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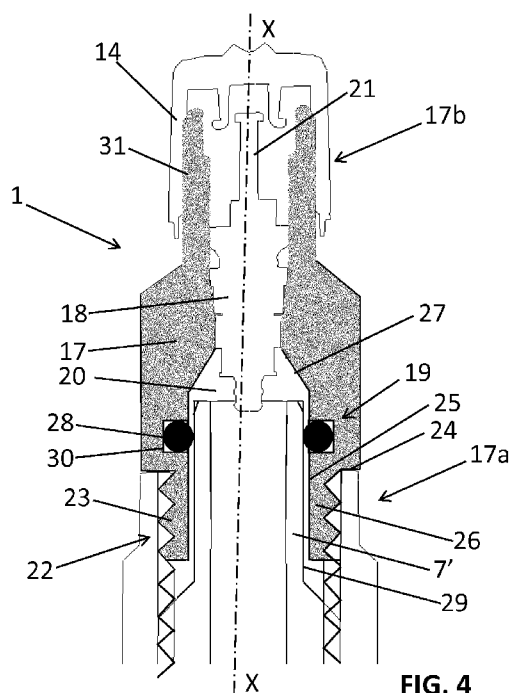
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(54) Title: REPAIR APPARATUS AND METHOD FOR REPAIRING A SEVERED VALVE



(57) Abstract: The present disclosure relates to a repair ap-
paratus (1) for repairing a severed valve stem (7'). The repair
apparatus (1) has a body (17) having a supply conduit (20).
The repair apparatus (1) has sealing means (19) for forming a
seal with the severed valve stem (7'). Furthermore, mounting
means (22) are provided for mounting the repair apparatus
(1). The mounting means (22) may mount the repair apparat-
us (1) to a mounting nut (12) disposed on the severed valve
stem (7'). The present disclosure also relates to a method of
repairing a severed valve stem (7').



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REPAIR APPARATUS AND METHOD FOR REPAIRING A SEVERED VALVE

TECHNICAL FIELD

5 The present disclosure relates to a repair apparatus and method and particularly, but not exclusively, to a repair apparatus and method for repairing a severed valve stem. Aspects of the present invention relate to a repair apparatus, to a kit of parts, to a method, to a vehicle wheel and to a vehicle.

BACKGROUND

10 Pneumatic vehicle tyres comprise a valve stem for supplying air to inflate the tyre. The valve stems are configured to be connected to inflating apparatus, such as a compressor. The inflating apparatus may comprise an inflation wand which connects to the valve stem. The connection of the inflation wand opens a valve core disposed in the valve stem to allow the supply of air to the tyre. The valve stem may inadvertently be severed during inflation of the
15 tyre. In particular, an end portion of the valve stem may be cleaved from the valve stem upon inadvertent application of a side-load if the inflation wand is displaced laterally. The valve core is often removed when this damage occurs meaning that the tyre deflates and cannot readily be re-inflated. It may be possible to repair the valve stem by dismantling the remaining components, or machining them *in situ*. However, this requires specialist
20 equipment and may introduce contaminants into the tyre. A valve stem repair kit and method are known from US 8,955,535.

It is increasingly common to provide a tyre pressure monitoring system (TPMS) module on pneumatic vehicle tyres. The TPMS module comprises a pressure sensor for directly
25 measuring the tyre pressure and transmitting a tyre pressure signal. The TPMS module comprises a TPMS nut which is mounted to a base of the valve stem. The provision of a TPMS module may create additional problems when attempting to repair damage to the valve core. In particular, dismantling the valve stem may cause the TPMS module to be dis-orientated or detached from the stem.

30

At least in certain embodiments, the present invention seeks to provide a repair apparatus for a valve stem.

SUMMARY OF THE INVENTION

35 Aspects of the present invention relate to a repair apparatus for a tyre pressure monitoring system; to vehicle wheel; to a kit of parts, to a vehicle; and to a method of repairing a severed valve stem of a tyre pressure monitoring system as claimed in the appended claims.

According to a further aspect of the present invention there is provided a repair apparatus for repairing a severed valve stem, the repair apparatus comprising:

a body having a supply conduit;

5 sealing means for forming a seal with the severed valve stem; and

10 mounting means for mounting the repair apparatus to a mounting nut disposed on the severed valve stem. A valve stem is associated with a pneumatic tyre for connection to inflating apparatus, such as a compressor. A valve core is provided in the valve stem and can be selectively opened and closed to allow the flow of air. If the valve stem is
10 inadvertently severed, for example during inflation, air will escape the tyre cavity and the tyre will deflate. The tyre cannot subsequently be re-inflated in the conventional way, via the valve stem, since the valve core is often removed or compromised. The repair apparatus in accordance with aspects of the present invention is configured to seal the severed valve
15 stem and to enable re-inflation of the tyre.

15 The repair apparatus may comprise a valve core for controlling the flow of air through said supply conduit. The valve core of the repair apparatus serves as a replacement (temporary or permanent) for the original valve core in the valve stem. The replacement valve core can be opened and closed to enable inflation/deflation of the tyre in conventional manner.

20 The mounting nut is typically provided to mount the valve stem, for example to a wheel. The valve stem may comprise a threaded section for receiving the mounting nut. The threaded section may be provided at the base of the valve stem. The mounting means is provided to mount the repair apparatus to the mounting nut. By mounting the repair apparatus to the
25 mounting nut, at least in certain embodiments the repair apparatus may be mounted without removing the mounting nut.

