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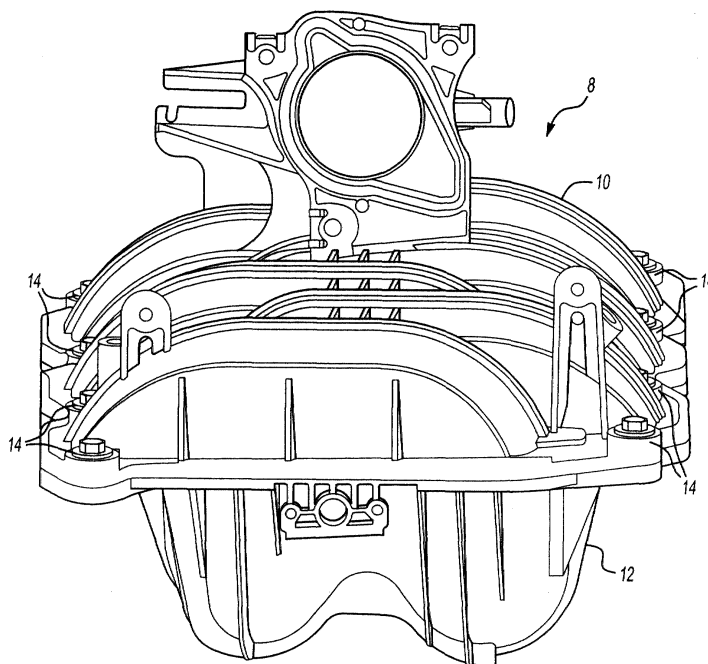
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(54) **Cylindrical compression limiter, intake manifold with such a limiter and method of forming such a compression limiter**

(57) A compression limiter formed by a roll forming process includes a substantially cylindrical body portion and a plurality of feet. A plurality of notches are stamped along a lower edge of a flat sheet of stock and bent to form the plurality of feet. The flat sheet of stock is then rolled to form the compression limiter. In the preferred

embodiment, the compression limiter is formed of a high carbon steel. The plurality of feet of the compression limiter transmit the bolt load of a fastener attaching a plastic intake manifold to a component. In an alternative embodiment, an angled portion attaches each foot to the body of the compression limiter which accommodates for variations in the height of the plastic intake manifold.



**Fig-1**

**EP 1 170 515 A2**

## Description

### BACKGROUND OF THE INVENTION

[0001] The present invention relates generally to an improved compression limiter utilized to transmit loads in an intake manifold assembly.

[0002] In an intake manifold assembly, fasteners are utilized to secure a plastic intake manifold to a component. The bolt load applied to the plastic intake manifold is reduced over time due to a condition known as material creep. Compression limiters are commonly employed to transmit the bolt load to the component and minimize plastic material creep.

[0003] In the prior art, metal compression limiters are inserted into a bore in the plastic intake manifold which receives the fastener, transmitting the bolt load to the component. However, the contact surface area of the compression limiter and the component is relatively small. Therefore, the compression limiters can press into and deform the material of the component over time, reducing the applied bolt load at the location of contact.

[0004] Hence, there is a need in the art for an improved compression limiter utilized to transmit loads in an intake manifold assembly.

### SUMMARY OF THE INVENTION

[0005] The present invention relates generally to an improved compression limiter utilized to transmit loads in an intake manifold assembly.

[0006] The compression limiter of the present invention includes a substantially cylindrical body portion and a plurality of feet. The compression limiter is formed by a roll forming process. A plurality of notches are stamped along a lower edge of a flat sheet of stock. The notches are then bent to form a plurality of feet. The flat sheet of stock is then rolled to form a substantially cylindrical compression limiter. In the preferred embodiment, the compression limiter is formed of a high carbon steel.

[0007] Once installed, plurality of feet of the compression limiter bears the bolt load of a fastener which attaches a plastic intake manifold to a component. The compression limiter is interference fit within the plastic intake manifold and the plurality of feet are received within a foot bore in the plastic intake manifold and the component. When the fastener is installed, the head of the fastener contacts and bears down against the compression limiter, and the plurality of feet contact and transmit the bolt load to the component.

[0008] In an alternative embodiment, an angled portion attaches each foot to the body of the compression limiter. The angled portion accommodates for variations in the height of the plastic intake manifold and accounts for the height variations by reducing the height of the compression limiter.

