



(43) International Publication Date
30 October 2014 (30.10.2014)

- (51) International Patent Classification:
B60C 25/00 (2006.01) *B60C 25/02* (2006.01)
- (21) International Application Number:
PCT/US2014/034922
- (22) International Filing Date:
22 April 2014 (22.04.2014)
- (25) Filing Language: English
- (26) Publication Language: English
- (30) Priority Data:
61/814,871 23 April 2013 (23.04.2013) US
13/951,256 25 July 2013 (25.07.2013) US
- (71) Applicant: **BRIDGESTONE AMERICAS TIRE OPERATIONS, LLC** [US/US]; 535 Marriott Drive, Nashville, Tennessee 37214 (US).
- (72) Inventor: **ASPER, Robert W.**; 351 Tolbert Street, Wadsworth, Ohio 44281 (US).
- (74) Agents: **FOX, Shaun** et al.; 10 East Firestone Blvd., Akron, Ohio 44317 (US).

(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, BN, 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, IR, IS, JP, KE, KG, 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, PA, PE, PG, PH, PL, PT, QA, RO, RS, RU, RW, SA, 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, RW, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, 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, KM, ML, MR, NE, SN, TD, TG).

Published:

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

[Continued on next page]

(54) Title: ULTRASONIC TIRE MOUNTING MACHINE

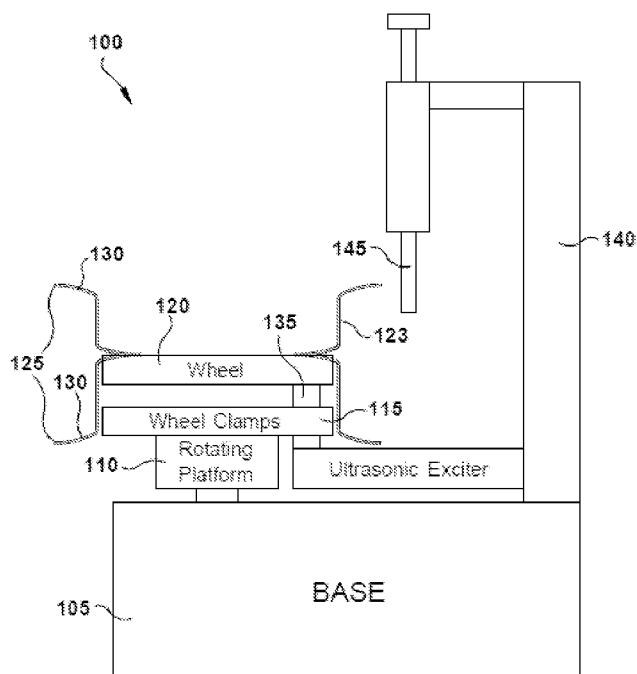


Fig. 1

(57) Abstract: Various embodiments of an ultrasonic tire mounting machine and system are disclosed. In one example embodiment, an ultrasonic tire mounting machine may include a base; a rotating platform; at least one wheel clamp; a tool arm; and an ultrasonic exciter operatively connected to at least one of a rim, a wheel, the at least one wheel clamp, and the tool arm.



-
- *before the expiration of the time limit for amending the claims and to be republished in the event of receipt of amendments (Rule 48.2(h))*

ULTRASONIC TIRE MOUNTING MACHINE

BACKGROUND

[0001] Pneumatic tires are often mounted on a wheel having a one-piece rim. Mounting or demounting a pneumatic tire on a one-piece rim requires significant effort, as the outer diameter of the rim's flange is larger than the inner diameter of the tire's bead. As a result, the tire and its bead must be deformed and stretched over the flange.

[0002] Further, following the mounting of a tire on a one-piece rim, the bead of the tire must be forced into contact with the bead seat portions of the rim. This process is commonly referred to as "bead seating." Many installers apply high air pressure within the tire for bead seating, in an attempt to force the tire's beads into the bead seat portions of the rim.