30 The severed valve stem may be a part of a tyre pressure monitoring system (TPMS) module and the mounting nut may be configured to mount the TPMS module to the wheel. In use, the mounting nut may mount the TPMS module to the wheel. The mounting nut may be a TPMS mounting nut.

35 The mounting means may comprise a threaded section for cooperating with a mounting nut. The mounting means may comprise an external thread for engaging an internal thread of said mounting nut. At least in certain embodiments the repair apparatus can be screwed into the mounting nut. The external thread may be at least substantially the same thread as that provided at the base of the valve stem for mounting the mounting nut. The external thread

may be adapted to engage an exposed portion of the internal thread when the mounting nut is disposed on the severed valve stem (i.e. to engage a portion of the internal thread extending beyond the external thread on which the mounting nut is disposed). The repair apparatus may thereby be installed with the mounting nut in situ. The external thread may be
5 formed on a sleeve configured to locate between the severed valve stem and the mounting nut.

The sealing means may be configured to engage a sidewall of the severed valve stem. The sealing means may be configured to engage the severed valve stem remote from the
10 external thread formed on the severed valve stem. The sealing means may comprise an annular seal for engaging the severed valve stem. The annular seal may form a seal with an outer sidewall of the severed valve stem. The sealing means may comprise more than one annular seal in certain embodiments. The annular seal may, for example, comprise an O-ring. Other sealing means are useful.

15 The repair apparatus may comprise a supply conduit for supplying air to the tyre. The supply conduit may be formed in the body. The supply conduit may extend along a longitudinal axis of the body. The valve core may be disposed in the supply conduit.

20 The body may comprise an aperture for receiving the end of the severed valve stem. The aperture may form an inlet of the supply conduit. The supply conduit may extend along a longitudinal axis of the body.

According to a further aspect of the present invention there is provided a repair apparatus for
25 repairing a severed valve stem, the repair apparatus comprising:

a body having a supply conduit;

sealing means for forming a seal with the severed valve stem; and

mounting means for mounting the repair apparatus;

wherein the sealing means is configured to engage a sidewall of the severed valve
30 stem to form a seal. The repair apparatus can be installed without removing a mounting nut disposed on the severed vase stem.

The sealing means may be configured to engage the severed valve stem remote from the external thread formed on the severed valve stem. The sealing means may comprise an
35 annular seal for engaging the severed valve stem. The annular seal may form a seal with an outer sidewall of the severed valve stem. The sealing means may comprise more than one

annular seal in certain embodiments. The annular seal may, for example, comprise an O-ring. Other sealing means are useful.

The mounting means may be adapted to mount the repair apparatus to a mounting nut disposed on the severed valve stem. Alternatively, the mounting means may be adapted to mount the repair apparatus to the severed valve stem.

According to a further aspect of the present invention there is provided a vehicle wheel in combination with a repair apparatus as described herein.

According to a still further aspect of the present invention there is provided a vehicle having one or more repair apparatus as described herein.

According to a further aspect of the present invention there is provided a kit comprising a repair apparatus and an adaptor for mounting to a severed valve stem, wherein the repair apparatus comprises mounting means for mounting the repair apparatus to the adaptor. The repair apparatus may be of the type described herein. The adaptor may comprise first adaptor mounting means for mounting the adaptor to an external thread disposed on the severed valve stem; and second adaptor mounting means for mounting a repair apparatus to the adaptor. The first adaptor mounting means and/or the second adaptor mounting means may comprise an internal (female) thread.

According to a still further aspect of the present invention there is provided an adaptor for mounting a repair apparatus to a severed valve stem, the adaptor comprising:

first adaptor mounting means for mounting the adaptor to an external thread disposed on the severed valve stem; and

second adaptor mounting means for mounting a repair apparatus to the adaptor.

The first adaptor mounting means and/or the second adaptor mounting means may comprise an internal (female) thread. The adaptor may comprise sealing means for forming a seal with a sidewall of the severed valve stem. The sealing means may comprise an annular seal, such as an O-ring. The sealing means may be separate from the first mounting means, for example displaced along a longitudinal axis. Alternatively, or in addition, the repair apparatus may comprise sealing means for forming a seal with a sidewall of the severed valve stem. The repair apparatus may be the repair apparatus described herein.

According to a further aspect of the present invention there is provided a method of repairing a severed valve stem, the method comprising:

locating a repair apparatus on the severed valve stem;

forming a seal between the severed valve stem and the repair apparatus; and

wherein a mounting nut is disposed on the severed valve stem and the method comprises mounting the repair apparatus without removing the mounting nut. The mounting nut may mount the severed valve stem to a wheel, for example engaging a rim of the wheel. The repair apparatus may be installed with the mounting nut in situ.

The method may comprise mounting the repair apparatus to the mounting nut. The repair apparatus may be indirectly mounted to the valve stem. The repair apparatus may comprise mounting means comprising an external (male) thread. The repair apparatus may be mounted to the mounting nut without removing the mounting nut.

The mounting means may comprise an external thread for engaging an internal thread of said mounting nut. The external thread may be formed on a sleeve. The method may comprise locating the sleeve between the severed valve stem and the mounting nut.

Alternatively, the method may comprise mounting the repair apparatus to the severed valve stem. The repair apparatus may be directly mounted to the severed valve stem. The repair apparatus may comprise mounting means comprising an internal (female) thread. The method may comprise screwing the repair apparatus onto an exposed section of thread formed on the severed valve stem. The repair apparatus may thereby both be mounted on the valve stem along with the mounting nut.

