US 20080302425A1

(19) United States
(12) Patent Application Publication
Hettle et al.
(10) Pub. No.: US 2008/0302425 A1
(43) Pub. Date: Dec. 11, 2008

(54) **FORMED FLANGE FOR PRESSURE MONITORING VALVE STEM MOUNT**

(75) Inventors: **Michael Hettle**, Onsted, MI (US); **Jean-Christophe Deniau**, Fenton, MI (US); **Franz Hillenmayer**, Burglengenfeld (DE); **Christain Kempf**, Toulouse (FR); **Francois Gory**, Tournefeuille (FR)

Correspondence Address:
CARLSON, GASKEY & OLDS, P.C.
400 WEST MAPLE ROAD, SUITE 350
BIRMINGHAM, MI 48009 (US)

(73) Assignee: **CONTINENTAL AUTOMOTIVE SYSTEMS US, INC.**, Auburn Hills, MI (US)

(21) Appl. No.: **12/133,693**

(22) Filed: **Jun. 5, 2008**

Related U.S. Application Data

(60) Provisional application No. 60/967,113, filed on Aug. 31, 2007, provisional application No. 60/937,410, filed on Jun. 27, 2007, provisional application No. 60/933,378, filed on Jun. 5, 2007.

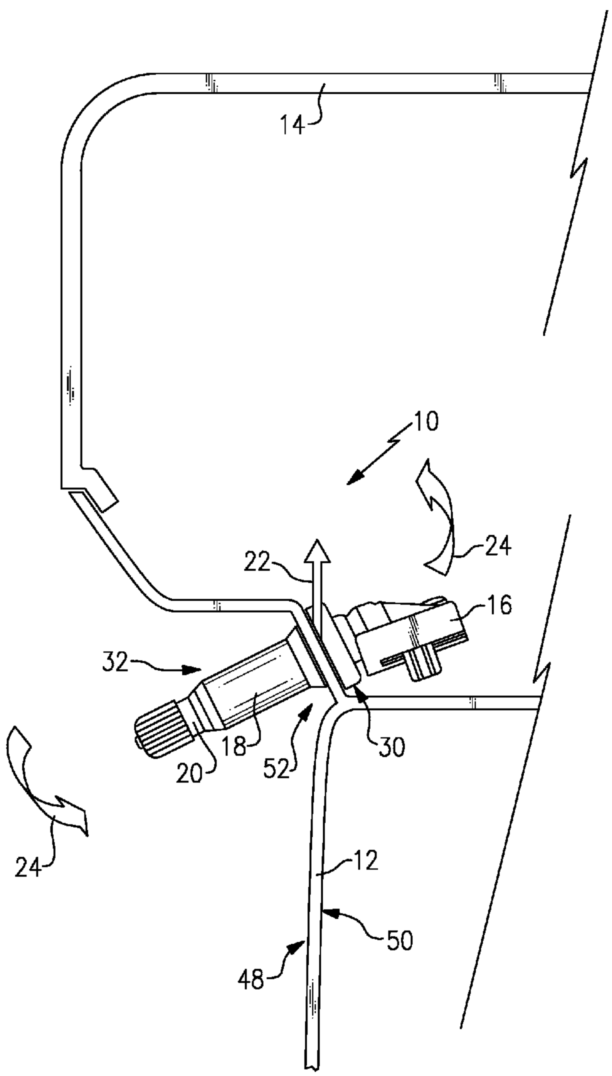
Publication Classification

(51) **Int. Cl.**
F16K 15/20 (2006.01)

(52) **U.S. Cl.** **137/227**

(57) **ABSTRACT**

A valve stem for mounting and supporting a tire pressure monitoring assembly includes a flange formed after insertion into the wheel rim for preventing movement caused by forces generated during wheel rotation.