[0009] Accordingly, the present invention provides an

improved compression limiter utilized to transmit loads in an intake manifold assembly.

[0010] These and other features of the present invention will be best understood from the following specification and drawings.

### BRIEF DESCRIPTION OF THE DRAWINGS

[0011] The various features and advantages of the invention will become apparent to those skilled in the art from the following detailed description of the currently preferred embodiment. The drawings that accompany the detailed description can be briefly described as follows:

Figure 1 illustrates a plastic intake manifold fastened to a component by a plurality of bolts.

Figure 2 illustrates a cross sectional view of Figure 1.

Figure 3 illustrates a front view of the formation of notches on the sheet stock utilized to form the compression limiter of the present invention.

Figure 4 illustrates a front view of the formation of feet on the sheet stock utilized to form the compression limiter of the present invention.

Figure 5 illustrates a side view of the sheet stock illustrated in Figure 4.

Figure 6 illustrates a perspective view of the compression limiter of the present invention.

Figure 7 illustrates a side view of the compression limiter of the present invention.

Figure 8 illustrates a top view of the compression limiter of the present invention.

Figure 9 illustrates cross-sectional side view of the compression limiter of the present invention installed in an assembly.

Figure 10 illustrates an alternative embodiment of the compression limiter.

### DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

[0012] Figure 1 illustrates an intake manifold assembly 8 including a plastic intake manifold 10 secured to a component 12, such as an engine, by a plurality of fasteners 14. As illustrated in Figure 2, a compression limiter 16 is commonly utilized on a plastic intake manifold 10 to transmit bolt load to the component 12 in the areas where the fasteners 14 are located.

[0013] The compression limiter 16 of the present invention is formed of by a roll forming process. In the preferred embodiment, the compression limiter 16 is formed of a high carbon steel. As illustrated in Figure 3, a plurality of notches 18 are stamped along the lower edge 20 of a substantially flat sheet of stock 22. In the preferred embodiment, the notches 18 are substantially rectangular in shape.

[0014] As illustrated in Figures 4 and 5, the notches

18 are bent to form a plurality of feet 24. It is preferred that the notches 18 are bent 90° to the sheet stock 22. Once installed, the plurality of feet 24 transmit the bolt load of the fastener 14 to the component 12.

**[0015]** The sheet stock 22 is then rolled to form the compression limiter 16 of the present invention as illustrated in Figures 6-8. The body 30 of the sheet stock 22 is rolled to form the substantially cylindrical compression limiter 16. When rolled, the side edges 26 of the compression limiter 16 do not substantially contact, forming a gap 28 between the side edges 26. The compression limiter 16 includes a limiter bore 48 of diameter sufficient to receive the fastener 14.

**[0016]** Figure 9 illustrates the compression limiter 16 installed in the intake manifold assembly 8. The plastic intake manifold 10 includes a bore 32 of sufficient diameter to receive the compression limiter 16. The plastic intake manifold 10 further includes a foot portion 34 located at the mating surface 36 of the plastic intake manifold 10 and the component 12 and centrally aligned with the bore 32. The foot portion 34 is of larger diameter than the bore 32 and receives the plurality of feet 24 of the compression limiter 16. The compression limiter 16 is interference fit within the bore 32 of the plastic intake manifold 10.

**[0017]** The component 12 includes a component bore 38 which is substantially aligned with the limiter bore 48 of the plastic intake manifold 12. The component bore 38 is of sufficient diameter to receive the fastener 14. The aligned bores 38 and 48 receive the fastener 14, securing the plastic intake manifold 10 to the component 12. When the fastener 14 is installed, the head 40 of the fastener 14 contacts and bears down against the upper surface 42 of the compression limiter 16 and the upper surface 44 of the plastic intake manifold 10. As the fastener 14 applies pressure to the compression limiter 16, the plurality of feet 24 contact the contact surface 46 of the component 12, transmitting the bolt load to the component 12.

**[0018]** Figure 10 illustrates an alternative compression limiter 116. In this embodiment, an angled portion 150 attaches each foot 124 to the body 130 of the compression limiter 116. This embodiment is otherwise formed similar to the earlier embodiment. If there is a diameter variation between the bore of the plastic intake manifold and the compression limiter 116, the angled portion 150 accommodates for variations in the height of the plastic intake manifold. As the fastener secures the plastic intake manifold to the component, the fastener contacts and presses downwardly on the upper surface 142 of the compression limiter 116. The flexible angled portions 150 account for height variations by reducing the height of the compression limiter 116 as the bolt load is applied.