The severed valve stem may be a part of a tyre pressure monitoring system (TPMS) module. The mounting nut may be configured to mount the TPMS module to the wheel. The mounting nut may be a TPMS mounting nut.

The sealing means may be configured to engage a sidewall of the severed valve stem. The repair apparatus may comprise an annular seal. The annular seal may form the seal with the severed valve stem when the repair apparatus is located on the severed valve stem. The annular seal may comprise an O-ring.

The repair apparatus may comprise a body. The mounting of the repair apparatus may comprise mounting the body to the mounting nut. The body may be configured to be mounted to the mounting nut disposed on the severed valve stem. The method may comprise mounting the repair apparatus by screwing the body into the mounting nut.

According to a further aspect of the present invention there is provided a method of repairing a severed valve stem, the method comprising:

mounting an adaptor to the severed valve stem;

mounting a repair apparatus to the adaptor;

5 forming a seal between the severed valve stem and the adaptor and/or the repair apparatus. The method may comprise mounting the adaptor to the severed valve stem while a mounting nut is located on the severed valve stem (i.e. without removing the mounting nut). Thus, the method may comprise mounting the adaptor with the mounting nut in situ. The method may comprise tightening the adaptor against the mounting nut. The severed
10 valve stem may form part of a tyre pressure monitoring system (TPMS) module.

The adaptor and/or the repair apparatus may comprise sealing means for forming a seal with the severed valve stem. The sealing means may be configured to form a seal with a sidewall of the severed valve stem. The sealing means may comprise an annular seal, such as an O-
15 ring.

Within the scope of this application it is expressly intended that the various aspects, embodiments, examples and alternatives set out in the preceding paragraphs, in the claims and/or in the following description and drawings, and in particular the individual features
20 thereof, may be taken independently or in any combination. That is, all embodiments and/or features of any embodiment can be combined in any way and/or combination, unless such features are incompatible. The applicant reserves the right to change any originally filed claim or file any new claim accordingly, including the right to amend any originally filed claim to depend from and/or incorporate any feature of any other claim although not originally
25 claimed in that manner.

BRIEF DESCRIPTION OF THE DRAWINGS

One or more embodiments of the present invention will now be described, by way of example only, with reference to the accompanying figures, in which:

30 Figure 1 shows a schematic representation of a vehicle having known tyre pressure monitoring system modules for measuring tyre pressure;

Figure 2 shows a perspective view of a known tyre pressure monitoring system module mounted to a tyre of the vehicle shown in Figure 1;

35 Figure 3 shows a sectional view through an upper portion of the known tyre pressure monitoring system module shown in Figure 2;

Figure 4 shows a repair apparatus in accordance with an aspect of the present invention.

DETAILED DESCRIPTION

A repair apparatus 1 for a tyre pressure monitoring system (TPMS) module 2 in accordance with an embodiment of the present invention will now be described with reference to the accompanying figures.

A vehicle 3 having a plurality of wheels 4 is illustrated in Figure 1. In the present embodiment the vehicle 3 is an automobile, such as a sports utility vehicle (SUV), having four wheels 4. The wheels 4 each comprise a rim 5 onto which a pneumatic tyre 6 is mounted. It will be appreciated that the present invention is applicable to other types of vehicle 3. One of the TPMS modules 2 is installed in each of the wheels 4 of the vehicle 3. Each TPMS module 2 comprises a pressure sensor operable to measure the pressure of the tyre 6 and a wireless transmitter for transmitting a tyre pressure signal. The tyre pressure signal is transmitted wirelessly to an electronic control unit disposed in the vehicle 3 to enable the pressure of each tyre 6 to be monitored directly.

The features and functionality of the TPMS module 2 fitted to one of the wheels 4 of the vehicle 3 will now be described with reference to Figures 2 and 3. The TPMS module 2 comprises a valve stem 7 connected to the tyre 6. The valve stem 7 comprises a base portion 8 having a first external thread 9; and an end portion 10 having a second external thread 11. A TPMS mounting nut 12 is disposed on the valve stem 7 to mount the TPMS module 2. In the example shown, the valve stem 7 is made of aluminium. Other materials are useful for the valve stem 7. The TPMS mounting nut 12 has a first internal (female) thread 13 which co-operates with the first external thread 9 to enable the TPMS mounting nut 12 to be screwed onto the base portion 8 of the valve stem 7. The end portion 10 of the valve stem 7 projects beyond the TPMS mounting nut 12 and a valve cap 14 is screwed onto the second external thread 11.

A valve core 15, shown in Figure 3, is disposed in the valve stem 7 to control the flow of air to and from the tyre 6. The valve core 15 comprises a valve pin 16 which is operable to open the valve core 15 and enable the flow of air through the valve stem 7. When a tyre inflator is connected to the valve stem 7, the valve pin 16 is displaced downwardly to open the valve core 15. The tyre inflator may, for example, comprise an inflation wand adapted to engage the end portion 10 of the valve stem 7 to inflate the tyre 6. The valve core 15 is located in the end portion 10 of the valve stem 7 to facilitate actuation of the valve pin 16. As described herein, the valve stem 7 may inadvertently be damaged during inflation of the tyre 6. In particular, the end portion 10, including the valve core 15, may be severed or otherwise

separated from the valve stem 7 upon application of a lateral load. Such an event compromises the integrity of the valve and causes the tyre to deflate. This form of damage may occur when an inflation wand connected to the valve stem 7 is displaced laterally, applying a side-loading to the valve stem 7 which severs the end portion 10 from the remainder of valve stem 7. The term "severed valve stem" (denoted by the reference numeral 7') is used herein to refer to the portion of the valve stem 7 remaining after the end portion 10 has been removed. The removal of the end portion 10 of the valve stem 7 is illustrated by a dashed line CC in Figure 3. The removal of the valve core 15 is particularly problematic since the tyre 6 cannot readily be re-sealed, potentially rendering the vehicle 3 inoperable. As shown in Figure 3 (and Figure 4), a section of the valve stem 7 remains within the TPMS mounting nut 12 after the end portion 10 has been severed. As described herein, the repair apparatus 1 is configured to cooperate with the remaining section of the severed valve stem 7' to seal the tyre 6.