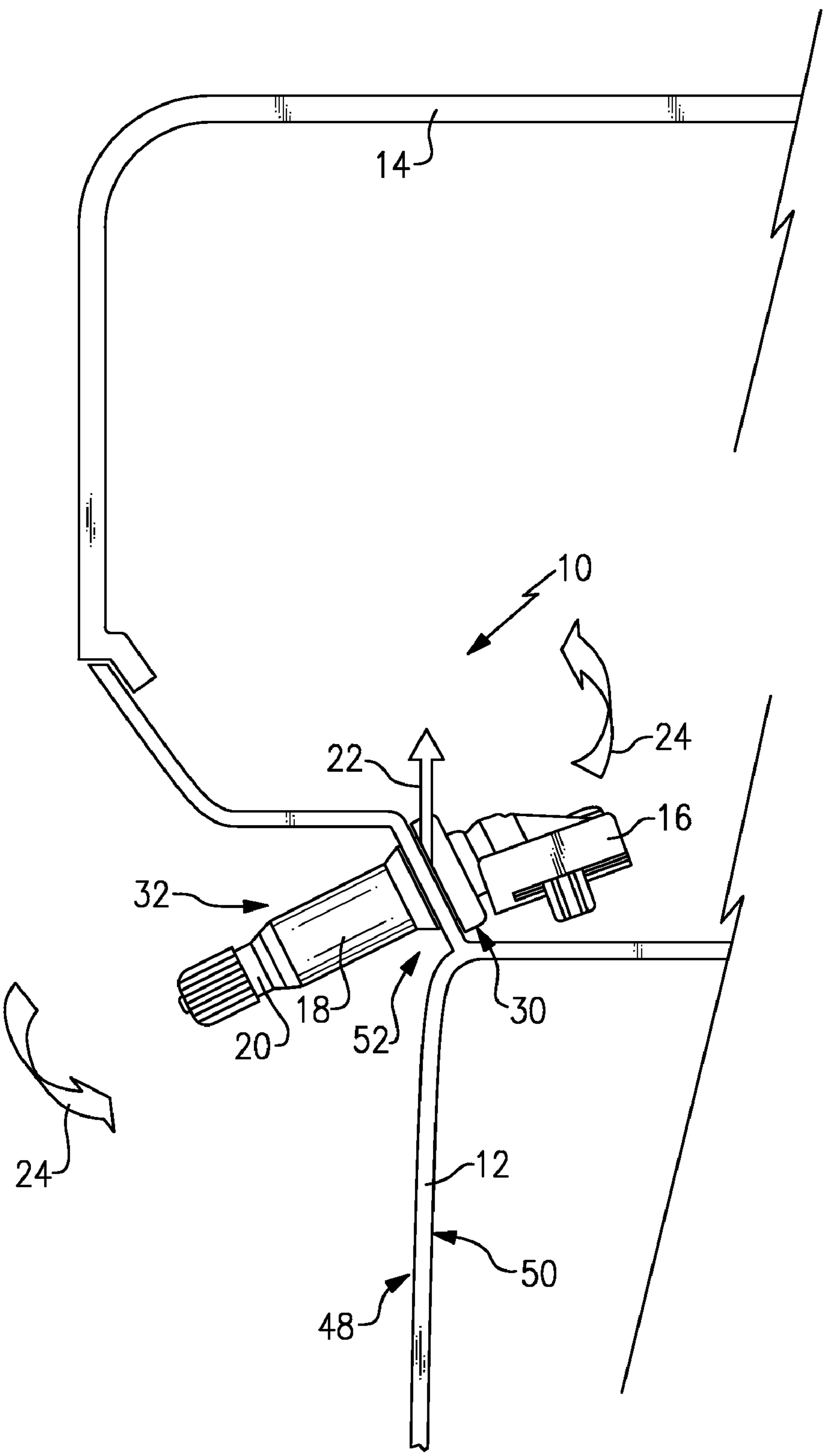
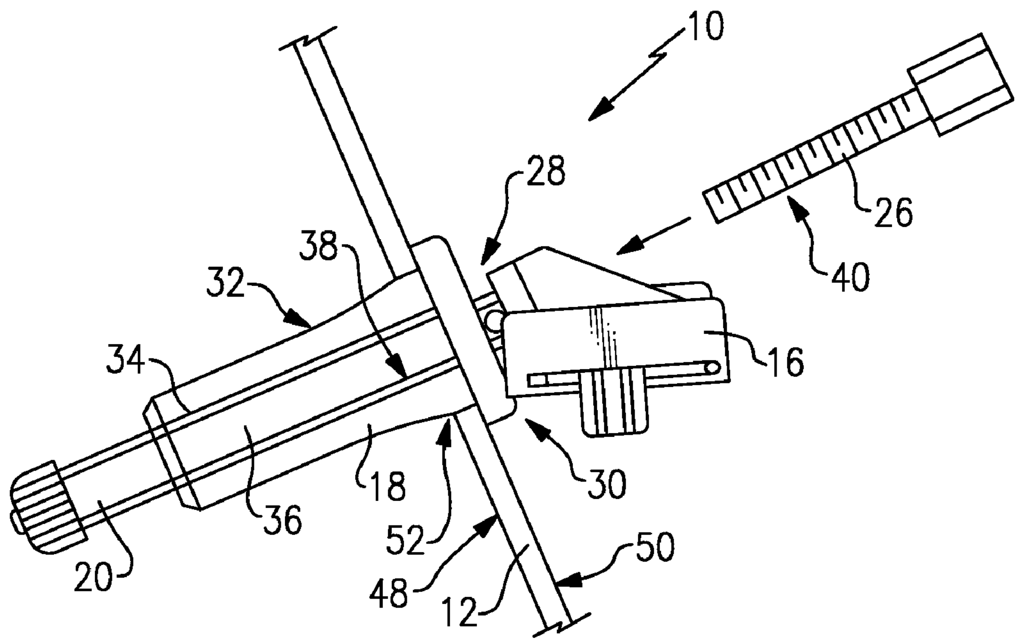