[0003] Rubber tires often have high coefficients of friction. Accordingly, the tire mounting/demounting and bead seating processes require significant forces to overcome the friction between the rubber tire and the rim.

[0004] An improved system is needed for reducing friction between a pneumatic tire and a rim during the mounting/demounting and bead seating processes.

SUMMARY

[0005] In one embodiment, an ultrasonic tire mounting machine is provided, comprising: a base; a rotating platform; at least one wheel clamp; a tool arm; and an ultrasonic exciter operatively connected to at least one of a rim, a wheel, the at least one wheel clamp, and the tool arm.

[0006] In another embodiment, an ultrasonic tire mounting machine is provided, comprising: at least one wheel clamp; and an ultrasonic exciter operatively connected to at least one of a rim, a wheel, and the at least one wheel clamp.

[0007] In one embodiment, an ultrasonic tire mounting system is provided, comprising: at least one wheel clamp; a tire; a tool arm; and an ultrasonic exciter operatively connected to at least one of a rim, a wheel, the tire, the at least one wheel clamp, and the tool arm.

BRIEF DESCRIPTION OF THE DRAWINGS

[0008] The accompanying figures, which are incorporated in and constitute a part of the specification, illustrate various example apparatuses and systems, and are used merely to illustrate various example embodiments. In the figures, like elements bear like reference numerals.

[0009] **FIG. 1** illustrates a side view of an example arrangement of an ultrasonic tire mounting machine.

[0010] **FIG. 2** illustrates a perspective view of an example arrangement of a prior art tire mounting machine.

DETAILED DESCRIPTION

[0011] Friction forces, such as those found between a tire and a rim during the tire mounting process, are characterized using the following equation: $F_r = \mu N$, where F_r is the friction force, μ is the coefficient of friction between materials (e.g., between the tire and the rim), and N is the normal force applied perpendicularly to the surfaces between which the friction force is acting.

[0012] To assist in overcoming the friction forces generated between a pneumatic tire and a rim during the tire mounting process, many installers utilize a chemical lubricant. The chemical lubricant may be oriented between the tire and the rim so as to reduce the coefficient of friction (μ) between the tire and the rim. The chemical lubricant is an added cost in the tire mounting/demounting process, and may have detrimental effects on the environment and the individuals, tires, wheels, and tire mounting machines that come into

contact with the chemical lubricant. Further, the chemical lubricant may contaminate the installer or the area around the tire mounting machine, requiring time-consuming cleanup.

[0013] Ultrasonic vibration has been shown to reduce friction at an interface between two materials, where one of the materials is being excited ultrasonically. This reduction of friction may be achieved without the use of a chemical lubricant. Accordingly, the application of ultrasonic excitation to one or both of a rim, or a tire, may result in the reduction of friction between the rim and the tire during mounting/demounting and bead seating processes.

[0014] Ultrasonic excitation of a material to reduce friction may include applying ultrasonic wave energy to the material, wherein the ultrasonic waves have a frequency between about 15 kHz and about 70 kHz. In one embodiment, the ultrasonic waves have a frequency between about 20 kHz and about 60 kHz. In another embodiment, the ultrasonic waves have a frequency greater than about 20 kHz, which is about the upper limit of a human's hearing capability. Thus, utilizing frequencies in excess of about 20 kHz may help prevent discomfort to individuals working with the ultrasonic tire mounting machine.

[0015] Ultrasonic excitation of a material may cause vibrations in the surface of the material. These vibrations may cause a cyclical reduction and increase of the normal forces (N) experienced at the interface of two materials, as the ultrasonically excited material will vibrate away from and then toward the non-excited material. Stated differently, ultrasonic excitation of the material may cause the material to cyclically retract from, and extend past, its unexcited position.

