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(71) Applicant(s)

Mining Equipment (Minquip) Pty Ltd

(72) Inventor(s)

David Byrne

(74) Agent/Attorney

A.P.T. PATENT AND TRADE MARK ATTORNEYS,GPO Box 772,ADELAIDE SA 5001

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A SEAL

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(71) Applicant(s)
MINING EQUIPMENT (MINQUIP) PTY LTD

(72) Inventor(s)
DAVID BYRNE

(74) Attorney or Agent
A.P.T. PATENT AND TRADE MARK ATTORNEYS , GPO Box 772, ADELAIDE SA 5001

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ABSTRACT

Disclosed is a seal consisting of an annular portion integrally formed in coaxial configuration with a substantially toroidal portion. A maximum diameter of the annular portion is smaller than a maximum diameter of the toroidal portion. The toroidal portion having a circumferential cavity about an inner surface. There are one or more circumferential ridges upon an outer surface of the toroidal portion about the first region and other ridges can be about the toroidal portion within the second region. The seal is adapted to be inserted into a hose coupling part so that the annular portion of the seal projects from an aperture and the toroidal portion resides within an annular concave recess within the aperture.

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COMPLETE SPECIFICATION

FOR A PETTY PATENT
ORIGINAL

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Name of Applicant:	Mining Equipment (Minquip) Pty Ltd
Actual Inventor:	David Byrne
Address for Service:	**A.P.T. Patent and Trade Mark Attorneys GPO Box 772, Adelaide, SA 5001**
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The following statement is a full description of this invention, including the best method of performing it known to us:-

The invention disclosed herein relates to a seal. The seal in a preferred form can be used in air hose joints through which compressed gas is passed.

The following illustrates the types of problems encountered with some types of seals and makes use of a specific form for explanation purposes. It will be understood that the invention is not intended to be limited to the specifics of the particular form used for explanation.

In Australian Patent No. 514 396 to Treloar a hose coupling and seal is disclosed. This hose coupling has been well received and accepted in the mining industry since its launch in the late 1970's. However, there are a number of problems with this type of coupling which are believed to be the result of characteristics of the seal.

The coupling uses two fittings which can be pushed together and twisted to engage a retaining means; somewhat similar to a bayonet mount. To create an air or fluid seal two rubber sealing rings are used, one in each fitting, which abut each other when the coupling is joined.

Each seal or sealing ring has a toroidal portion which fits into a suitable annular cavity within a fitting thereby providing a seal between fitting and air or fluid path. At the other end is a face of an annular portion which abuts the corresponding face of a sealing ring in another fitting thereby providing a seal between the fittings.

The toroidal portion has an outer surface which, in profile, is substantially semi-circular. Therefore, a lip of the outer surface distal from the face is substantially parallel to the face. Upon the outer surface proximal the lip are a plurality of ridges intended to form a labyrinth seal with the annular cavity within the fitting.

The sealing ring illustrated in Australian Patent No. 514 396 and also in a corresponding Australian Registered Design No. 70322 also to Treloar has not, to the present inventor's knowledge, been manufactured for sometime. What has been manufactured by the owner of Australian Patent No. 514 396 and Australian Registered Design No. 70322 is a sealing ring very similar to that illustrated except that the flat face of the seal is curved so that the sealing area is greatly reduced by comparison to that illustrated.

Why this was done is not known but it is suggested that it might be for ease of moulding or making less surface area in contact with each other therefore creating less frictional effort when turning couplings through 45° to lock together. It also demonstrates that whilst development has occurred over the life of Australian Patent No. 514 396 this has not led to a solution to the problems that have plagued the use of the coupling disclosed in Australian Patent No. 514 396.

In use the coupling and sealing rings described above have not provided a problem free joining system. The following problems have been experienced by users of the couplings since becoming available.

At low air or fluid pressures, below 345 kPa (50 P.S.I.), the couplings tend to leak. This results in increased operation costs due to providing air or fluid to compensate for such leaks. It also can lead to dust, mud and other problems which can hinder efficient work practices. This can lead to increased operation cost and also increased danger to personnel.

At high pressures above, above 2756 kPa (400 P.S.I.), the couplings tend to blow apart. When this occurs work has to be halted and the broken section isolated and repaired before work can recommence. This leads to obvious costs. Such high pressures need not be much greater than normal working pressures and so there is a limited margin over normal operation pressure. This margin can easily be exceeded during normal work procedures and is not regarded as an unusual or unexpected occurrence.