FIG.1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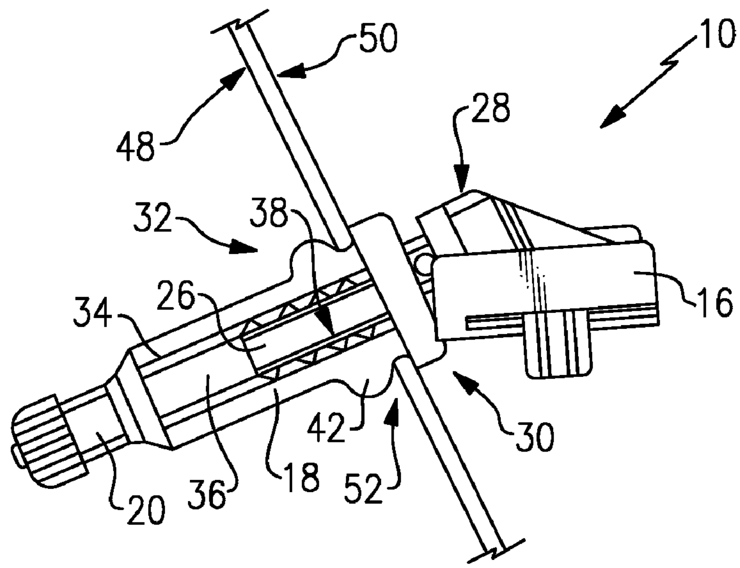
28
26
40
38
32
34
16
30
18
36
52
20
48
12
50

FIG.2


10
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32
38
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42
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36
18
52