**[0019]** There are several advantages to utilizing the compression limiter 16, 116 of the present invention. For one, the plurality of feet 24 of the compression limiter 16 transmit the bolt load of the fastener 14 to the com-

ponent 12. By employing a plurality of feet 24, the surface area of the compression limiter 16 contacting the component 12 is increased. This reduces the likelihood of the compression limiter 16 pressing into and deforming the material of the component and reducing the bolt load applied to the component.

**[0020]** The foregoing description is only exemplary of the principles of the invention. Many modifications and variations of the present invention are possible in light of the above teachings. The preferred embodiments of this invention have been disclosed, however, so that one of ordinary skill in the art would recognize that certain modifications would come within the scope of this invention. It is, therefore, to be understood that within the scope of the appended claims, the invention may be practiced otherwise than as specially described. For that reason the following claims should be studied to determine the true scope and content of this invention.

## Claims

### 1. A compression limiter comprising:

a body portion having an upper surface and a lower surface;  
a plurality of protrusions extending from said lower surface of said body portion to apply a load to a component when a force is applied to said upper surface of said body portion.

2. The compression limiter as recited in claim 1 wherein said compression limiter is formed of a high carbon steel.

3. The compression limiter as recited in claim 1 wherein said plurality of protrusions extend 90° from said body portion.

4. The compression limiter as recited in claim 1 wherein said body portion of said compression limiter is substantially cylindrical and forms a limiter bore.

5. The compression limiter as recited in claim 1 wherein each of said plurality of protrusions of said compression limiter further includes an angled portion located between said body portion and each of said plurality of feet.

6. The compression limiter as recited in claim 1 wherein a fastener is inserted within a limiter bore of said compression limiter and applies said force to said upper surface of said body portion of said compression limiter.

### 7. An intake manifold assembly comprising:

an intake manifold including a plurality of man-

ifold apertures, each of said plurality of manifold apertures having a foot portion of larger diameter than said manifold aperture;

a plurality of compression limiters each positioned within one of said plurality of manifold apertures including a body portion having an upper surface, a lower surface, and a limiter bore, and a plurality of protrusions extending from said lower surface of said body portion and being received by said foot portion of said intake manifold to apply a load to a component when a force is applied to said upper surface of said body portion, said limiter bore being substantially aligned with a component aperture; and  
a plurality of fasteners each passing through one of said aligned limiter apertures and to extend into component apertures to secure said intake manifold to said component.

8. The assembly as recited in claim 7 wherein said compression limiter is formed of a high carbon steel.

9. The assembly as recited in claim 7 wherein said plurality of protrusions extend 90° from said body portion.

10. The assembly as recited in claim 7 wherein said body portion of said compression limiter is substantially cylindrical and forms a limiter bore.

11. The assembly as recited in claim 7 wherein said load is applied by said plurality of fasteners.

12. The assembly as recited in claim 7 wherein each of said plurality of protrusions of said compression limiter further includes an angled portion located between said body portion and each of said plurality of feet.

13. The assembly as recited in claim 7 wherein fastener is inserted within a limiter bore of said compression limiter and applies said force to said upper surface of said body portion of said compression limiter.

14. A method to form a compression limiter for a manifold assembly comprising the steps of:

forming a plurality of protrusions along a lower edge of a sheet of stock; and  
roll forming said sheet of stock to form said compression limiter.

