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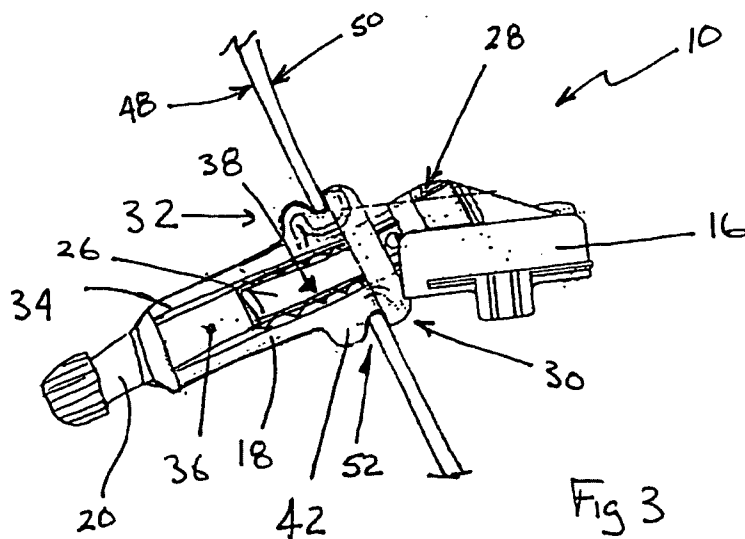
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(54) Title: FORMED FLANGE FOR PRESSURE MONITORING VALVE STEM MOUNT



(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.

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FORMED FLANGE FOR PRESSURE MONITORING VALVE STEM MOUNT

CROSS REFERENCE TO RELATED APPLICATION

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

BACKGROUND OF THE INVENTION

10 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.

 Tire pressure monitoring sensors can be secured within a wheel rim to a
15 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
20 back to the rubber housing and cause deformation that in turn disrupts the desired air tight seal with the wheel rim.

 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
25 of the desired seal.

SUMMARY OF THE INVENTION

 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.

30 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
5 through 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.

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
10 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.

15 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

20 Figure 1 is a schematic view of an example tire pressure monitoring assembly mounted within a wheel.

Figure 2 is a schematic view of an example tire pressure monitoring assembly prior formation of the mounting flange.

25 Figure 3 is a schematic view of an example tire pressure monitoring assembly mounted within to a wheel rim.

Figure 4 is a schematic view of another example tire pressure monitoring assembly prior to formation of the mounting flange.

Figure 5 is a schematic view of the example tire pressure monitoring assembly of Figure 4 mounted to the wheel rim.

30 Figure 6 is a schematic view of another tire pressure monitoring assembly including a push on nut.

Figure 7 is a schematic view of the tire pressure monitoring assembly of Figure 6 mounted to the wheel rim.

Figure 8 is a schematic view of an example anti-rotation feature.

Figure 9 is another schematic view of another example anti-rotation feature.

5 Figure 10 is a schematic view of yet another example anti-rotation feature.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring to Figure 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
10 includes a sensor housing 16 that includes a sensor and a transmitter for measuring and communicating conditions within the tire 14.

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
15 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.

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
20 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.

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
25 surface 48 of the wheel rim 12.

Referring to Figure 2, with continued reference to Figure 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
30 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.

The housing 16 includes an opening 28 through 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.

Referring to Figure 3 with continued reference to Figures 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.

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.

Referring to Figures 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 external 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.

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.

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.

Referring to Figure 6, another example TPM assembly 70 includes the valve 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.

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.

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.

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
5 this invention.

Referring to Figure 7, with continued reference to Figure 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
10 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.
15 The example nut 72 is pushed on and threaded off.

Referring to Figure 8 and back to Figure 2, a rear end view of the interface between the housing 16 and the valve body 20 of Figure 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
20 body 20 and the sensor housing 16 substantially prevent relative rotation of the sensor housing 16 relative to the valve stem 18.

Referring to Figure 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
25 feature that prevents relative rotation between the valve stem 18 and the sensor housing 16.

Referring to Figure 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
30 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.

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.

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.

CLAIMS

1. A tire pressure monitoring assembly comprising:
 - an elastic valve stem including an inner portion, an outer portion and a cavity
 - 5 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
 - 10 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
- 15 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.
- 20

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 1, wherein the bore of the valve body
- 25 includes threads corresponding to threads of the fastening member.

6. 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.
- 30

7. 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.
- 5 8. 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 9. The assembly as recited in claim 8, wherein the capture features comprise grooves on outer surface of the valve body engageable to threads on an inner surface of the push nut.
10. The assembly as recited in claim 9, wherein the push nut is adapted for
15 unthreading from the capture features.
11. 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
20 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.
- 25 12. The method as recited in claim 11, comprising deforming the outer portion of the valve stem by fastening a fastening member to a valve body disposed within the valve stem.