FIG.3

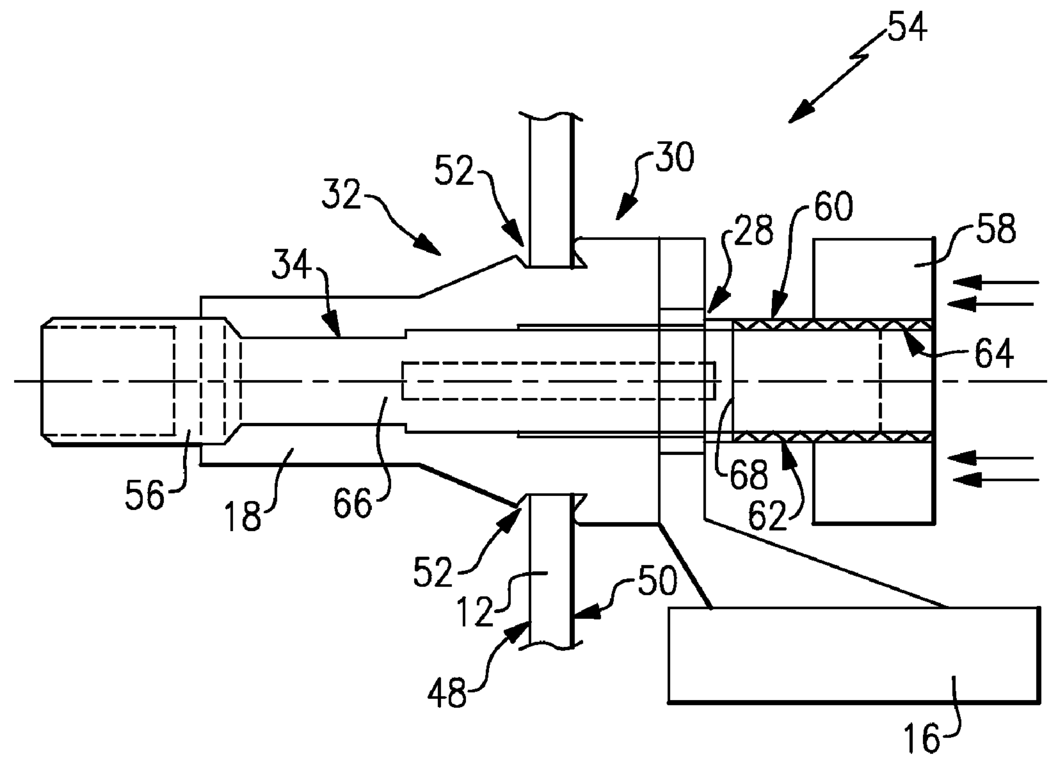

54
30
52
32
60
28
58
34
64
56
18
66
68
62
52
12
50
48
16

FIG.4

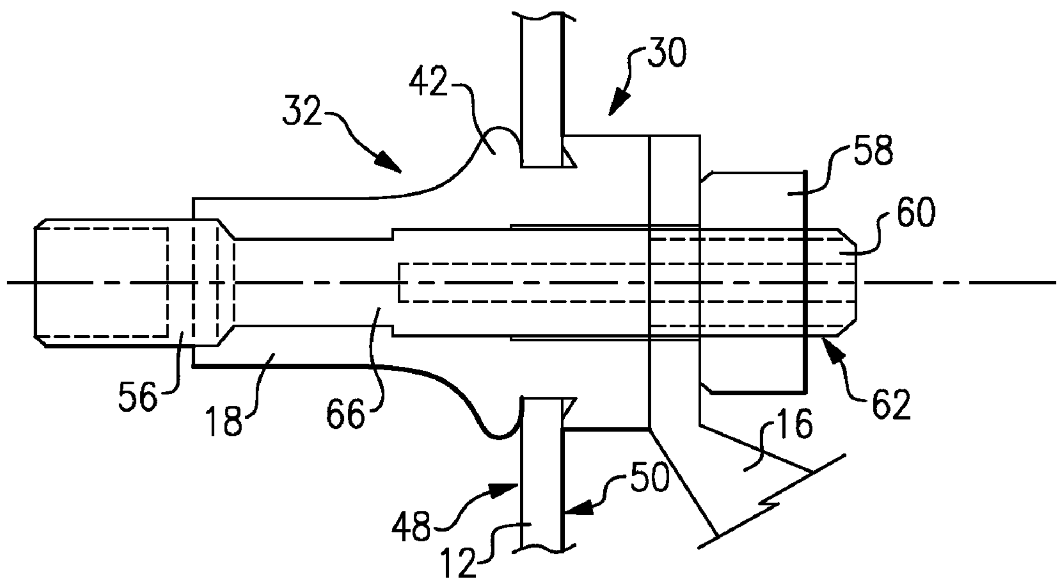
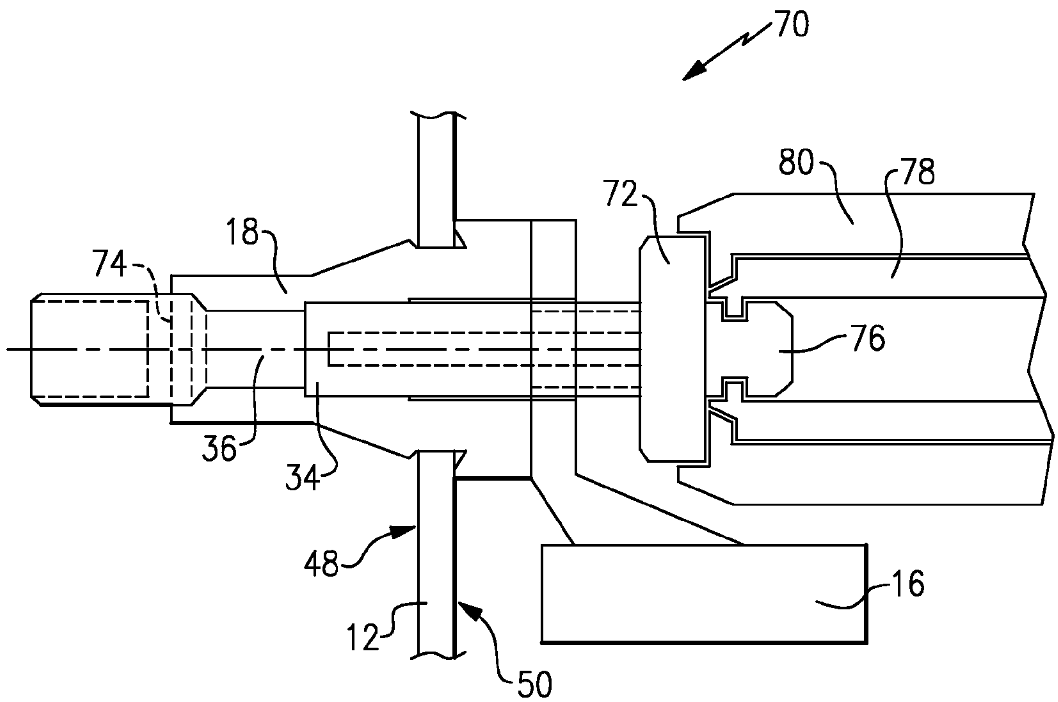

30
42
32
58
60
56
18
66
16
62
50
48
12

FIG.5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80
78
72
18
74
76
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16
12
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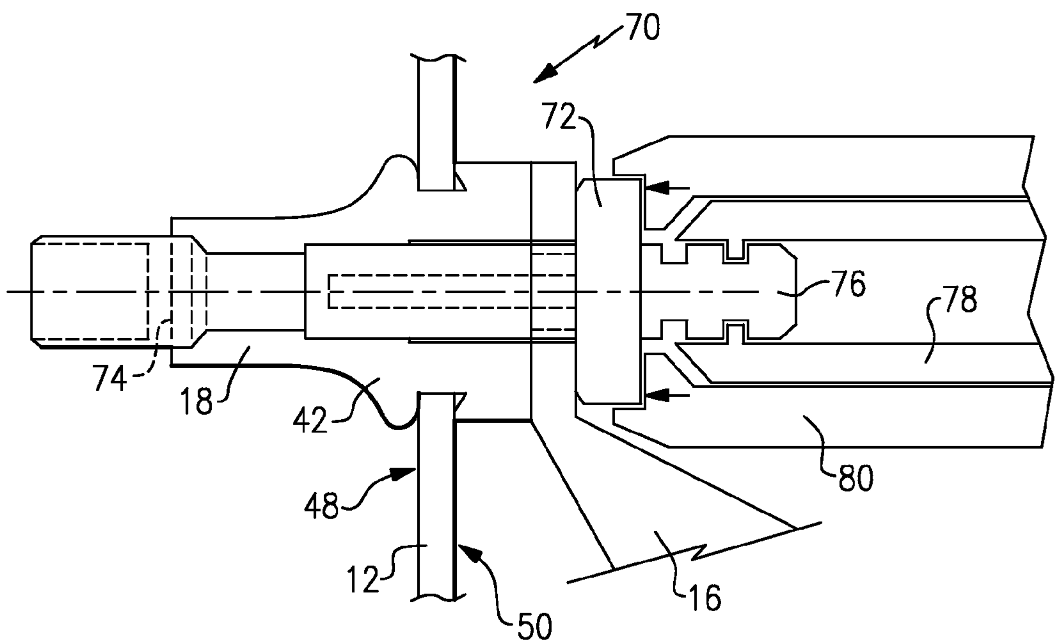
FIG.6