With reference to Figure 4, the repair apparatus 1 comprises a body 17, a replacement valve core 18 and sealing means 19 for forming a seal with the severed valve stem 7'. The body 17 in the present embodiment is made of steel, but could be formed from other materials such as a metal alloy, aluminium or plastic. The body 17 has a longitudinal axis XX for alignment with a longitudinal axis of the severed valve stem 7'. The body 17 comprises a supply conduit 20 extending through the repair apparatus 1 to form a pneumatic line for inflating/deflating the tyre 6. The supply conduit 20 extends along the longitudinal axis XX in the present embodiment. The replacement valve core 18 is mounted in the supply conduit 20 to control the flow of air through the repair apparatus 1. The operation of the replacement valve core 18 is the same as that of the valve core 15 in the original valve stem 7. In particular, the replacement valve core 18 is opened and closed by actuating a replacement valve pin 21.

A first end 17a of the body 17 is adapted to be mounted to the TPMS module 2; and a second end 17b of the body 17 is adapted to be connected to inflating apparatus to inflate the tyre 6. The body 17 comprises mounting means 22 for mounting the repair apparatus 1 to the TPMS module 2. The mounting means 22 in the present embodiment is adapted to be mounted to the TPMS mounting nut 12. The mounting means 22 in the present embodiment is in the form of an external (male) thread 23 formed at said first end 17a of the body 17. The external thread 23 is formed on a sleeve 26 configured to locate between the severed valve stem 7' and the TPMS mounting nut 12. The external thread 23 is adapted to engage the first internal thread 13 formed in the TPMS mounting nut 12. In particular, the external thread 23 is substantially the same as the first external thread 9. The body 17 has an annular

shoulder 24 for engaging an upper end of the TPMS mounting nut 12. The supply conduit 20 comprises an inlet 25 for receiving an end of the severed valve stem 7'. The inlet 25 is formed by a circular bore formed in the body 17. A taper 27 is formed at the end of the inlet 25. The sealing means 19 in the present embodiment comprises an O-ring 28 for engaging an outer sidewall 29 of the severed valve stem 7' to form a fluid-tight seal. In the present embodiment, the supply conduit 20 comprises an annular recess 30 in which the O-ring 28 is disposed. The O-ring 28 is made of an elastomeric material, such as rubber, for engaging the outer sidewall 29 of the severed valve stem 7' to form a seal when the repair apparatus 1 is mounted to the TPMS module 2. More than one O-ring 28 may be provided. It will be appreciated that the sealing means 19 may comprise other types of seal. Alternatively, or in addition, a seal may be formed between the body 17 and the TPMS mounting nut 12.

As described herein, the end portion 10 may inadvertently be severed from the remainder of the valve stem 7. The valve core 15 is typically removed together with the end portion 10 of the valve stem 7. It will be appreciated that at least a portion of the second external thread 11 is removed when the end portion 10 of the valve stem 7 is severed. The second end 17b of the body 17 comprises a replacement external thread 31 for replacing the second external thread 11. The replacement external thread 31 is configured to cooperate with the valve cap 14.

If the valve stem 7 is severed, the tyre 6 deflates and cannot be re-inflated since the valve core 15 is missing. The repair apparatus 1 in accordance with the present embodiment is operable to seal the severed valve stem 7' and to provide a replacement valve core 18. The installation of the repair apparatus 1 will now be described with reference to the accompanying figures. The repair apparatus 1 is aligned with the TPMS module 2 such that the severed valve stem 7' locates within the inlet 25 of the supply conduit 20. The body 17 of the repair apparatus 1 is rotated such that the external thread 23 engages the first internal thread 13 formed in the TPMS mounting nut 12. The sleeve 26 locates between the severed valve stem 7' and the TPMS mounting nut 12. The body 17 is rotated until the annular shoulder 24 engages the TPMS mounting nut 12. The repair apparatus 1 may thereby be fastened to the TPMS module 2. The O-ring 28 disposed in the annular recess 30 engages the outer sidewall 29 of the valve stem 7 and forms a seal around the outside of the valve stem 7. The repair apparatus 1 comprises a replacement valve core 18 which is operative to seal the tyre 6. An inflating apparatus may be connected to the second end 17b of the body 17. The replacement valve core 18 is opened by the inflating apparatus in conventional manner to enable compressed air to be supplied to the tyre 6. When the inflating apparatus is removed, the replacement valve core 18 closes, thereby sealing the tyre 6. It will be

appreciated, therefore, that the tyre 6 may be re-inflated once the repair apparatus 1 has been installed.

5 It will be appreciated that various changes and modifications may be made to the repair apparatus 1 described herein without departing from the scope of the present invention.