30

13. The method as recited in claim 12, 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.

5

14. The method as recited in claim 12, 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.

10

15. The method as recited in claim 14, 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.

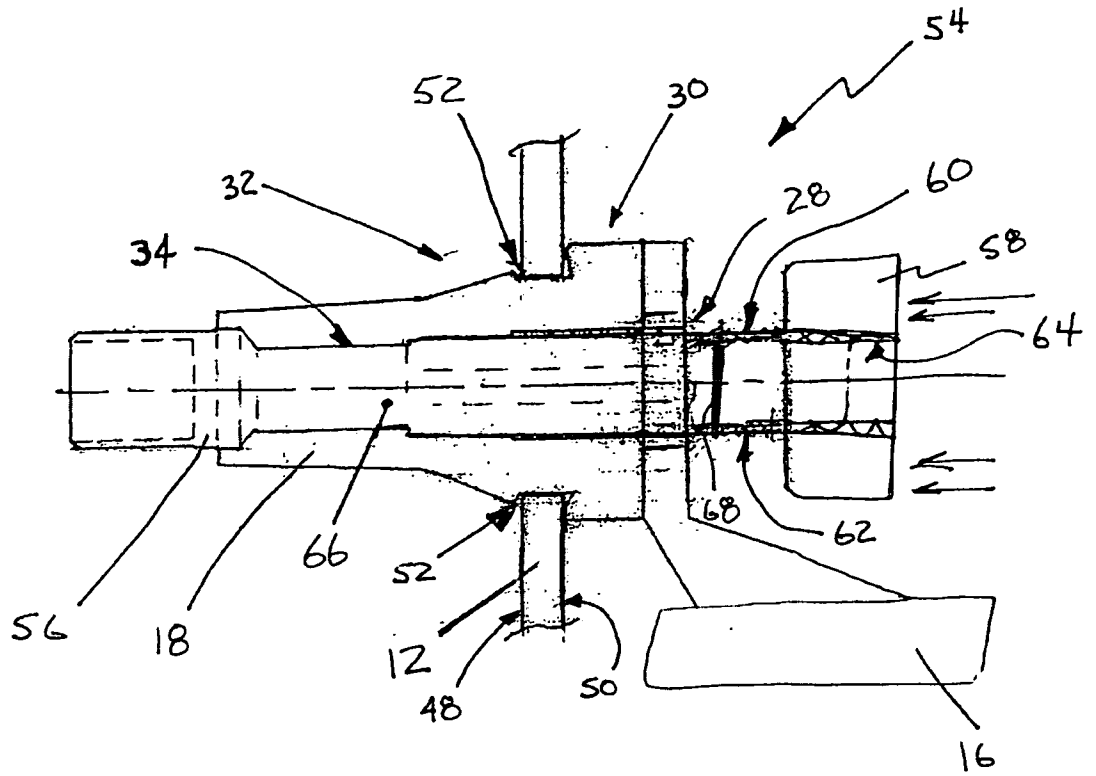


Fig 4

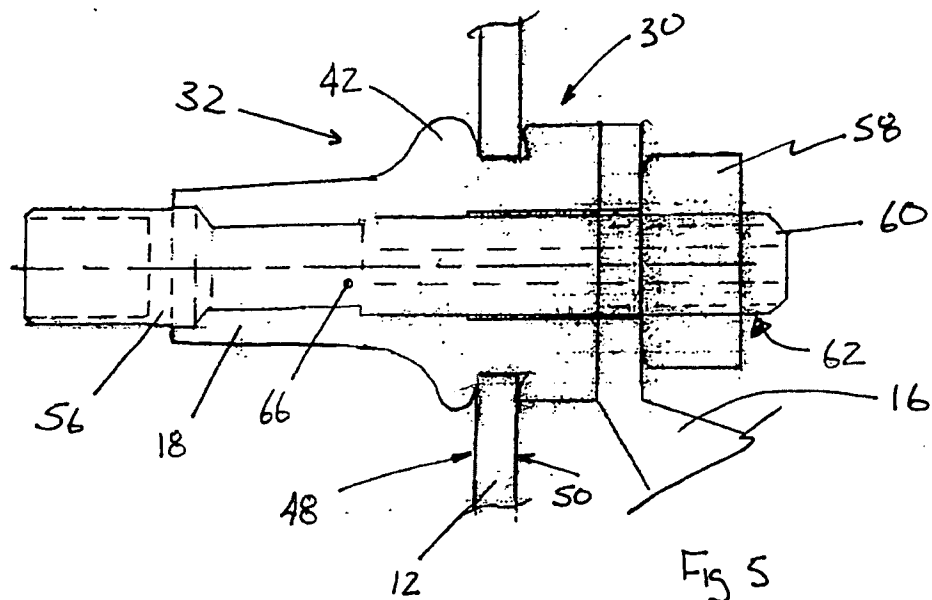


Fig 5

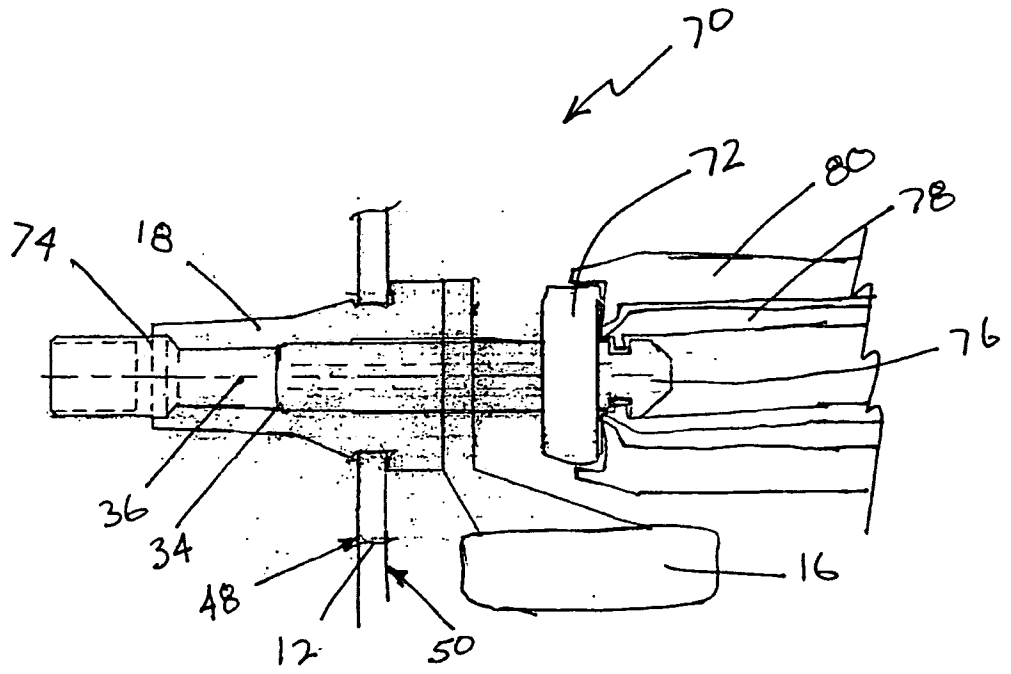


Fig 6

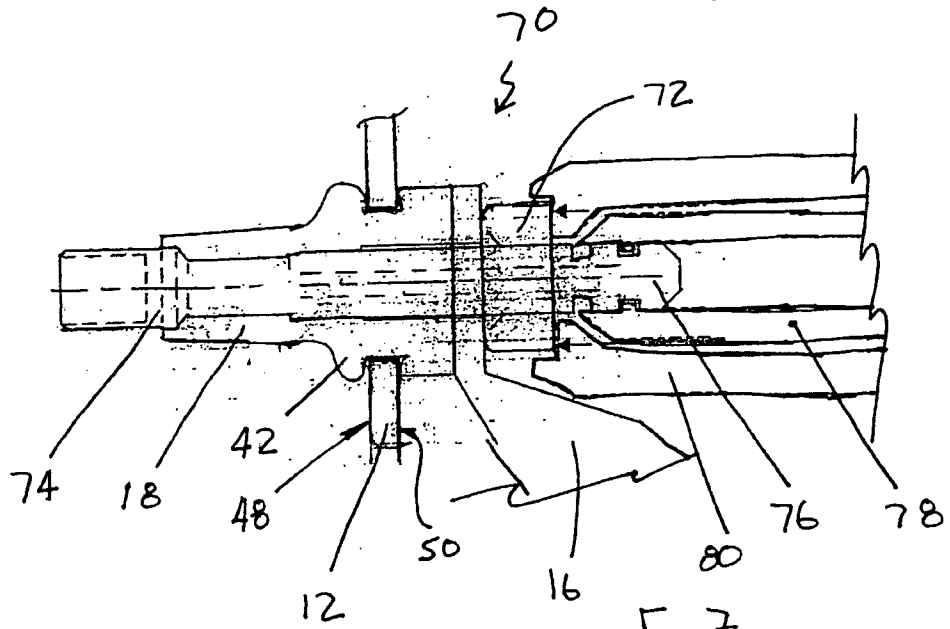


Fig 7

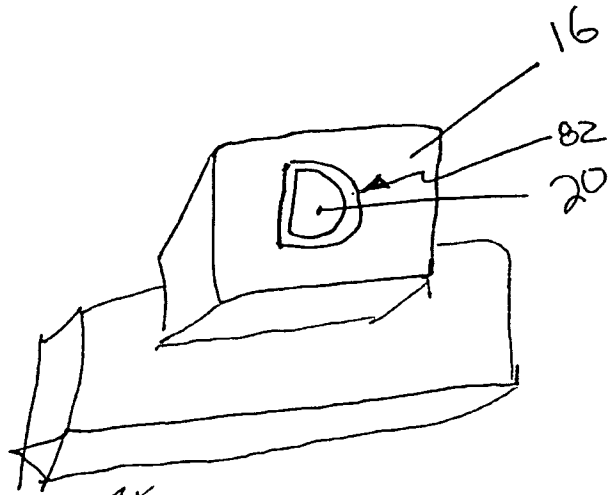


Fig 8