It is a proposed object of this invention to provide a seal to obviate or minimise at least one of the aforementioned problems, or at least provide the public with a useful choice.

The improvements substantially reduce or eliminate the low pressure leak problem, and allow a higher or much higher pressure margin between normal operational pressures and pressures where couplings can tend to blow apart. Whilst the improvements may appear small the practical advantages are significant. It should also be kept in mind that the above mentioned coupling system has been in use for many years with its associated problems.

The actual cause of the problems overcome or substantially reduced by the proposed new seal utilising the invention have not been fully ascertained. Accordingly, there are discussed herein unsubstantiated theories as to the cause of the problems which have

plagued the above mentioned previously known seals and couplings since the late 1970's. Seals exhibiting the invention have been tested and used in the field and have been found to offer superior performance.

The invention may be said to reside, not necessarily in the broadest or only form, in an elastomer seal consisting of an annular portion, having an axis, integrally formed in coaxial configuration with a substantially toroidal portion, also having an axis, a maximum diameter of the annular portion being smaller than a maximum diameter of the toroidal portion, the toroidal portion having an outer surface, a lip part distal the annular portion, a first region of the outer surface between the annular portion and a greatest diameter of the toroidal portion, a second region of the outer surface between the lip part and the greatest diameter of the toroidal portion being when the seal is not deformed, between a first line between the greatest diameter and a centre of the radius of the external surface of the toroidal portion and a second line passing through the said centre of the radius and at an angle of less than 55° relative to the first line, one or more circumferential ridges on upon the outer surface of the lip, and one or more circumferential ridges upon the outer surface of the toroidal portion about the second region.

In a preferred form, the seal includes one or more circumferential ridges upon the outer surface of the toroidal portion about the second region.

According to one preferred form, the seal includes one or more circumferential ridges upon the outer surface of the toroidal portion proximal and on the lip.

In another preferred form seal includes a circumferential cavity about an inner surface of the toroidal portion. Such a cavity permits the toroidal portion or bellows portion to partially collapse as a coupling is joined together thereby making the joining easier to perform.

According to one preferred form, the annular portion has a substantially flat face distal from the toroidal portion substantially co-planar to a plane to which the axis of the annular portion is normal.

In a preferred form, the invention may be said to reside, again not necessarily in the broadest or only form, in a seal consisting of an annular portion, having an axis, integrally formed in coaxial configuration with a substantially toroidal portion, also having an axis, a maximum diameter of the annular portion being smaller than a maximum diameter of the toroidal portion;

the toroidal portion having a circumferential cavity and a first region of wall thickness thicker proximal to the annular portion than a second region distal from the annular portion;

one or more circumferential ridges upon an outer surface of the toroidal portion about the first region; and,

the seal being such that pressure upon the outer surface at the second region can cause flexing of the seal within or proximal to that region but resists flexing within the first region thereby maintaining the relative location of the ridge or ridges relative to the annular portion.

In this manner, the action of air or fluid attempting to flow between the seal and the fitting is greatly resisted. The ridges which make a labyrinth seal are relatively unaffected by the flexing of the seal in the second region.

Preferably, the transition from the first region to the second region occurs substantially abruptly. This is believed to encourage flexing of the second region to occur along the circumferential transition region or in the relatively thin walled section of the second region. In this manner the effect of the ridges is believed to be enhanced.

Such flexing is believed to occur at low air or fluid pressure. With the seal in a fitting the fit is not always perfect. Air, for example, is believed to flow about the seal between the fitting causing the mentioned flexing. This causes, with previously known seals, it is believed, a leak path to result by moving the ridges away from the annular cavity within the fitting. At higher pressures the pressure is such as to ensure the flexing does not occur.

In preference there is a further ridge or ridges upon the outer surface about the second region. Such ridges make a labyrinth seal with the fitting.

In a preferred form a lip of the second region is biased along the axis of the toroidal portion away from the annular portion. In this manner the seal at the second region is biased into or towards the wall of the fitting. This is believed to result in the seal being more resistant to air or fluid flowing between the fitting and the seal. In preference the lip is biased to form an angle between 5 and 20 ° relative to a line normal to the axis of the seal.