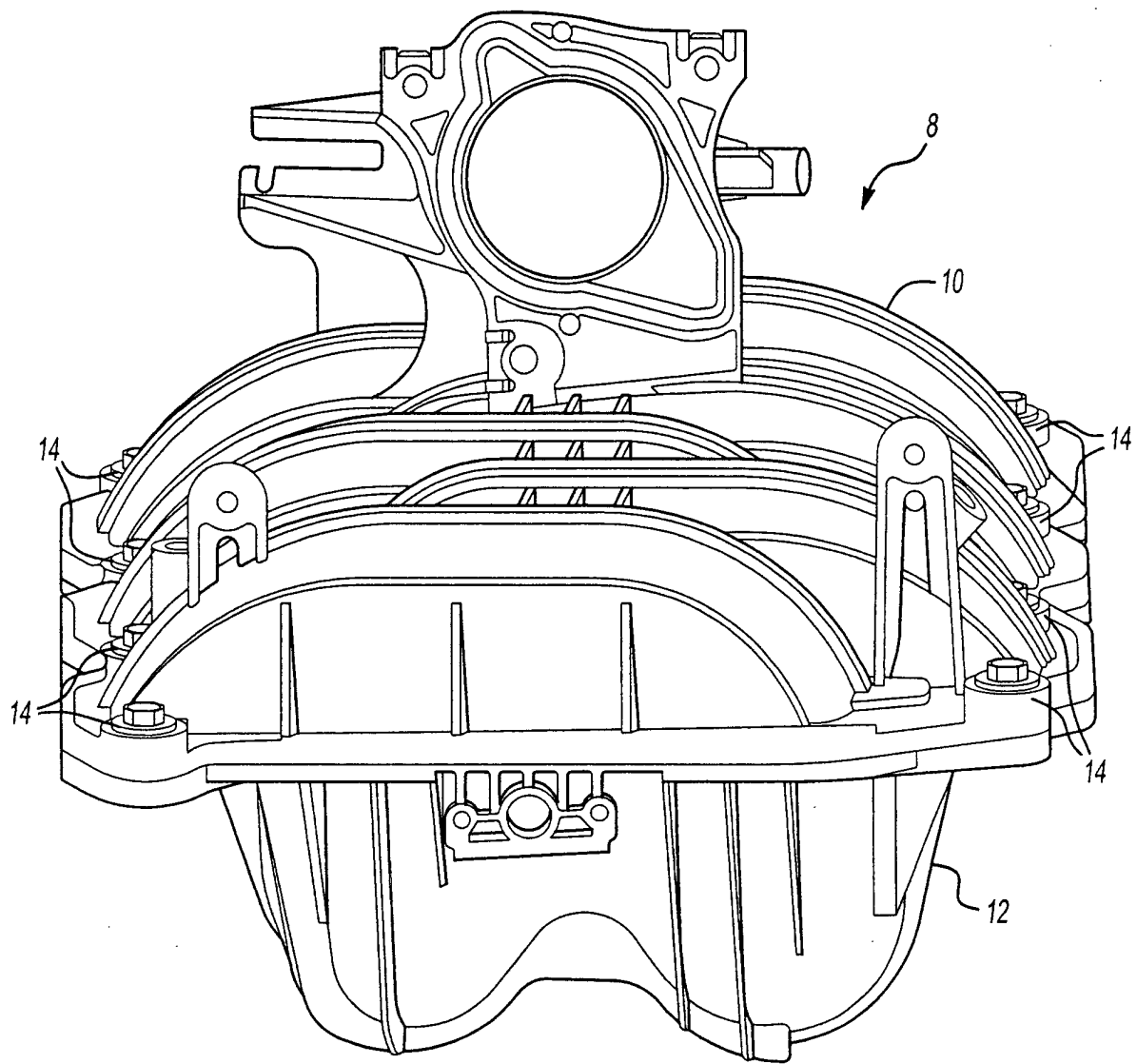
15. The method as recited in claim 14 wherein said sheet of stock is a high carbon steel.

16. The method as recited in claim 14 wherein the step of forming said plurality of protrusions further in-

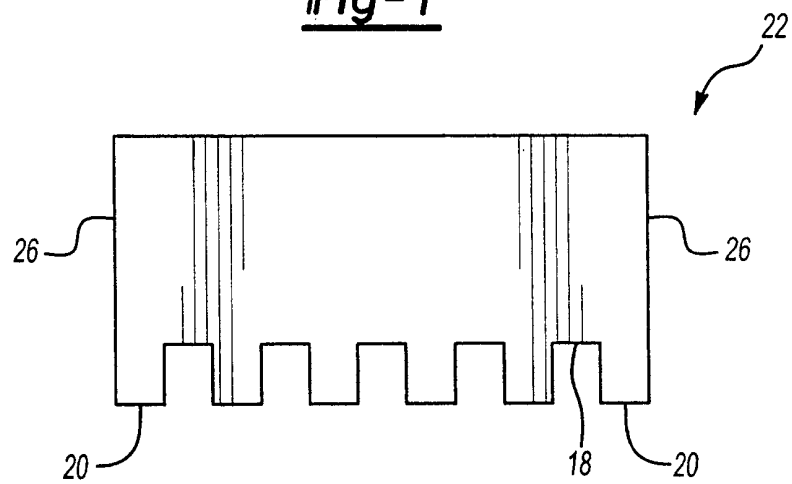
clude stamping a plurality of notches along said lower edge of said sheet of stock and bending said plurality of notches to form said plurality of protrusions so that said plurality of protrusions are 90° from said sheet of stock.