10 The repair apparatus 1 has been described herein as mounting directly to the TPMS mounting nut 12. This mounting arrangement requires that a section of the first internal thread 13 on the TPMS mounting nut 12 is exposed (i.e. extends beyond the first external thread 9 provided on the base portion 8 of the valve stem 7). In certain arrangements, for example motorcycle wheels, the first external thread 9 may extend beyond the TPMS mounting nut 12. Thus, there may not be an exposed section of the first internal thread 13 on which to mount the repair apparatus 1. The body 17 may be modified, for example by providing an internal (female) thread at said first end 17a for mounting directly to the severed valve stem 7' rather than the TPMS mounting nut 12.

15 Alternatively, an adaptor (not shown) may be used to enable the repair apparatus 1 to be mounted to the first external thread 9. The adaptor may comprise first adaptor mounting means for mounting the adaptor to the severed valve stem 7'. The first adaptor mounting means may comprise a first internal thread for engaging the first external thread 9. The adaptor may comprise second adaptor mounting means for mounting the repair apparatus 1. The second adaptor mounting means may comprise a second internal thread for engaging the external thread 23 provided on the repair apparatus 1. The first and second internal threads on the adaptor may have the same size. Indeed, the adaptor may comprise a single continuous thread extending along its length. In certain embodiments, the first and second internal threads on the adaptor may have different sizes. In use, the adaptor may be screwed onto the valve stem 7 to enable the repair apparatus 1 to be installed. The adaptor is fitted without removing the TPMS mounting nut 12. The adaptor may be tightened against the TPMS mounting nut 12 or against a shoulder formed on the valve stem 7. It will be appreciated that in this arrangement the sleeve 26 locates between the severed valve stem 7' and the adaptor. At least in certain embodiments, the sealing means 19 in the repair apparatus 1 forms a seal with a sidewall of the severed valve stem 7'. Alternatively, or in addition, the adaptor may comprise sealing means for engaging a sidewall of the valve stem 7 to form a seal. The repair apparatus 1 and the adaptor may be supplied in a kit.

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CLAIMS:

1. A repair apparatus for repairing a severed valve stem, the repair apparatus comprising:
 - 5 a body having a supply conduit;
 - sealing means for forming a seal with the severed valve stem; and
 - mounting means for mounting the repair apparatus to a mounting nut disposed on the severed valve stem.
- 10 2. A repair apparatus as claimed in claim 1, wherein, in use, the mounting nut mounts the severed valve stem to a wheel.
3. A repair apparatus as claimed in claim 2, wherein the severed valve stem is a part of a tyre pressure monitoring system (TPMS) module and the mounting nut is configured to
15 mount the TPMS module to the wheel.
4. A repair apparatus as claimed in claim 2 or claim 3, wherein the mounting means comprises an external thread for engaging an internal thread of said mounting nut.
- 20 5. A repair apparatus as claimed in claim 4, wherein the external thread is adapted to engage an exposed portion of the internal thread when the mounting nut is disposed on the severed valve stem.
6. A repair apparatus as claimed in claim 4 or claim 5, wherein the external thread is
25 formed on a sleeve configured to locate between the severed valve stem and the mounting nut.
7. A repair apparatus as claimed in any one of the preceding claims, wherein the sealing means comprises an annular seal for engaging the severed valve stem.
- 30 8. A repair apparatus as claimed in any one of the preceding claims, wherein the body comprises an aperture for receiving the end of the severed valve stem.
9. A repair apparatus as claimed in any one of the preceding claims, wherein the
35 aperture forms an inlet of the supply conduit.

10. A repair apparatus as claimed in any one of the preceding claims, wherein the valve core is disposed in the supply conduit.

11. A vehicle wheel in combination with a repair apparatus as claimed in any one of the preceding claims.

12. A vehicle having one or more repair apparatus as claimed in any one of claims 1 to 10.

13. A kit comprising a repair apparatus and an adaptor for mounting to a severed valve stem, wherein the repair apparatus comprises mounting means for mounting the repair apparatus to the adaptor.

14. A method of repairing a severed valve stem, the method comprising:
locating a repair apparatus on the severed valve stem; and
forming a seal between the severed valve stem and the repair apparatus;
wherein a mounting nut is disposed on the severed valve stem and the method comprises mounting the repair apparatus without removing the mounting nut.

15. A method as claimed in claim 14 comprising mounting the repair apparatus to the mounting nut.

16. A method as claimed in claim 15, wherein the mounting means comprises an external thread formed on a sleeve for engaging an internal thread of said mounting nut.

17. A method as claimed in 16, wherein the method comprises locating the sleeve between the severed valve stem and the mounting nut.

18. A method as claimed in claim 14 comprising mounting the repair apparatus to the severed valve stem.

19. A method as claimed in claim 18, wherein the repair apparatus comprises an internal thread and the method comprises screwing the repair apparatus onto an exposed section of thread formed on the severed valve stem.

20. A method as claimed in any one of claims 14 to 19, wherein the severed valve stem is a part of a tyre pressure monitoring system (TPMS) module and the mounting nut is configured to mount the TPMS module to the wheel.

5 21. A method as claimed in any one of claims 14 to 20, wherein the repair apparatus comprises an annular seal which forms the seal with the severed valve stem when the repair apparatus is located on the severed valve stem.