70
72
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42
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FIG.7

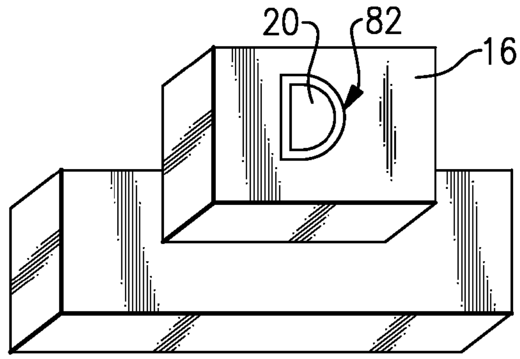

FIG.8

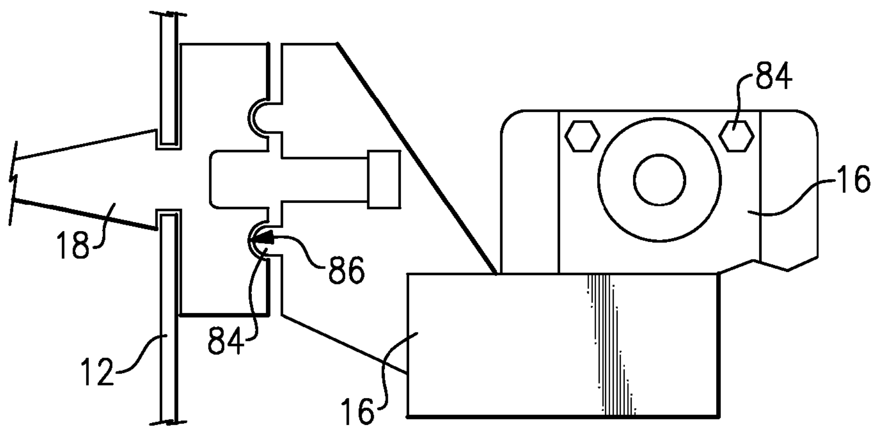

FIG.9

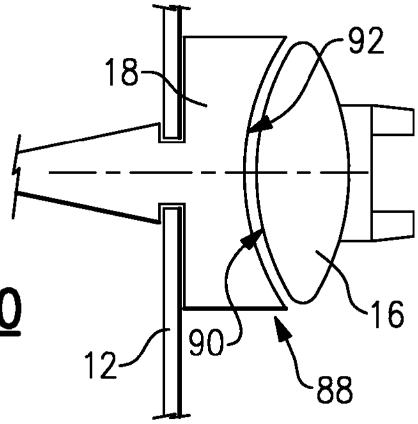

FIG.10

FORMED FLANGE FOR PRESSURE MONITORING VALVE STEM MOUNT

CROSS REFERENCE TO RELATED APPLICATION

[0001] The application claims priority to U.S. Provisional Application Nos. 60/967,113, filed Aug. 31, 2007; 60/937,410, filed Jun. 27, 2007; and 60/933,378 filed on Jun. 5, 2007.

BACKGROUND OF THE INVENTION

[0002] A disclosed example valve stem includes a deformable housing for securement within a wheel rim. More particularly, the disclosed example valve stem includes features for securing a valve stem supporting a tire pressure monitoring sensor within a wheel rim.

[0003] Tire pressure monitoring sensors can be secured within a wheel rim to a valve stem. A conventional valve stem is received within an opening of the wheel rim and secured therein by an elastically deformable rubber housing. Disadvantageously, the weight added by a tire pressure monitoring device attached to the valve stem can cause undesired deformation during rotation of the wheel rim. Centrifugal forces acting on the tire pressure monitoring device can be transmitted back to the rubber housing and cause deformation that in turn disrupts the desired air tight seal with the wheel rim.

[0004] Accordingly, it is desirable to design and develop a method and device for securing a tire pressure monitoring device to a valve stem that does not result in loss of the desired seal.