[0016] In one example, during the mounting/demounting of a tire on a rim, the rim may be ultrasonically excited. As the rim's surface vibrates, it may cyclically extend toward, and retract from, the tire. During the portion of the cycle when the rim retracts from the tire, the

normal force (N) experienced at the rim-tire interface drops (and in the event that the rim momentarily separates from the tire, the normal force is effectively eliminated), which leads to a momentary drop in the friction force (F_r) experienced at the rim-tire interface. Likewise, during the portion of the cycle when the rim extends toward the tire, the normal force (N) experienced at the rim-tire interface increases, which leads to a momentary increase in the friction force (F_r) experienced at the rim-tire interface. As a result, the constant application of a non-normal force between the tire and the rim, such as, for example, a lateral force applied by a tire machine forcing the tire bead over the rim flange, may cause the tire to move relative to the rim during the momentary drop in friction force (F_r) experienced at the rim-tire interface. This act is repeated over many extremely short cycles until the tire bead has cleared the flange of the rim.

[0017] In another example, the rim may be ultrasonically excited during bead seating. The application of ultrasonic waves to the rim may decrease the friction between the tire and the rim, thus requiring less internal air pressure to effectively complete the bead seating process. This requirement of less internal air pressure may at least partially prevent over-pressurization of the tire. Over-pressurization of the tire may result in damage to the tire. Over-pressurization of the tire may also result in catastrophic failure of the tire, including a rapid pressure drop or an explosion, either of which may be potentially harmful to individuals and equipment in the vicinity.

[0018] During the mounting/demounting and/or bead seating processes, ultrasonic waves applied to the rim may have a frequency between about 15 kHz and about 70 kHz. In one embodiment, the ultrasonic waves have a frequency between about 20 kHz and about 60 kHz. In another embodiment, the ultrasonic waves have a frequency greater than about 20 kHz.

[0019] **FIG. 1** illustrates a side view of an example arrangement of an ultrasonic tire mounting machine **100**. Machine **100** may comprise a base **105**. Base **105** may support and be operatively connected to a rotating platform **110**. At least one wheel clamp **115** may be directly connected or operatively connected to rotating platform **110**.

[0020] In one embodiment, machine **100** is configured to at least one of mount, demount, or seat the beads of a pneumatic tire on a one-piece rim. In one embodiment, machine **100** comprises at least one of electric motors or actuators, hydraulic motors or actuators, or pneumatic motors or actuators configured to mount, demount, or seat the beads of a tire on a one-piece rim. In another embodiment, machine **100** comprises a manual tire mounting, demounting, or bead seating apparatus, wherein a user utilizes a tire iron to manipulate the tire onto the rim. In another embodiment, machine **100** is configured to at least one of mount, demount, or seat the beads of a non-pneumatic tire on a rim.

[0021] Base **105** may act as a support for the remainder of machine **100**. In one embodiment, base **105** is fixed to one or more surfaces. In another embodiment, base **105** comprises a weight sufficient to prevent the unintended movement or tipping of machine **100**. In one embodiment, base **105** contains at least one of the controls, valves, programming, connections, wiring, and motor of machine **100**.

[0022] Rotating platform **110** may comprise an apparatus configured to selectively rotate a wheel **120** having a rim **123**. In one embodiment, rotating platform **110** is configured to selectively rotate rim **123** at least about 360 degrees. In another embodiment, rotating platform **110** is configured to selectively rotate rim **123** less than about 360 degrees. In another embodiment, rotating platform **110** is configured to selectively rotate rim **123** in either a clockwise or counter-clockwise direction.

[0023] Rotating platform **110** may be driven by a motor operatively connected to rotating platform **110**, including, for example, at least one of an electric motor, a hydraulic motor, a pneumatic motor, and an engine.

[0024] At least one wheel clamp **115** may be operatively connected to rotating platform **110**. At least one wheel clamp **115** may comprise at least one jaw configured to selectively engage at least a portion of wheel **120**. In one embodiment, at least one wheel clamp **115** may comprise at least one jaw configured to selectively engage at least a portion of rim **123**. In another embodiment, at least one wheel clamp **115** is configured to selectively extend radially outwardly to engage at least a portion of the inner edge of rim **123**. In another embodiment, at least one wheel clamp **115** is configured to selectively extend radially inwardly to engage at least a portion of the outer edge of rim **123**. In another embodiment, at least one wheel clamp **115** is configured to selectively engage the center bore of wheel **120**. In another embodiment, at least one wheel clamp **115** is configured to selectively engage at least one bolt hole of wheel **120**.