In a further preferred form the annular portion has a substantially flat face distal from the toroidal portion substantially co-planar to a plane to which the axis of the annular portion is normal. With the face being substantially flat and at ninety degrees to the axis of the seal when two such seal abut face to face there is a greater contact area over which to seal. This is believed to result in the improved high pressure performance to the seal. It also permits some tolerance to dust and grit because the seal is made over a greater area.

In preference the wall thickness of the annular portion is at least 8 mm.

Preferably the ratio of the diameter of the inner wall of the annular portion compared to the diameter of the outer wall is greater than 0.6.

In a preferred form, the one or more circumferential ridges about the first region project from the toroidal portion between the end portion and a circumferential location of the greatest diameter of the toroidal portion. Preferably, there are at least two of the circumferential ridges about the first region between the end portion and the circumferential location. The flexing of the lip has little effect on these ridges so not normally breaking the seal formed between seal and a fitting.

In an alternative form, the invention may be said to reside, again not necessarily in the broadest or only form, in a combination of a hose coupling part and a seal:

the hose coupling part including a body with a first end, the first end including engaging means for selectively retaining and coupling with the first end of another similar hose coupling part, a fluid conduit through the hose coupling part with an aperture at one end, proximal to the first end, for alignment and communication with a similar aperture of a similar house coupling part thereby to form a continuous fluid conducting conduit, and the fluid conduit having an annular concave recess proximal to the aperture;

the seal consisting of an annular portion, having an axis, integrally formed in coaxial configuration with a substantially toroidal portion, also having an axis, a maximum diameter of the annular portion being smaller than a maximum diameter of the toroidal portion;

the toroidal portion having a circumferential cavity and a first region of wall thickness thicker proximal to the annular portion than a second region distal from the annular portion;

one or more circumferential ridges upon an outer surface of the toroidal portion about the first region; and,

the seal being coaxially inserted into the fluid conduit with the annular portion projecting from the aperture and the toroidal portion residing within the annular concave recess and adapted such that pressure upon the outer surface at the second region can cause flexing of the seal within or proximal to that region but resists flexing within the first region thereby maintaining the relative location of the ridge or ridges relative to the annular portion.

In a preferred form, engaging means includes at least one lug projecting axially from the first end for engaging with a detent of a similar hose coupling part, the two hose coupling parts being of adaptation and configuration so that they can be axially pressed together against the projection portions of the inserted seals and twisted to engage the lug and detent.

In one preferred form the transition from the first region to the second region occurs substantially abruptly.

In another preferred form the combination is one including a further ridge or ridges upon the outer surface about the second region.

In one preferred form, the combination is one wherein a lip of the second region is biased along the axis of the toroidal portion away from the annular portion. Preferably, the lip is biased away from the annular portion by an angle between 5 and 20 ° relative to line normal to the axis of the second part.

In an alternative form, the invention may be said to reside, again not necessarily in the broadest or only form, in the combination of a fitting of the type disclosed in Australian Patent No. 514 396 and a seal consisting of an annular portion, having an axis, integrally formed in coaxial configuration with a substantially toroidal portion, also having an axis, a maximum diameter of the annular portion being smaller than a maximum diameter of the toroidal portion;

the toroidal portion having a circumferential cavity and a first region of wall thickness thicker proximal to the annular portion than a second region distal from the annular portion;

one or more circumferential ridges upon an outer surface of the toroidal portion about the first region; and,

the seal being such that pressure upon the outer surface at the second region can cause flexing of the seal within or proximal to that region but resists flexing within the first region thereby maintaining the relative location of the ridge or ridges relative to the annular portion.

To assist in the understanding of the invention a preferred embodiment will now be described with reference to the accompanying drawings:

Figure 1 illustrates a coupling and seals in cross section;

Figure 2 illustrates an under-view of a seal according to this preferred embodiment;

Figure 3 illustrates a top view of the seal shown in Figure 2;

Figure 4 illustrates a cross sectional view of the seal along X-X' marked in Figure 2;

Figure 5 illustrates a side view of the seal shown in Figure 2;

Figure 6 illustrates a perspective view of the seal shown in Figure 2;

Figure 7 illustrates another perspective view of the seal shown in Figure 2;

Figure 8 illustrates a portion of the seal in cross section in more detail;

Figure 9 illustrates a portion of the seal in cross section illustrating the flexing that can occur;

Figure 10 is a perspective sketch of the coupling part of Figure 1.