SUMMARY OF THE INVENTION

[0005] An example valve stem for mounting and supporting a tire pressure monitoring assembly includes a flange formed after insertion into the wheel rim for preventing movement caused by forces generated during wheel rotation.

[0006] An example tire pressure monitoring (TPM) assembly is mounted to a valve stem received within an opening of the wheel rim. The valve stem includes an inner portion disposed within the rim and an outer portion that extends outward from the rim. A valve body is disposed within the valve stem and provides an air passage through the rim for filling the tire. The valve stem includes the inner portion that abuts an inner surface of the rim. A flange is formed in the valve stem to expand against an outer surface of the wheel rim. In one disclosed example, a screw extends though the housing and engages internal threads formed in the valve body. Tightening of the thread pulls the valve body inwardly to cause deformation of the valve stem to form a flange abutting the outer surface of the wheel rim.

[0007] In another disclosed example, the valve body includes external threads on a portion that extends through the sensor body. A nut is then either pushed or threaded on to provide the desired deformation of the valve stem to form the desired formed flange that secures the valve stem to the wheel rim. Accordingly, the example valve stem flange formed TPM assemblies provide a robust valve stem wheel rim interface that prevents leakage caused by force generated by rotation of the wheel rim.

[0008] These and other features of the present invention can be best understood from the following specification and drawings, the following of which is a brief description.

BRIEF DESCRIPTION OF THE DRAWINGS

[0009] FIG. **1** is a schematic view of an example tire pressure monitoring assembly mounted within a wheel.

[0010] FIG. **2** is a schematic view of an example tire pressure monitoring assembly prior formation of the mounting flange.

[0011] FIG. **3** is a schematic view of an example tire pressure monitoring assembly mounted within to a wheel rim.

[0012] FIG. **4** is a schematic view of another example tire pressure monitoring assembly prior to formation of the mounting flange.

[0013] FIG. **5** is a schematic view of the example tire pressure monitoring assembly of FIG. **4** mounted to the wheel rim.

[0014] FIG. **6** is a schematic view of another tire pressure monitoring assembly including a push on nut.

[0015] FIG. **7** is a schematic view of the tire pressure monitoring assembly of FIG. **6** mounted to the wheel rim.

[0016] FIG. **8** is a schematic view of an example anti-rotation feature.

[0017] FIG. **9** is another schematic view of another example anti-rotation feature.

[0018] FIG. **10** is a schematic view of yet another example anti-rotation feature.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

[0019] Referring to FIG. **1** a tire pressure monitoring sensor (TPM) assembly **10** is mounted to a wheel rim **12**. The rim **12** supports a tire **14** and the TPM assembly **10** includes a sensor housing **16** that includes a sensor and a transmitter for measuring and communicating conditions within the tire **14**.

[0020] The TPM assembly **10** includes a valve stem **18** comprised of an elastic material such as for example rubber. The valve stem **18** includes an inner portion **30** disposed within the rim **12** and outer portion **32** that extends outward from the rim **12**. A valve body **20** is disposed within the valve stem **18** and provides an air passage through the rim **12** for filling the tire **14**.

[0021] The sensor housing **16** is supported within the rim **12** by the valve stem **18** and is susceptible to movement responsive to rotation. A centripetal force in a direction indicated at **22** is generated by rotation of the rim **12**. The force **22** is exerted on the sensor housing **16** that causes movement in a direction indicated by arrows **24**. This twisting movement is not desirable and is substantially reduced and prevented by the disclosed TPM assembly **10** and mounting methods.

[0022] The valve stem **18** includes the inner portion **30** that abuts an inner surface **40** of the rim **12**. A flange is formed in the valve stem **18** to expand against an outer surface **48** of the wheel rim **12**.

[0023] Referring to FIG. **2**, with continued reference to FIG. **1**, the example TPM assembly **10** includes a screw **26** with threads **40**. The valve body **20** defines the bore **36** and includes internal threads **38** that engage the threads **40** of the screw **26**. The valve stem **18** is received through an opening **52** in the rim **12** such that the inner portion **30** abuts the inner surface **50**. The outer portion **32** is a clearance to slight interference fit with the opening **52**. The slight interference fit is such that the valve stem **18** will remain within the opening **52**, but is not yet substantial enough to prevent forces generated during rotation from distorting a desired seal with the rim **12**.

[0024] The housing **16** includes an opening **28** though which the screw **26** extends to engage the threads **38** of the valve body **20**. The outer portion **32** of the valve stem **18** includes a thickness that provides for a desired flexibility and deformability. Tightening of the screw **26** within the valve body **20** pulls the valve body **20**, and thereby the valve stem **18** toward the rim **12** to buckle and deform the outer portion **32** to form a flange against the outer surface **48** of the wheel rim **12**.