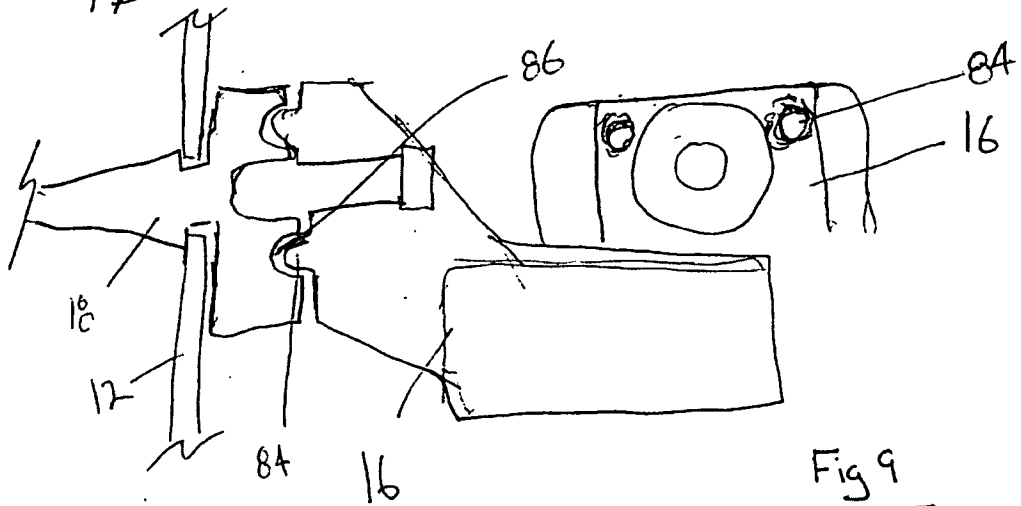


Fig 9

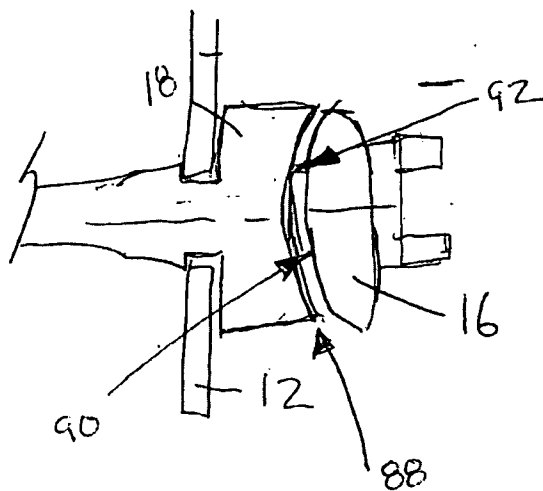


Fig 10

INTERNATIONAL SEARCH REPORT

International application No
PCT/US2008/065871

A. CLASSIFICATION OF SUBJECT MATTER INV. B60C23/04		
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		
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 practical, search terms used) EPO-Internal, WPI Data		
C. DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 6 851 308 B2 (FONTENEAU CHRISTOPHE [FR]) 8 February 2005 (2005-02-08) column 5, line 40 - column 6, line 17 figure 4	1-15
X	US 6 163 255 A (BANZHOF FRANK S [US] ET AL) 19 December 2000 (2000-12-19) column 2, line 3 - column 3, line 26 figure 3	1-15
<input type="checkbox"/> Further documents are listed in the continuation of Box C.		
<input checked="" type="checkbox"/> 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 document 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	
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INTERNATIONAL SEARCH REPORT

Information on patent family members

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