[0025] In one embodiment, at least one wheel clamp **115** is configured to selectively arrest the motion of rim **123** relative to machine **100**. In another embodiment, at least one wheel clamp **115** is configured to selectively arrest the motion of rim **123** relative to rotating platform **110**, such that rim **123** rotates with rotating platform **110**.

[0026] Rim **123** may comprise at least one flange **125**, which may extend radially outwardly from wheel **120**. Rim **123** may comprise at least one bead seat **130**. At least one bead seat **130** may be substantially oriented at or near the base of at least one flange **125**.

[0027] Rim **123** may comprise any of a variety of materials, including for example a metal such as steel, an alloy such as an aluminum alloy, a polymer, or a composite.

[0028] In one embodiment, machine **100** comprises an ultrasonic exciter **135** operatively connected to at least one of rim **123**, wheel **120**, at least one wheel clamp **115**, and a tire (not shown). In another embodiment, ultrasonic exciter **135** is operatively connected to rim **123**. In another embodiment, ultrasonic exciter **135** directly contacts at least a portion of rim **123**, wheel **120**, at least one wheel clamp **115**, and/or a tire (not shown). In another embodiment, ultrasonic exciter **135** directly contacts at least a portion of the inner edge of rim **123**.

[0029] Ultrasonic exciter **135** may be configured to selectively impart ultrasonic waves upon at least one of rim **123**, wheel **120**, at least one wheel clamp **115**, and a tire (not shown). In one embodiment, ultrasonic exciter **135** is configured to selectively impart ultrasonic waves upon at least one of at least one flange **125** and at least one bead seat **130**. In one embodiment, ultrasonic exciter **135** imparts ultrasonic waves at a frequency between about 15 kHz and about 70 kHz. In another embodiment, ultrasonic exciter **135** imparts ultrasonic waves at a frequency between about 20 kHz and about 60 kHz. In another embodiment, ultrasonic exciter **135** imparts ultrasonic waves at a frequency greater than about 20 kHz.

[0030] In one embodiment, ultrasonic exciter **135** is selectively activated to decrease friction forces between rim **123** and a tire (not shown) during at least one of tire mounting, tire demounting, and bead seating.

[0031] In one embodiment, ultrasonic exciter **135** is operatively and/or directly connected to at least one of base **105**, rotating platform **110**, at least one wheel clamp **115**, a vertical standard **140**, or a tool arm **145**. In another embodiment, ultrasonic exciter **135** is integrally connected to at least one of base **105**, rotating platform **110**, at least one wheel clamp **115**, vertical standard **140**, or tool arm **145**. In another embodiment, ultrasonic exciter **135** imparts ultrasonic waves to at least one of base **105**, rotating platform **110**, at least one wheel clamp **115**, vertical standard **140**, or tool arm **145**.

[0032] Tool arm **145** may be configured to manipulate a tire (not shown) during at least one of mounting or demounting. In one embodiment, tool arm **145** is configured to break a bead seal on a mounted tire. In one embodiment, tool arm **145** is actuated by at least one of an electric actuator, a hydraulic actuator, a pneumatic actuator, or a motor. In another embodiment, tool arm **145** is manually operated by an individual. In another embodiment, tool arm **145** may comprise a tire iron manually operated by an individual. In another embodiment, tool arm **145** may be replaced with a tire iron manually operated by an individual.

[0033] In one embodiment, machine **100** results in sufficiently reduced friction forces between rim **123** and wheel **120** during at least one of mounting, demounting, or bead seating, in the absence of chemical lubricant.