17. The method as recited in claim 14 wherein the step of roll forming said sheet of stock further includes bringing a pair of opposing edges of said sheet of stock substantially proximate, creating a gap therebetween.

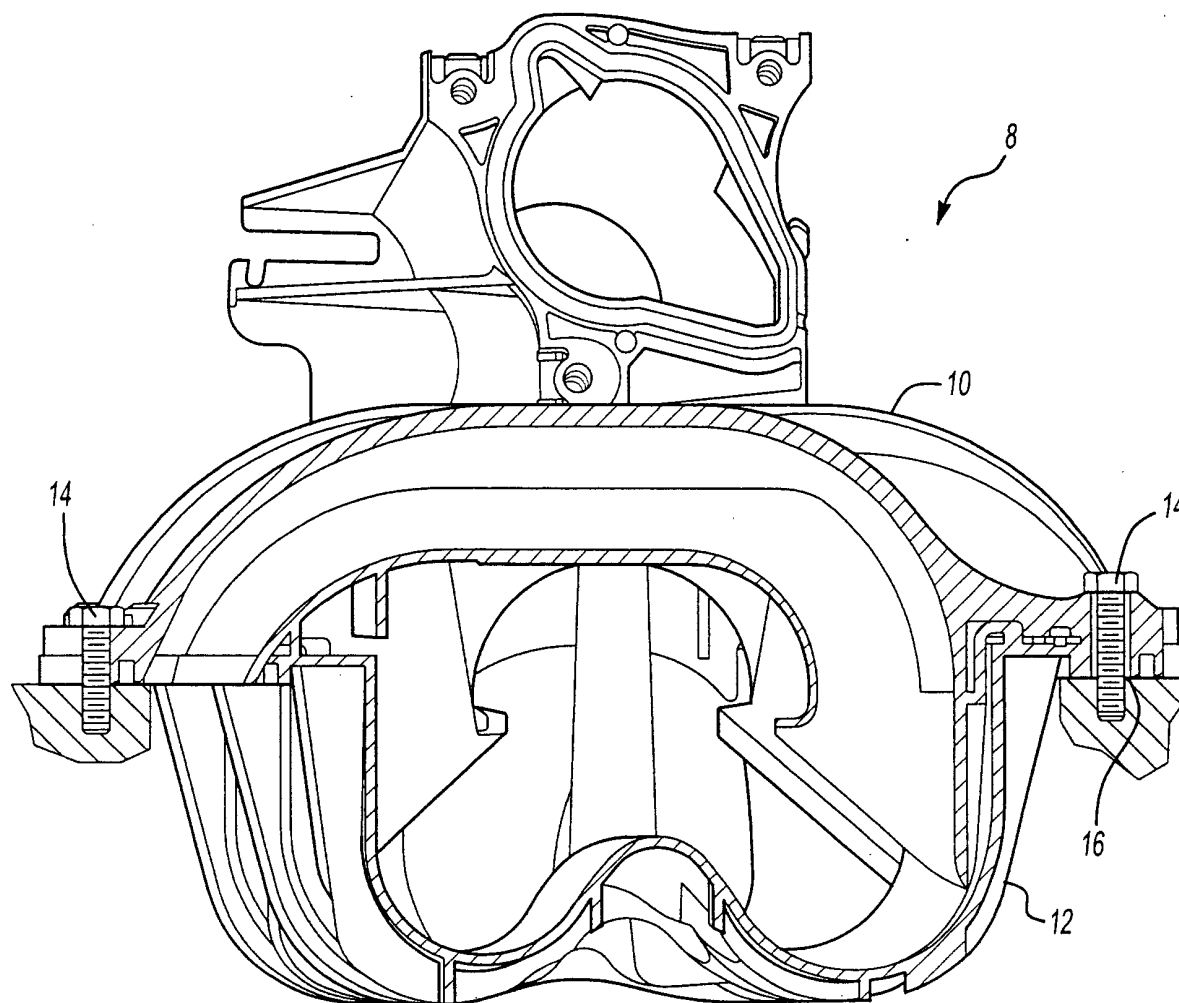
18. The method as recited in claim 14 wherein the method of forming said compression limiter further comprises forming a plurality of angled portions along said lower edge of said sheet stock, said plurality of angled portions being located between a body portion of said compression limiter and said plurality of protrusions.