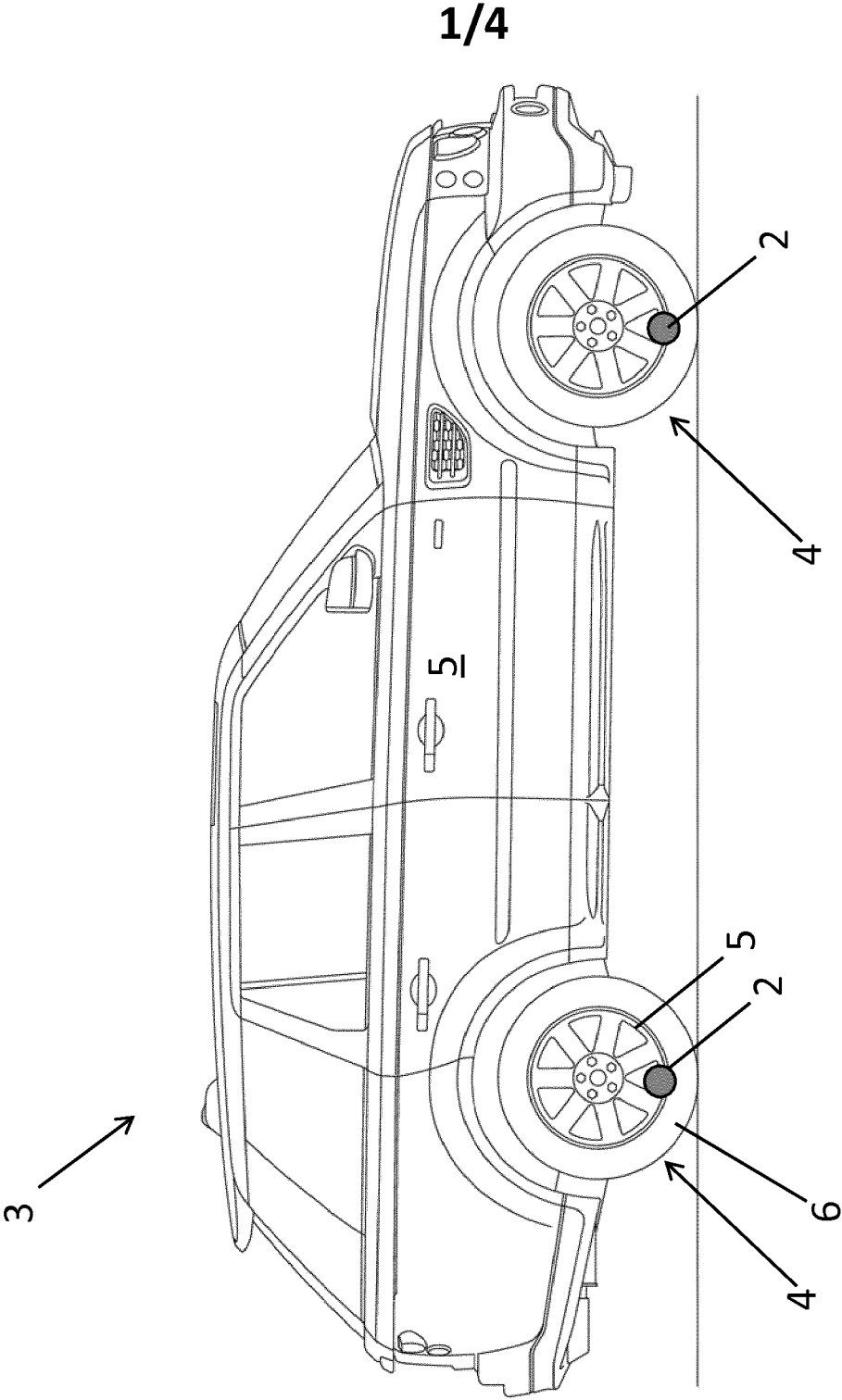
10 22. A repair apparatus substantially as herein described with reference to the accompanying figures.

23. A tyre pressure monitoring system (TPMS) module substantially as herein described with reference to the accompanying figures.

15 24. A wheel substantially as herein described with reference to the accompanying figures.

25. A vehicle substantially as herein described with reference to the accompanying figures.

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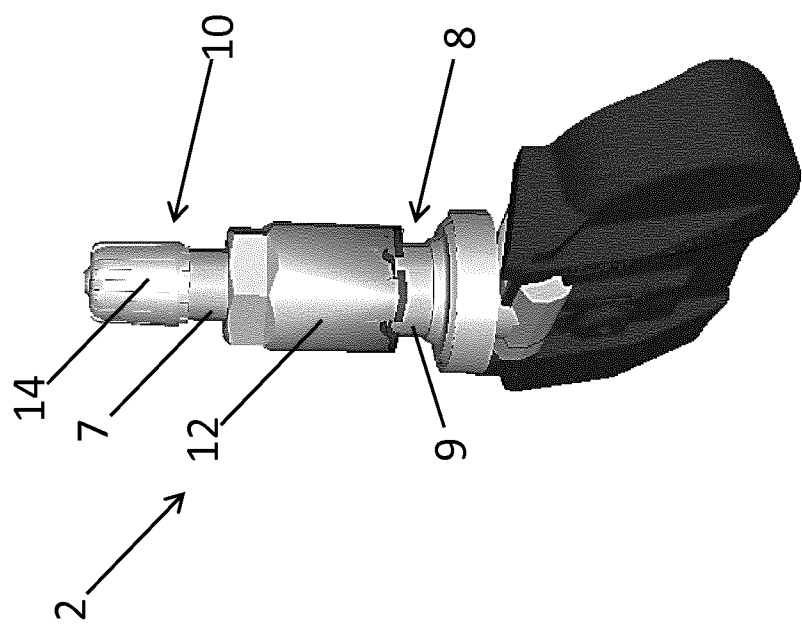