[0034] **FIG. 2** illustrates a perspective view of an example arrangement of a prior art tire mounting machine **200**. Machine **200** consists of a base **205**, a rotating platform **210**, and a wheel clamp **215**. As shown, machine **200** is connected to a wheel **220** having a flange **225**. A tire **227** is mounted on wheel **220**. Machine **200** has a vertical standard **240** connected to a tool arm **245**.

[0035] In operation, machine **200** requires application of a chemical lubricant to sufficiently reduce the friction forces between the rim of wheel **220** and tire **227** during at least one of mounting, demounting, or bead seating.

[0036] To the extent that the term “includes” or “including” is used in the specification or the claims, it is intended to be inclusive in a manner similar to the term “comprising” as that term is interpreted when employed as a transitional word in a claim. Furthermore, to the extent that the term “or” is employed (e.g., A or B) it is intended to mean “A or B or both.” When the applicants intend to indicate “only A or B but not both” then the term “only A or B

but not both” will be employed. Thus, use of the term “or” herein is the inclusive, and not the exclusive use. See Bryan A. Garner, *A Dictionary of Modern Legal Usage* 624 (2d. Ed. 1995). Also, to the extent that the terms “in” or “into” are used in the specification or the claims, it is intended to additionally mean “on” or “onto.” To the extent that the term “substantially” is used in the specification or the claims, it is intended to take into consideration the degree of precision available in the relevant industry, which in one embodiment is ± 0.25 inches. To the extent that the term “selectively” is used in the specification or the claims, it is intended to refer to a condition of a component wherein a user of the apparatus may activate or deactivate the feature or function of the component as is necessary or desired in use of the apparatus. To the extent that the term “operatively connected” is used in the specification or the claims, it is intended to mean that the identified components are connected in a way to perform a designated function. As used in the specification and the claims, the singular forms “a,” “an,” and “the” include the plural. Finally, where the term “about” is used in conjunction with a number, it is intended to include $\pm 10\%$ of the number. In other words, “about 10” may mean from 9 to 11.

[0037] As stated above, while the present application has been illustrated by the description of embodiments thereof, and while the embodiments have been described in considerable detail, it is not the intention of the applicants to restrict or in any way limit the scope of the appended claims to such detail. Additional advantages and modifications will readily appear to those skilled in the art, having the benefit of the present application. Therefore, the application, in its broader aspects, is not limited to the specific details, illustrative examples shown, or any apparatus referred to. Departures may be made from such details, examples, and apparatuses without departing from the spirit or scope of the general inventive concept.

CLAIMS

1. An ultrasonic tire mounting machine, comprising:
a base;
a rotating platform;
at least one wheel clamp;
a tool arm; and
an ultrasonic exciter operatively connected to at least one of a rim, a wheel, the at least one wheel clamp, and the tool arm.
2. The ultrasonic tire mounting machine of claim 1, further comprising a tire operatively connected to the rim.
3. The ultrasonic tire mounting machine of claim 1, the rim comprising at least one flange, and wherein the ultrasonic exciter is operatively connected to the at least one flange.
4. The ultrasonic tire mounting machine of claim 1, the rim comprising at least one bead seat, and wherein the ultrasonic exciter is operatively connected to the at least one bead seat.
5. The ultrasonic tire mounting machine of claim 1, wherein the ultrasonic exciter is configured to impart ultrasonic waves comprising a frequency between about 15 kHz and about 70 kHz.
6. An ultrasonic tire mounting machine, comprising:
at least one wheel clamp; and
an ultrasonic exciter operatively connected to at least one of a rim, a wheel, and the at least one wheel clamp.
7. The ultrasonic tire mounting machine of claim 6, further comprising a tire operatively connected to the rim.

8. The ultrasonic tire mounting machine of claim 6, the rim comprising at least one flange, and wherein the ultrasonic exciter is operatively connected to the at least one flange.

9. The ultrasonic tire mounting machine of claim 6, the rim comprising at least one bead seat, and wherein the ultrasonic exciter is operatively connected to the at least one bead seat.