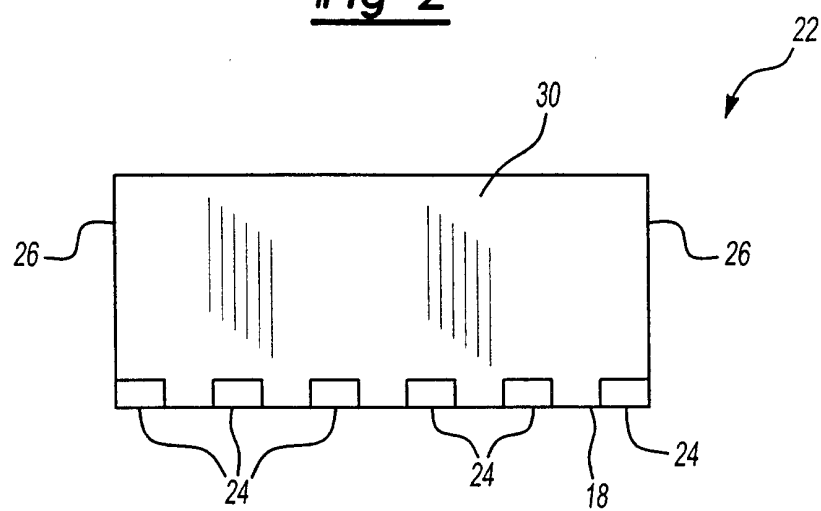
**Fig-1**



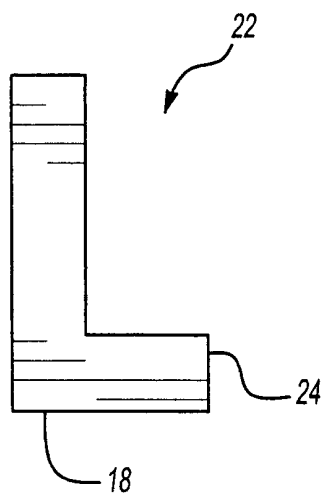
**Fig-3**



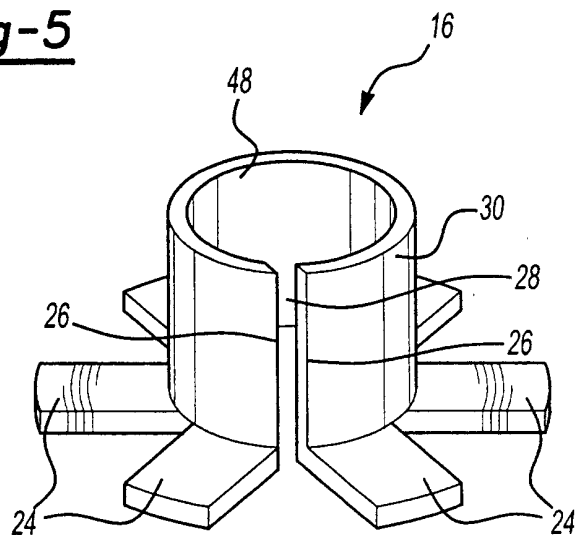
**Fig-2**



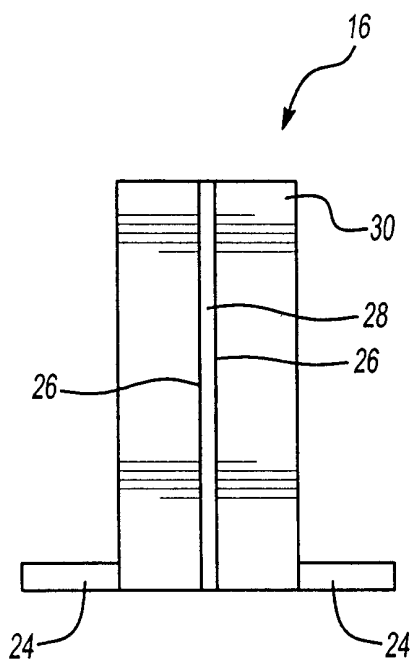