The same reference numerals are used throughout the Figures to indicate the same feature. It will be appreciated that the Figures are not necessarily to scale and some features may be distorted slightly or unobservable to permit easy recognition and discussion of such features or practical illustration.

Into each fitting 1 and 2, best seen in Figures 1 and 10, is inserted a seal 3 and 4. The fittings and the seals are of suitable shape and dimension for this purpose. This can be seen in Figure 1. The fittings are pushed together and twisted so that a detent 5 is retained by a lug 6. This action forces the faces of the seals 3 and 4 together.

Taking fitting 1 and seal 3 as examples, fitting 1 has a first end 25 and an annulus cavity or concave recess 7 into which a toroidal portion 8 of the seal 3 fits. This provides a seal between the fitting 1 and the outer surface of seal 3. The seal 3 has a lip 9 which is biased into the fitting 1 substantially at 10. This assists in making the seal between fitting 1 and seal 3.

Integrally formed with the toroidal portion 8 is an annular portion 11. The annular portion 11 has an outside surface 12 dimensioned to fit snugly within the fitting 1 past the cavity 7. That is, within the aperture 26 and slightly projecting therefrom. There is a flat face 13 which is substantially perpendicular to the axis of the seal which is indicated in Figure 1 by reference 14. This configuration permits the respective faces of the seals to abut when fittings are joined. This abutment makes a seal between the fluid or air path within the fittings and the surrounding environment.

The wall thickness of the annular portion 11, that is the width of the face 13, is selected to be as large as possible without unduly reducing the air or fluid path diameter. This permits the abutment of the seals, for example 3 and 4, to be over a considerable area thereby increasing the effectiveness of the seal so formed.

Having described the operation of the seal within the fittings the seal itself will now be described in more detail with reference to Figures 2 to 9.

The seal can be made by moulding or otherwise of a suitable elastomer used for the purposes of making seals; eg Buna-N Nitrile Duro 57-65, E.P.D.M. and silicone rubbers. The particular choice will depend upon the specific requirements of the application of the seal.

The seal 15 has the toroidal portion 16, the annular portion 17 and the flat face 18 as mentioned above.

In this specific preferred embodiment the overall diameter of the annular portion 17 is about 50 mm with a wall thickness of about 9 mm. This gives a fluid or air path diameter of about 32 mm which does not unduly affect fluid or air flow whilst giving a large surface of the face 18 with which a seal can be made. This large surface or area has been found to greatly improve seal performance under high pressures. It is believed that the large area permits more sealing contact and tolerance to dust and grit over the face 18.

The toroidal portion 16 has an overall diameter of about 65 mm. It has a cavitous profile as best seen in Figure 4 and indicated by reference 19. The wall thickness of the toroidal portion 16 categorises this seal into two broad regions. A first region 20 has a thick wall. A second region 21 has a thin wall. There is also a lip part 22. The transition between these regions can be quite abrupt if desired. Further, the lip part 22 is biased outward generally away from the annular portion 17 (best seen in Figure 8) and so, when fitted, presses firmly into a fitting. This biasing of the lip is about 10 ° with respect to a line parallel to the flat face 18.

On the outer surface of the toroidal portion 16 are a first plurality of ridges 23 over the first region 20 and a second plurality of ridges 24 over the lip and a further ridge 27 over the second region 21. The ridges 23 and 24 form labyrinth seals with the fitting.

This configuration permits the lip 22 to flex towards the centre of the seal 15 under the action of air or fluid at low pressure. The flexing can be substantially about the transition between the regions; this is best seen in Figure 9. However, the toroidal portion 16 at the first region 20 remains unmoved or substantially relatively unmoved in response to such flexing. In this manner the problem of low pressure leaking appears to be solved because the suspected flexing does not break the seal of the first ridges 23. Under normal operating pressures the second ridges 24 and ridge 27 provide a main seal between seal and fitting.

The external surface of the toroidal portion, as best seen in a longitudinal cross section of the seal, is curved and substantially, at least until the lip, being of a radius from a centre. Relative to the centre and the greatest diameter of the toroidal portion, the first region extends to the annulus portion with ridges 23 at approximately 15° and 35° and preferably with 38°. The second region extends between the greatest diameter and the lip to approximately 50 - 55°. Within the second region is the ridge 27 at approximately 20 - 30° and preferably within 50°.

The ridges project from the outside surface of the toroidal portion by about 0.5 mm.