[0025] Referring to FIG. **3** with continued reference to FIGS. **1** and **2**, the screw **26** is engaged with the threads **38** of the valve body **20** and tightened to cause the outer portion **32** of the valve stem **18** to buckle and form a flange portion **42**. The flange portion **42** secures the outer portion **32** against the outer surface of the wheel rim **12**. The flange portion **42** comprises the buckled and deformed portion of the valve stem **18** caused by tightening and securing of the screw **26**.

[0026] The elastic characteristics of the valve stem **18** creates a compression biasing force between the formed flange **42** and the inner portion **32** that counters forces generated during rotation of the wheel rim **12**. Further, because the compression biasing forces are only exerted after the valve stem **18** is received within the opening **52**, the compression forces holding the valve stem **18** can be much higher than if a flange is formed prior to insertion and required to be pushed through the opening **52**. As appreciated, conventional valve stem mounting methods simply force the elastic valve stem **18** through the opening. Accordingly, the amount of force available for pushing the flange through the opening limits the size of the flange. In the disclosed method, because the flange **42** is formed after insertion through the opening **52**, it can be larger and thereby provide a greater compression to hold the valve stem **18** in place.

[0027] Referring to FIGS. **4** and **5**, another TPM assembly **54** includes a valve body **56** that includes an inner portion **60** that extends outwardly from the valve stem **18**. The inner portion **60** of the valve body **56** includes eternal threads **62**. The sensor housing **16** includes an opening **28** through which the inner portion **60** extends. A nut **58** includes internal threads **64** that engage the threads **62**. Tightening of the nut **58** secures the sensor housing **16** to the valve body **56**.

[0028] Further tightening of the nut **58** causes deformation of the outer portion **32** of the valve stem **18** thereby forming the flange **42**. The flange **42** comprises buckled material of the outer portion **32** that abuts against the outer surface **48** of the wheel rim **12**. The flange **42** compresses against the wheel rim **12** to hold and secure the valve stem **18** in place. The increased compressive forces that are exerted and formed by tightening the nut **58** result in an improved seal that is substantially resistant to movements caused by rotation of the wheel.

[0029] The threads **62** are provided along a defined length such that the nut **58** can only be tightened a desired amount. Therefore, during installation, the nut **58** is tightened until the threads end. The end of the threads corresponds to a tightened amount that provides a desired flange **42** and that also provides a desired compression against the wheel rim **12**. The defined length of the threads provides a desired fit and substantially prevents over tightening.

[0030] Referring to FIG. **6**, another example TPM assembly **70** includes the valves stem **18** with a valve body **74**. The valve body **74** includes an inner portion **76**. The inner portion **76** extends outwardly from the valve stem **18** and extends into an interior portion of the wheel rim **12**. The inner portion **76** includes features **82** for engaging a push on nut **72**. The example features **82** comprise threads configured to allow pushing on of the nut **72** and threading off for removal of the TPM assembly **70**. The engagement features could also comprise barbs adapted to engage and secure the nut in a desired position.

[0031] Pushing of the nut **72** onto the valve body **74** causes the desired deformation of the outer portion **32** of the valve stem **18**, thereby providing the desired compressive forces to hold the valve stem **18** within the opening **52**.

[0032] Installation of the example TPM assembly **70** is accomplished with a clamping tool **78** and a pushing tool **80**. Installation proceeds by initially inserting the valve stem **18** and valve body **74** through the opening **52** in the wheel rim **12**. The amount of force required for this step is substantially reduced as compared to conventional methods because the outer flange is not yet formed.

[0033] The nut **72** can be pre-assembled to the valve body **74** to ease assembly operations. Once the valve stem **18** is disposed within the opening **52**, the clamping tool **78** and pushing tool **80** can be engaged to the valve body **74** and the nut **72** respectively. As appreciated, is also within the contemplation of this invention that the clamping and pushing tool comprises a portion of the tool utilized to insert the valve stem **18** within the wheel rim **12**. Further, other configuration as would be understood by a worker experienced in this field is also within the contemplation of this invention.

[0034] Referring to FIG. **7**, with continued reference to FIG. **6**, installation is completed by concurrently pushing on the nut **72**, and holding, or pulling on the valve body **74**. The rear portion **76** of the valve body includes notch features that can be configured to break away under a desired load. Breaking way of the notch features on the rear portion **76** of the valve body provides a limit on the load that can be exerted by the nut **72**. The resulting fit of the nut **72** against the housing **16** and the inner portion **30** of the valve stem **18** causes a buckling that forms the flange **42**. The flange **42** is formed to abut against the outer surface **48** of the wheel rim **12**. The compression provided by the nut **72** is maintained until the nut **72** is removed. The example nut **72** is pushed on and threaded off.

[0035] Referring to FIG. **8** and back to FIG. **2**, a rear end view of the interface between the housing **16** and the valve body **20** of FIG. **2** is shown with an anti-rotational feature that includes the valve body **20** with a D-shaped cross-section **82** that corresponds with the opening **28**. The keyed corresponding shapes of the valve body **20** and the sensor housing **16** substantially prevent relative rotation of the sensor housing **16** relative to the valve stem **18**.