**Fig-4**



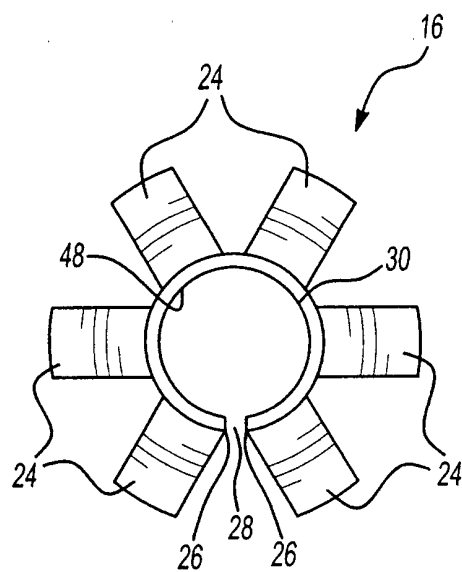
**Fig-5**



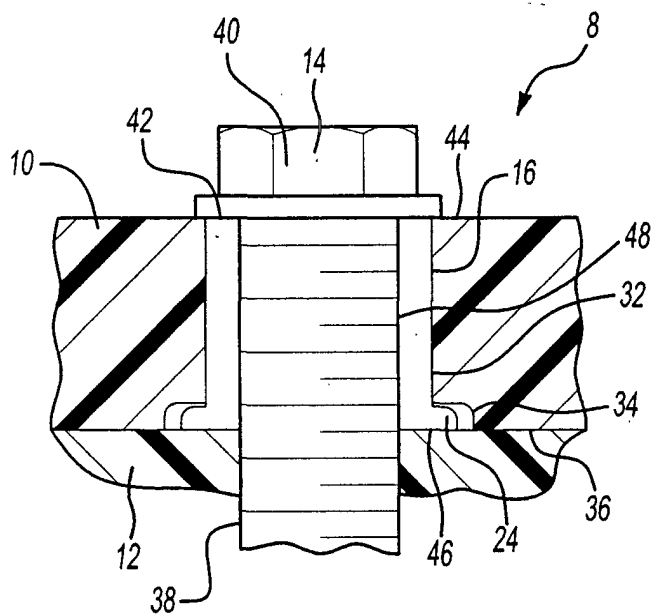
**Fig-6**



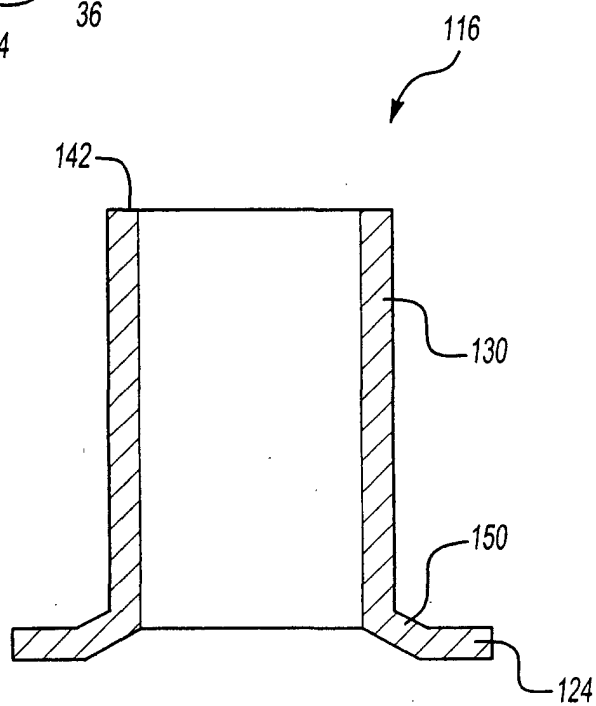
**Fig-7**



**Fig-8**



**Fig-9**



**Fig-10**