FIG. 2

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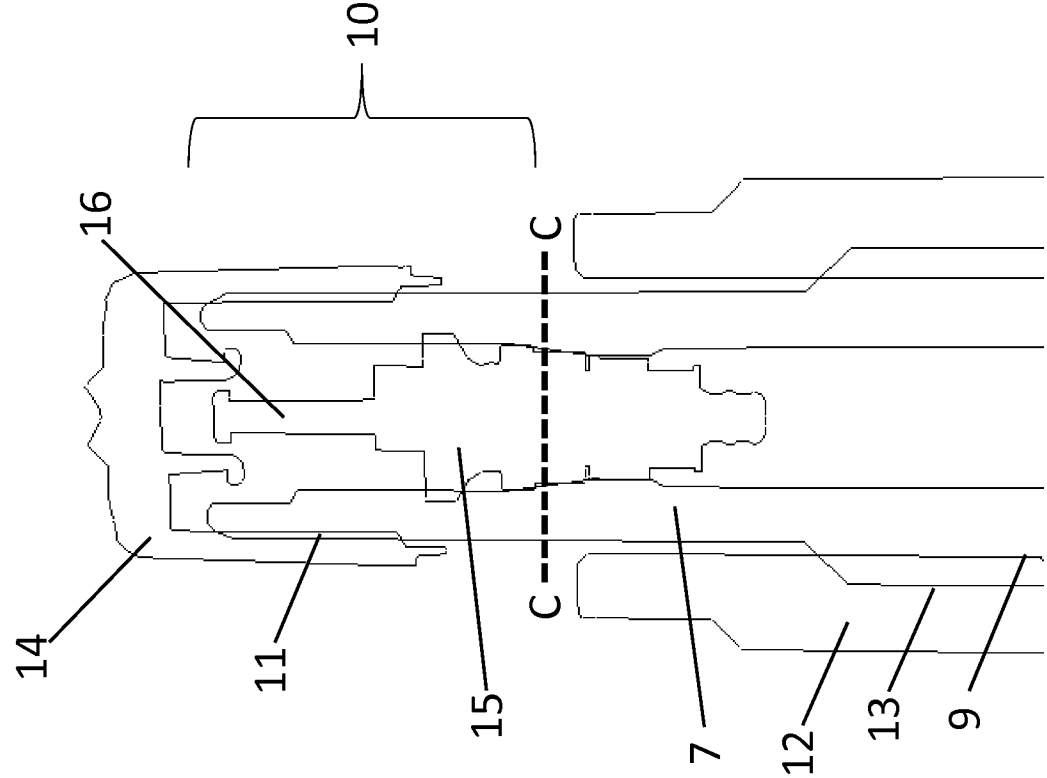