[0036] Referring to FIG. **9**, another anti-rotation configuration include tabs **84** on the sensor housing **16** that engage corresponding indentations **86** within the valve stem **18**. The tabs **84** engage the indentations **86** to provide a positive locating feature that prevents relative rotation between the valve stem **18** and the sensor housing **16**.

[0037] Referring to FIG. **10**, another anti-rotation interface between the valve stem **18** and the housing **16** include interlocking shapes **88** that prevent relative rotation. The example interlocking shapes **88** include a curved longitudinal surface **90** on the sensor housing **16** that fits within a concave portion **92** of the valve stem **18**. The interlocking shapes **88** thereby prevent relative rotation between the valve stem **18** relative to the sensor housing **16**. Further, the example interlocking features also facilitate an angular adjustment of the housing angle relative to the valve stem to accommodate various wheel rim angles with a single housing interface configuration. As is appreciated, the example interlocking shapes **88** can be reversed with the concave portion on the sensor housing **16** and the curved portion on the valve stem **18**. Additionally, the interlocking shapes can include other configurations that provide and maintain a desired relative orientation.

[0038] Further, as the flange is formed by compression against the wheel rim, the frictional interface between the valve stem **18** and the wheel rim substantially prevent rotation of the valve stem **18** relative to the rim **12**. Accordingly, the anti-rotation features that prevent rotation of the sensor housing **16** relative to the valve stem substantially prevent rotation of the entire TPM assembly **10**. Further, the example valve stem flange formed TPM assemblies provide a robust valve stem wheel rim interface that prevents leakage caused by force generated by rotation of the wheel rim and retention of the sensor.

[0039] Although a preferred embodiment of this invention has been disclosed, a worker of ordinary skill in this art would recognize that certain modifications would come within the scope of this invention. For that reason, the following claims should be studied to determine the true scope and content of this invention.

What is claimed is:

1. A tire pressure monitoring assembly comprising:
- an elastic valve stem including an inner portion, an outer portion and a cavity extending from the inner portion to the outer portion;
- a valve body disposed within the cavity and defining a bore;
- a fastening member including a first end engageable to the valve body and a second end engaged with the inner portion of the elastic valve stem for deforming the outer portion of the valve stem; and
- a sensor housing secured to the valve stem by the fastening member.

2. The assembly as recited in claim **2**, including an anti-rotation feature disposed between the sensor housing and at least one of the valve body and the valve stem for preventing relative rotation of the sensor housing relative to the at least one of the valve body and the valve stem.

3. The assembly as recited in claim **2**, wherein the anti-rotation feature comprise a tab on one of the valve stem and the sensor housing and an indentation receiving the tab on the other of the valve stem and the sensor housing.

4. The assembly as recited in claim **2**, wherein anti-rotation feature comprise a key on the valve body that corresponds to a receiving feature of the sensor housing.

5. The assembly as recited in claim **2**, wherein the key and receiving feature provide for an angular adjustment between the valve stem and sensor housing.

6. The assembly as recited in claim **1**, wherein the bore of the valve body includes threads corresponding to threads of the fastening member.

7. The assembly as recited in claim **1**, wherein the valve body extends outwardly from the inner portion of the valve stem and includes threads on an external surface and the fastening member comprises a nut securable to the threads.

8. The assembly as recited in claim **5**, wherein the threads on the valve body include a stop that defines a desired deformation of the outer portion of the valve stem.

9. The assembly as recited in claim **1**, wherein the valve body extends outwardly from the inner portion of the valve stem and includes capture features and the fastening member comprises a push nut engageable to the capture features for holding the valve body in a secured position.

10. The assembly as recited in claim **9**, wherein the capture features comprise grooves on outer surface of the valve body engageable to threads on an inner surface of the push nut.

11. The assembly as recited in claim **10**, wherein the push nut is adapted for unthreading from the capture features.

12. The assembly as recited in claim **9**, wherein the capture features include a frangible portion that breaks away responsive to application of a desired load.

13. A method of securing a tire pressure monitoring sensor assembly to a wheel rim comprising:
- inserting a valve stem comprising an elastically deformable material through an opening in a wheel rim;
- seating an inner portion of the valve stem against an inner surface of the wheel rim; and
- deforming an outer portion of the valve stem against an outer surface of the wheel rim.

14. The method as recited in claim **13**, comprising deforming the outer portion of the valve stem by fastening a fastening member to a valve body disposed within the valve stem.

15. The method as recited in claim **14**, comprising, engaging a threaded member to a threaded portion of the valve body for compressing the outer portion of the valve stem and forming a flange in the valve stem against the outer surface of the wheel rim.

16. The method as recited in claim **14**, comprising, pulling on a valve body in a first direction aligned with the valve stem and pushing on the fastening member in a second direction opposite the first direction for forming a flange in the valve stem against the outer surface of the wheel rim.

17. The method as recited in claim **16**, wherein the fastening member comprises a push-on nut engageable to features on the valve stem for compressing the outer portion of the valve stem.

* * * * *