10. The ultrasonic tire mounting machine of claim 6, wherein the ultrasonic exciter is configured to impart ultrasonic waves comprising a frequency between about 15 kHz and about 70 kHz.

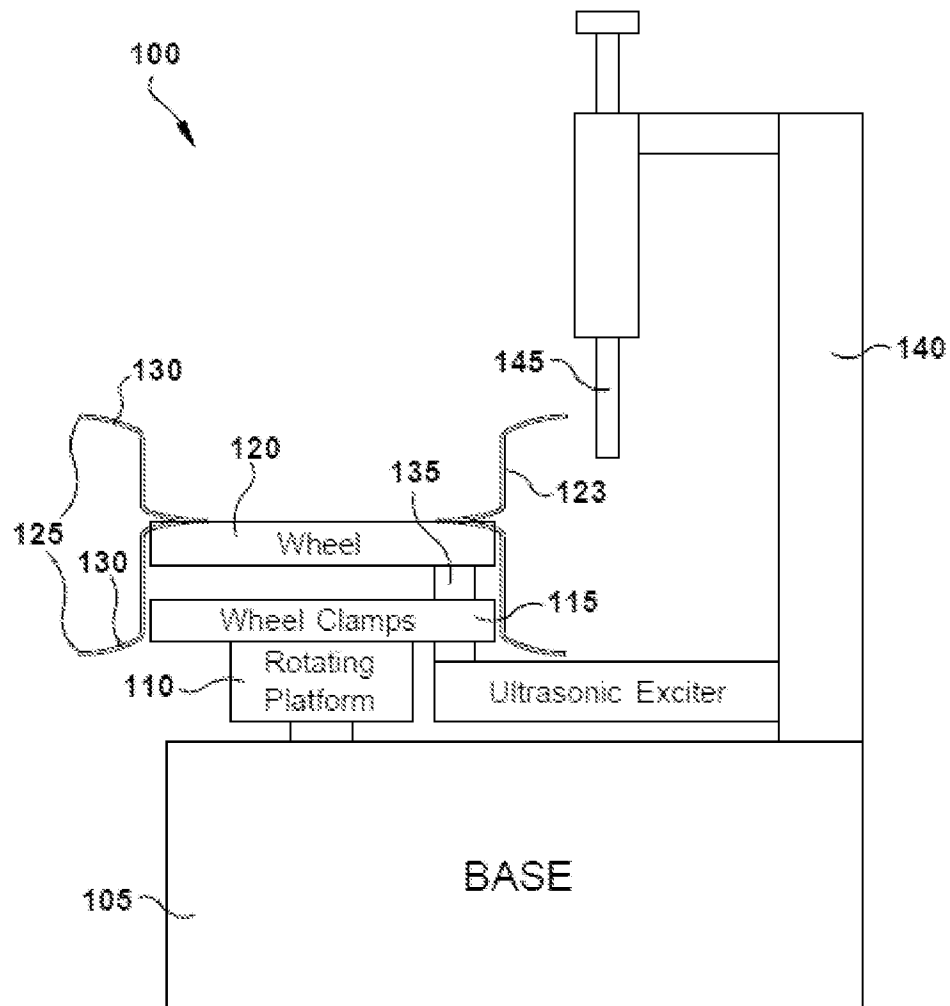
11. An ultrasonic tire mounting system, comprising:
at least one wheel clamp;
a tire;
a tool arm; and
an ultrasonic exciter operatively connected to at least one of a rim, a wheel, the tire, the at least one wheel clamp, and the tool arm.

12. The ultrasonic tire mounting system of claim 11, the rim comprising at least one flange, and wherein the ultrasonic exciter is operatively connected to the at least one flange.

13. The ultrasonic tire mounting system of claim 11, the rim comprising at least one bead seat, and wherein the ultrasonic exciter is operatively connected to the at least one bead seat.

14. The ultrasonic tire mounting system of claim 11, wherein the ultrasonic exciter is configured to impart ultrasonic waves comprising a frequency between about 15 kHz and about 70 kHz.