It will be appreciated that this disclosure is not intended to limit the invention to preferred the embodiment or details thereof. It is intended to give an overview of the invention as conceived. It is appreciated that various other embodiments can be made utilising the invention which would all fall within the spirit of the invention disclosed herein.

THE CLAIMS DEFINING THE INVENTION ARE AS FOLLOWS:

1. An elastomer seal consisting of an annular portion, having an axis, integrally formed in coaxial configuration with a substantially toroidal portion, also having an axis, a maximum diameter of the annular portion being smaller than a maximum diameter of the toroidal portion, the toroidal portion having an outer surface, a lip part distal the annular portion, a first region of the outer surface between the annular portion and a greatest diameter of the toroidal portion, a second region of the outer surface between the lip part and the greatest diameter of the toroidal portion being when the seal is not deformed, between a first line between the greatest diameter and a centre of the radius of the external surface of the toroidal portion and a second line passing through the said centre of the radius and at an angle of less than 55° relative to the first line, one or more circumferential ridges on upon the outer surface of the lip, and one or more circumferential ridges upon the outer surface of the toroidal portion about the second region.

2. A seal as in Claim 1 including one or more circumferential ridges upon the outer surface of the toroidal portion about the first region.

3. A seal as in Claim 1 or 2 wherein the one or more circumferential ridges in the second region are between 20° and 30° relative to the first line.

Dated this 14th day of October 1999

MINING EQUIPMENT (MINQUIP) PTY LTD
By its Patent Attorneys,
A. P. T. Patent and Trade Mark Attorneys

