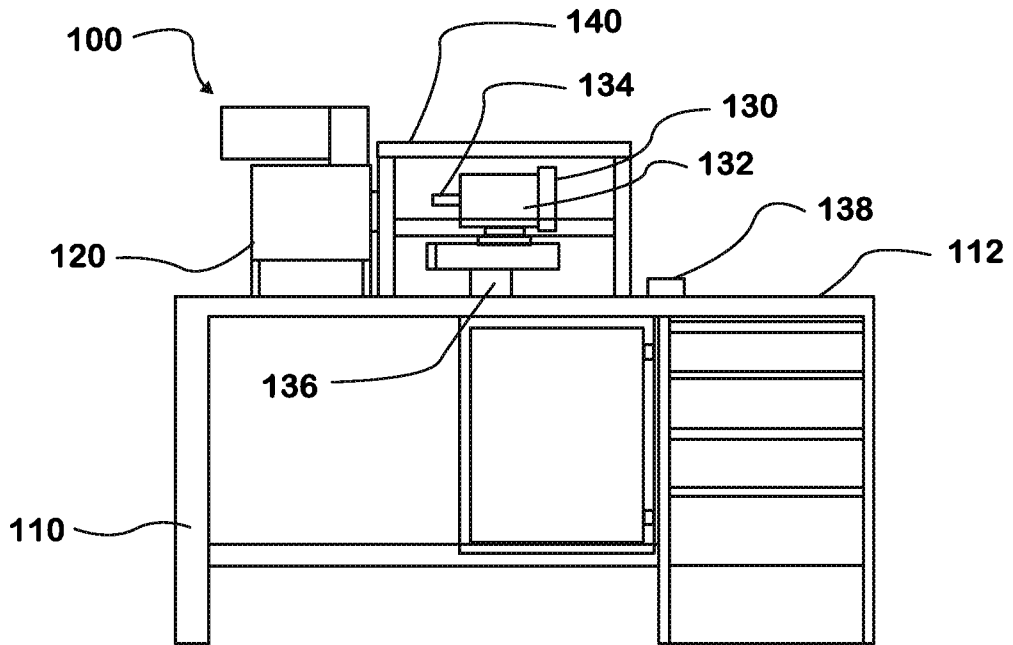


FIG. 1

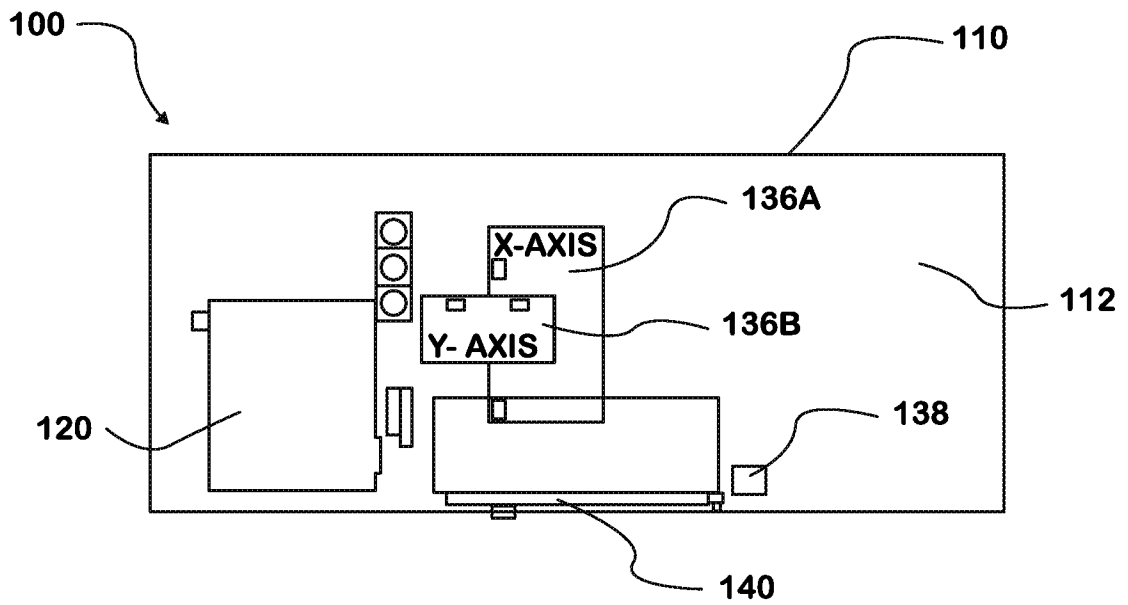


FIG. 2

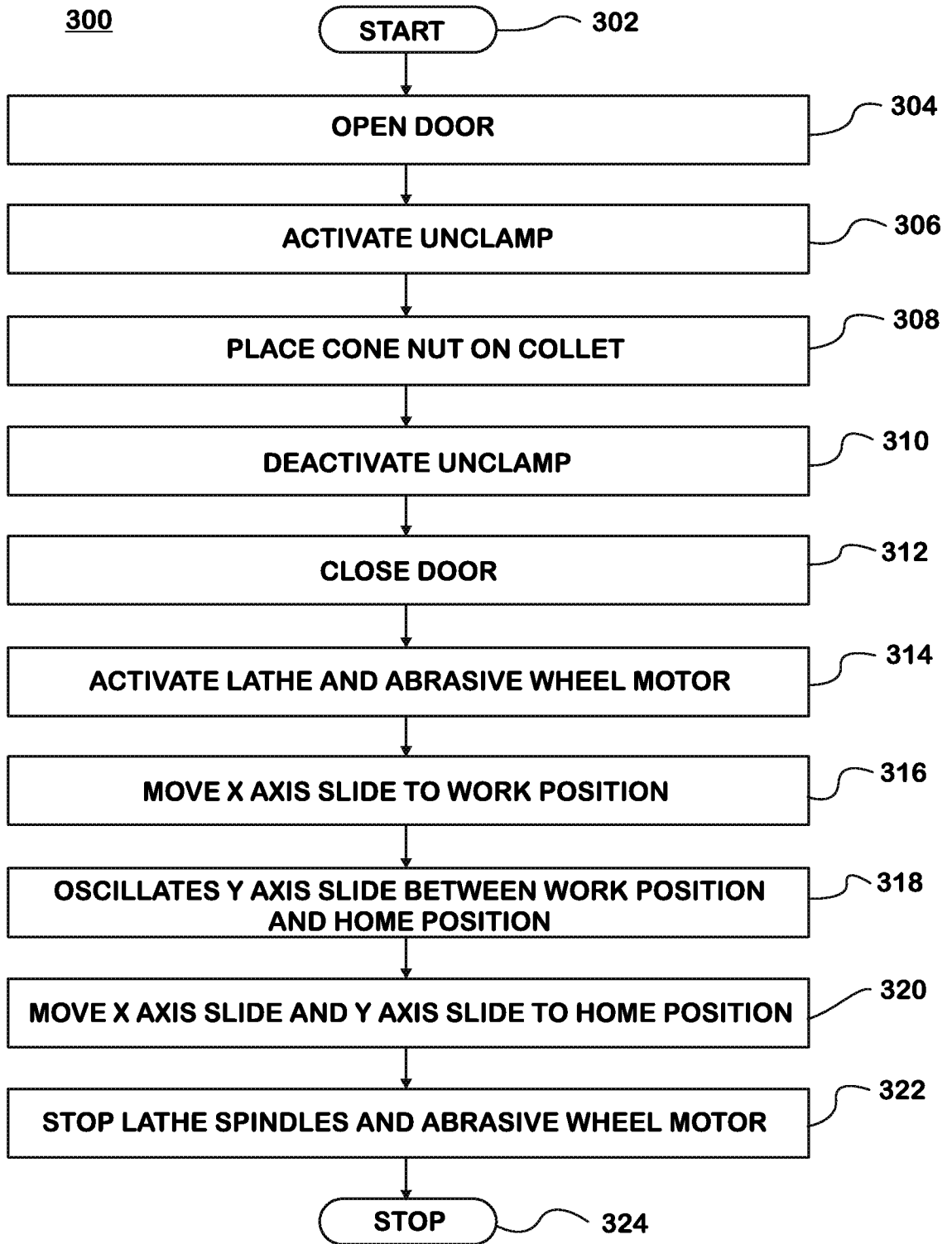


FIG. 3

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US2011/027174

A. CLASSIFICATION OF SUBJECT MATTER
 IPC(8) - B21B 45/04 (2011.01)
 USPC - 29/81.05
 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(8) - B21B 45/04 (2011.01)
 USPC - 29/81.05, 81.12, 81.13

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)
 MicroPatent, USPTO online database

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X --- Y	US 2,751,617 A (MCLAGGAN) 26 June 1956 (26.06.1956) entire document	1, 4-10, 13, 15-18 ----- 2, 3, 11-12, 14, 19-20
Y	US 5,348,704 A (TANAKA) 20 September 1994 (20.09.1994) entire document	2, 3
Y	US 5,649,887 A (TAKI et al) 22 July 1997 (22.07.1997) entire document	11, 14
Y	US 4,514,936 A (HURTADO) 07 May 1985 (07.05.1985) entire document	12, 20
Y	US 3,001,280 A (LYON) 26 September 1961 (26.09.1961) entire document	19

Further documents are listed in the continuation of Box C.

* Special categories of cited documents:

"A" document defining the general state of the art which is not considered to be of particular relevance	"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"E" earlier application or patent but published on or after the international filing date	"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
"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)	"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
"O" document referring to an oral disclosure, use, exhibition or other means	"&" document member of the same patent family
"P" document published prior to the international filing date but later than the priority date claimed	

Date of the actual completion of the international search 20 April 2011	Date of mailing of the international search report 27 APR 2011
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