15. The ultrasonic tire mounting system of claim 11, wherein the ultrasonic exciter is configured to impart ultrasonic waves comprising a frequency greater than about 20 kHz.

**Fig. 1**

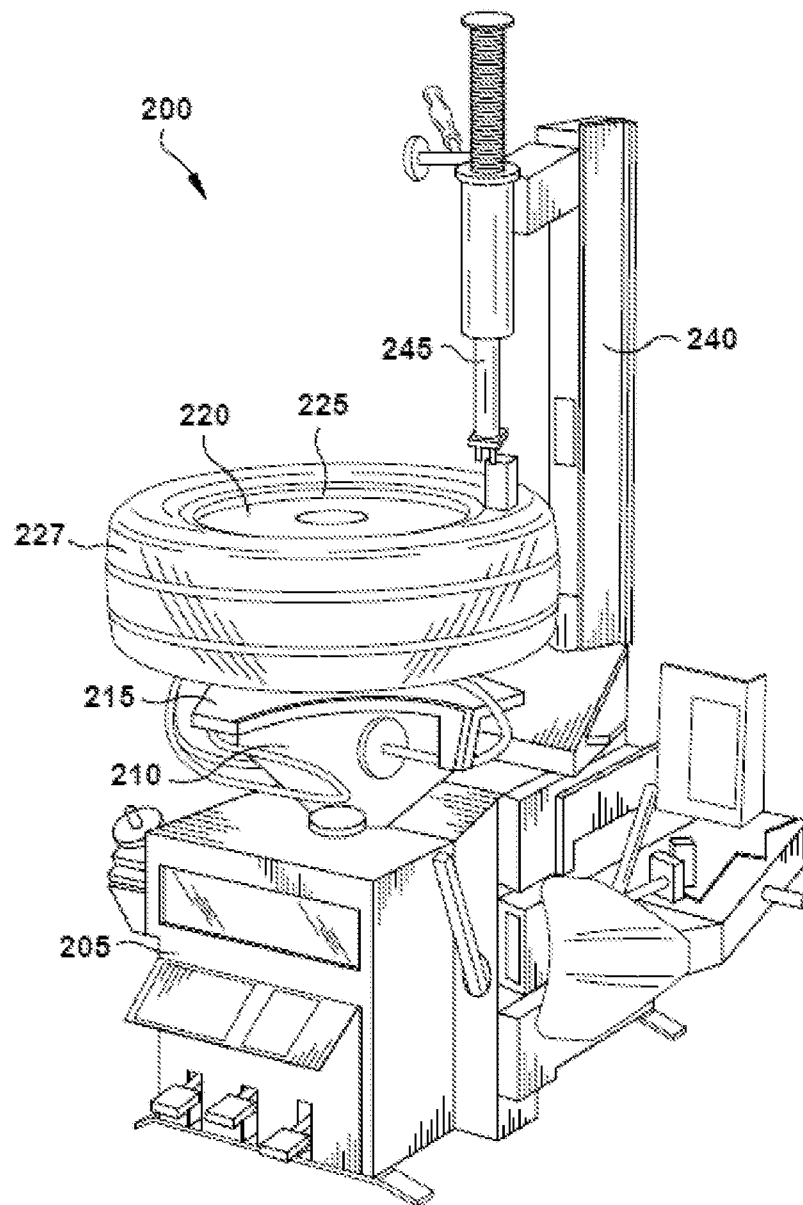


Fig. 2
(Prior Art)

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US2014/034922**A. CLASSIFICATION OF SUBJECT MATTER****B60C 25/00(2006.01)i, B60C 25/02(2006.01)i**

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

B. FIELDS SEARCHEDMinimum documentation searched (classification system followed by classification symbols)
B60C 25/00; G01M 17/02; G01M 1/02; G01N 29/20; B60C 25/138; E01C 23/00; B60C 25/02Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched
Korean utility models and applications for utility models
Japanese utility models and applications for utility modelsElectronic data base consulted during the international search (name of data base and, where practicable, search terms used)
eKOMPASS(KIPO internal) & Keywords: ultrasonic, tire mounting machine, wheel, rim and tool arm**C. DOCUMENTS CONSIDERED TO BE RELEVANT**