FIG. 3

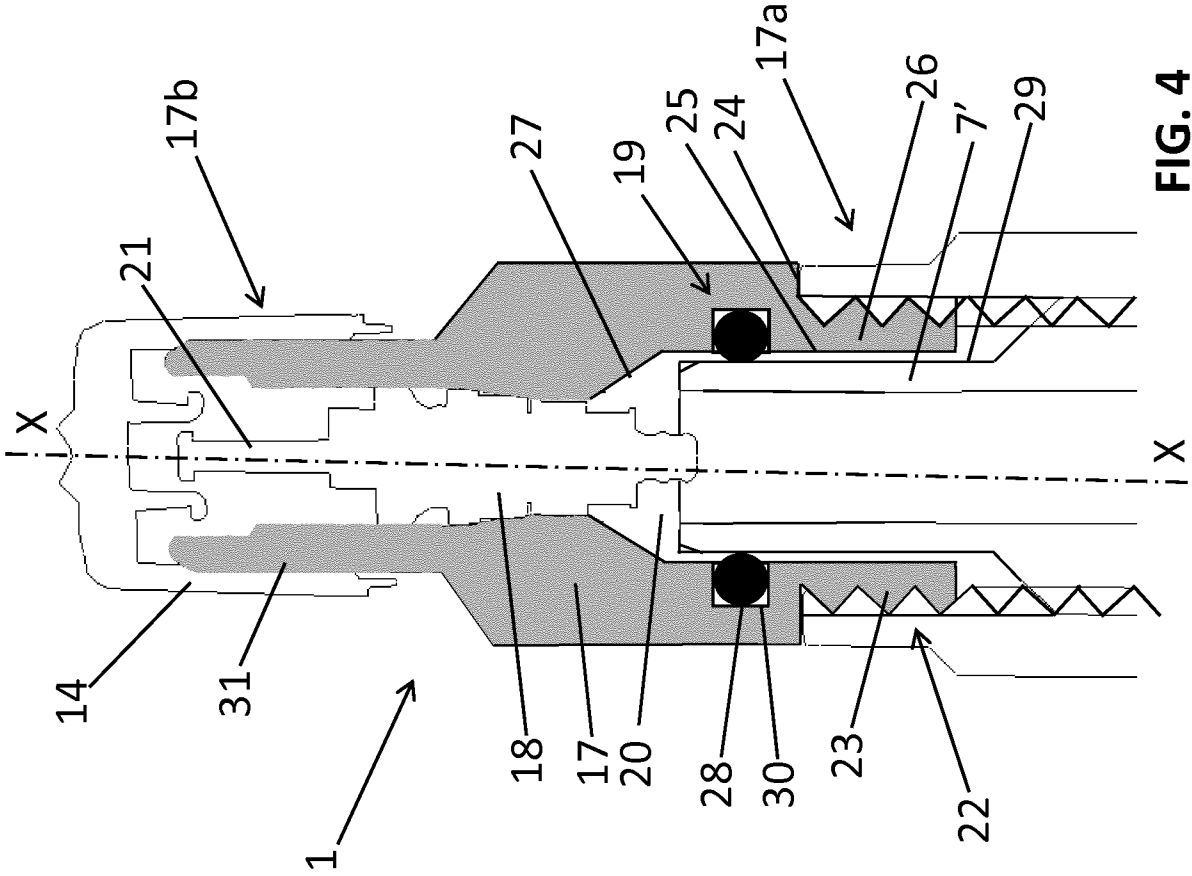


FIG. 4

INTERNATIONAL SEARCH REPORT

International application No

PCT/EP2016/080691

A. CLASSIFICATION OF SUBJECT MATTER

INV. B60C23/04 B60C29/06 F16K15/20 F16K43/00 B60C25/18
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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)

B60C F16K B25B B23P

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 A	US 2 652 858 A (SNYDER ROBERT V) 22 September 1953 (1953-09-22) column 1, line 34 - column 3, line 49 figures -----	1,7-15, 18,21-25 16,17
X	US 2 355 871 A (KRAFT HERMAN T) 15 August 1944 (1944-08-15) page 1, right-hand column, line 64 - page 2, left-hand column, line 64 figures -----	1,7-14, 18,21-25
X	CN 103 867 762 A (HANGZHOU HAMATON TYRE VALVES CO LTD) 18 June 2014 (2014-06-18) figures -----	1-14,18, 20,21
X	US 1 469 966 A (CHARLES SCHWEINERT MAXIMILIAN) 9 October 1923 (1923-10-09) the whole document ----- -/-	1,8, 10-14,18



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

9 March 2017

Date of mailing of the international search report

21/03/2017

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Authorized officer

Avisse, Marylène

INTERNATIONAL SEARCH REPORT

International application No

PCT/EP2016/080691

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	CN 203 752 809 U (HANGZHOU HAMATON TYRE VALVES CO LTD) 6 August 2014 (2014-08-06) figures -----	1-6, 8-14, 18-20, 22-25
X	US 2013/068318 A1 (KLISKEY ROGER [US] ET AL) 21 March 2013 (2013-03-21) paragraph [0018] - paragraph [0031] figures -----	1-5, 10-14, 18,20, 22-25
X	US 2014/014197 A1 (RENAKER ROBERT [US] ET AL) 16 January 2014 (2014-01-16) abstract; figures paragraph [0014] paragraph [0030] - paragraph [0037] -----	1,8-14, 18,19, 22-25
X	US 1 875 874 A (JOHNSON CHARLES H) 6 September 1932 (1932-09-06) page 1, line 36 - line 75 figures -----	1,8-13

INTERNATIONAL SEARCH REPORT

International application No.
PCT/EP2016/080691

Box No. II Observations where certain claims were found unsearchable (Continuation of item 2 of first sheet)

This international search report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. ☐ Claims Nos.:
because they relate to subject matter not required to be searched by this Authority, namely:
2. ☐ Claims Nos.:
because they relate to parts of the international application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out, specifically:
3. ☐ Claims Nos.:
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

Box No. III Observations where unity of invention is lacking (Continuation of item 3 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:

see additional sheet

1. ☐ As all required additional search fees were timely paid by the applicant, this international search report covers all searchable claims.
2. ☒ As all searchable claims could be searched without effort justifying an additional fees, this Authority did not invite payment of additional fees.
3. ☐ As only some of the required additional search fees were timely paid by the applicant, this international search report covers only those claims for which fees were paid, specifically claims Nos.:
4. ☐ No required additional search fees were timely paid by the applicant. Consequently, this international search report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:

Remark on Protest

- ☐ The additional search fees were accompanied by the applicant's protest and, where applicable, the payment of a protest fee.
- ☐ The additional search fees were accompanied by the applicant's protest but the applicable protest fee was not paid within the time limit specified in the invitation.
- ☐ No protest accompanied the payment of additional search fees.

FURTHER INFORMATION CONTINUED FROM PCT/ISA/ 210

This International Searching Authority found multiple (groups of) inventions in this international application, as follows:

1. claims: 1-25

Repair apparatus, kit and method for repairing a severed valve stem

1.1. claims: 1-12, 22-25

Repair apparatus for repairing a severed valve stem, vehicle wheel comprising said repair apparatus or vehicle comprising said repair apparatus

1.2. claim: 13

Kit comprising a repair apparatus and an adaptor

1.3. claims: 14-21

A method of repairing a severed valve stem comprising the steps of locating a repair apparatus on the severed valve stem wherein mounting of the repair apparatus occurs without removing a mounting nut disposed on the severed valve stem

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No

PCT/EP2016/080691

Patent document cited in search report		Publication date	Patent family member(s)	Publication date
US 2652858	A	22-09-1953	NONE	
US 2355871	A	15-08-1944	NONE	
CN 103867762	A	18-06-2014	NONE	
US 1469966	A	09-10-1923	NONE	
CN 203752809	U	06-08-2014	NONE	
US 2013068318	A1	21-03-2013	NONE	
US 2014014197	A1	16-01-2014	NONE	
US 1875874	A	06-09-1932	NONE	