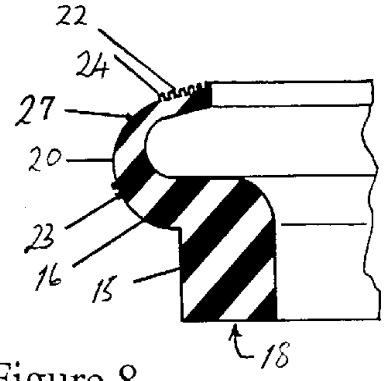

Figure 8

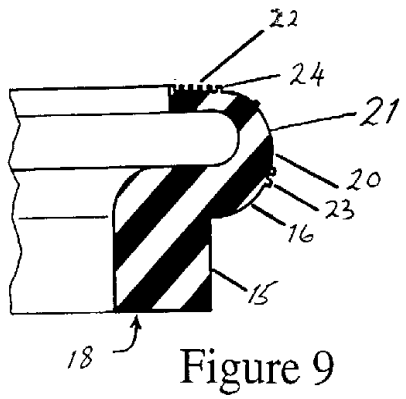

Figure 9

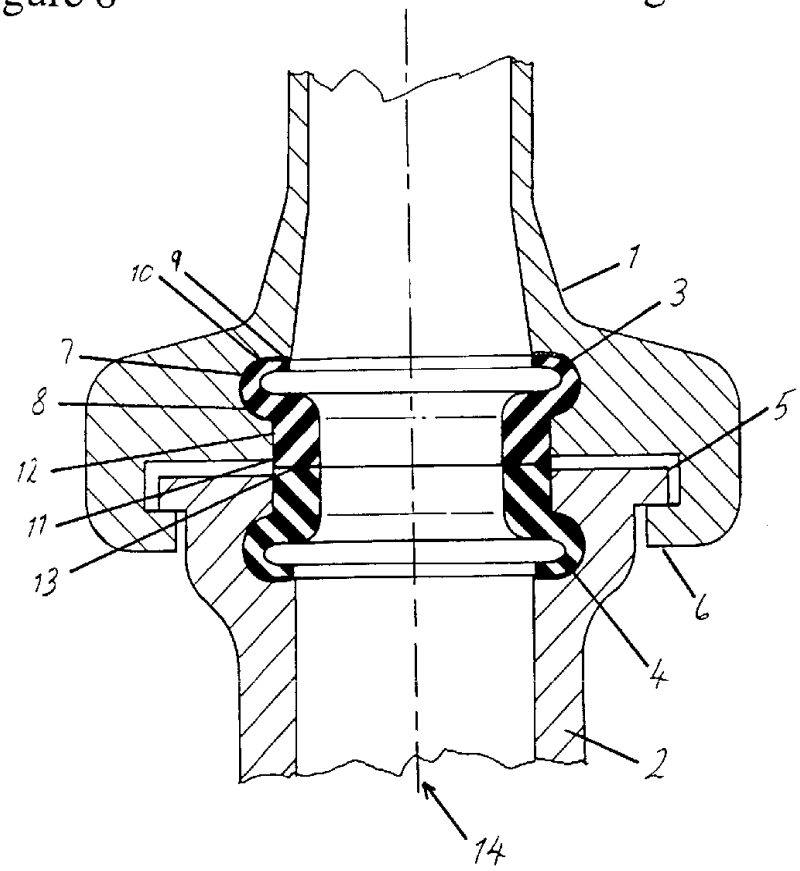

Figure 1

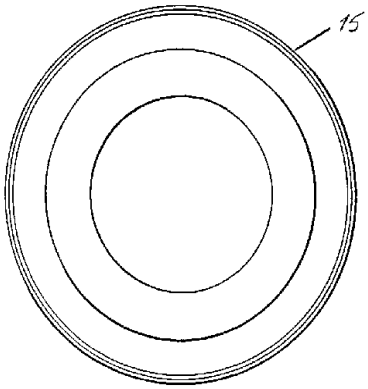

Figure 2

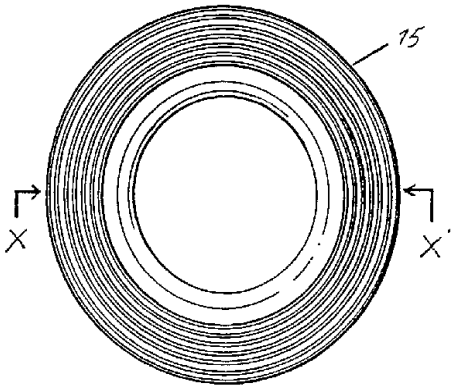

Figure 3

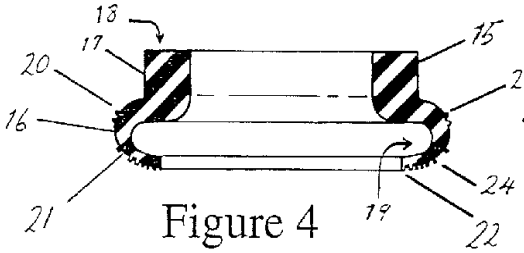

Figure 4

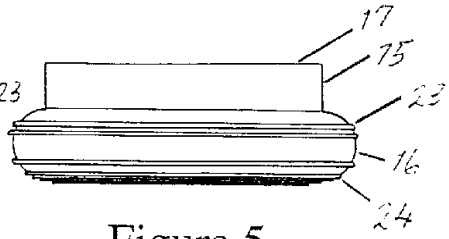

Figure 5

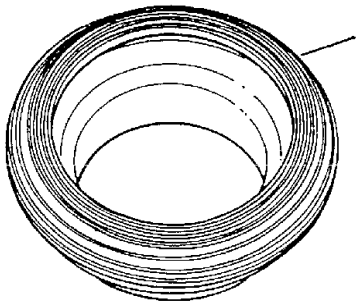

Figure 6

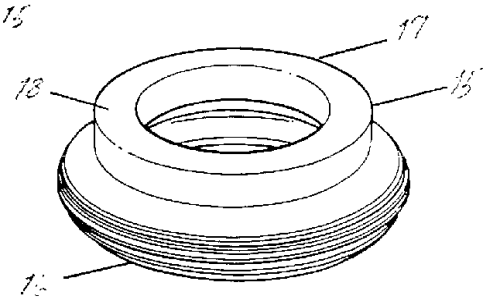

Figure 7

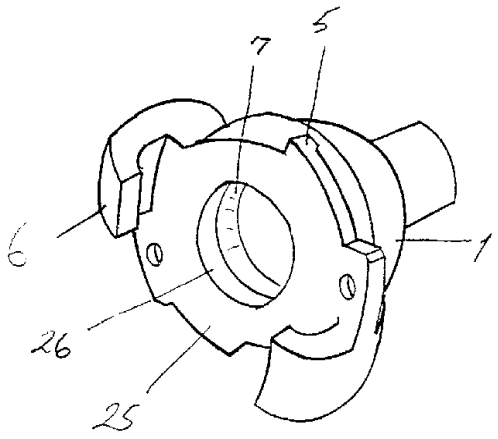

Figure 10