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	JP 2004-003971 A (BRIDGESTONE CORP.) 08 January 2004 See paragraphs [0006],[0010],[0011],[0013]; claims 1,4 and figures 1-5.	1-15
A	US 2013-0042980 A1 (SOTGIU, PAOLO) 21 February 2013 See paragraphs [0004]-[0026] and figures 1-5.	1-15
A	JP 08-175134A (NISSAN ALTIA CO., LTD.) 09 July 1996 See paragraphs [0002]-[0008] and figure 1.	1-15
A	US 2010-0263801 A1 (LAWSON et al.) 21 October 2010 See paragraphs [0001]-[0003] and figures 1-7.	1-15
A	US 2002-0011103 A1 (KIMBARA et al.) 31 January 2002 See paragraphs [0013]-[0032] and figures 1-5.	1-15



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

"E" earlier application or patent but published on or after the international filing date

"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)

"O" document referring to an oral disclosure, use, exhibition or other means

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

"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

"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

22 August 2014 (22.08.2014)

Date of mailing of the international search report

22 August 2014 (22.08.2014)

Name and mailing address of the ISA/KR

International Application Division
Korean Intellectual Property Office
189 Cheongsu-ro, Seo-gu, Daejeon Metropolitan City, 302-701,
Republic of Korea

Facsimile No. +82-42-472-7140

Authorized officer

LEE, Chang Ho

Telephone No. +82-42-481-8398



INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No.

PCT/US2014/034922

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
JP 2004-003971 A	08/01/2004	None	
US 2013-0042980 A1	21/02/2013	CN 102770290 A EP 2361791 A1 EP 2361791 B1 EP 2536578 A1 EP 2634016 A1 WO 2011-101006 A1	07/11/2012 31/08/2011 05/06/2013 26/12/2012 04/09/2013 25/08/2011
JP 08-175134A	09/07/1996	JP 2959750 B2	06/10/1999
US 2010-0263801 A1	21/10/2010	CA 2591674 A1 CA 2591674 C CA 2783183 A1 CA 2783183 C CN 101176086 A0 CN 101176086 B CN 102632779 A EP 1841606 A2 EP 1841606 B1 EP 2193875 A1 EP 2588330 A2 EP 2588330 A4 JP 04864011 B2 JP 2008-526618 A US 2006-0169415 A1 US 2011-0042015 A1 US 7845655 B2 US 8176960 B2 US 8365794 B2 WO 2006-078784 A2 WO 2006-078784 A3 WO 2012-005866 A2 WO 2012-005866 A3	27/07/2006 25/09/2012 27/07/2006 08/04/2014 07/05/2008 27/06/2012 15/08/2012 10/10/2007 12/05/2010 09/06/2010 08/05/2013 04/12/2013 25/01/2012 24/07/2008 03/08/2006 24/02/2011 07/12/2010 15/05/2012 05/02/2013 27/07/2006 29/11/2007 12/01/2012 19/04/2012
US 2002-0011103 A1	31/01/2002	AU 2000-53451 A1 AU 2000-53451 B2 CA 2316274 A1 CA 2342392 A1 CA 2342392 C DE 60108435 D1 DE 60108435 T2 EP 1138527 A2 EP 1138527 A3 EP 1138528 A2 EP 1138528 A3 EP 1138528 B1 ID 29708 A JP 03602805 B2	04/10/2001 30/10/2003 29/09/2001 29/09/2001 10/05/2005 24/02/2005 07/07/2005 04/10/2001 05/02/2003 04/10/2001 29/01/2003 19/01/2005 04/10/2001 15/12/2004

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No.

PCT/US2014/034922Patent document
cited in search reportPublication
datePatent family
member(s)Publication
dateJP 2001-341507 A
US 6581448 B211/12/2001
24/06/2003