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(54) **DIMPLED RISER FLOATATION MODULE**

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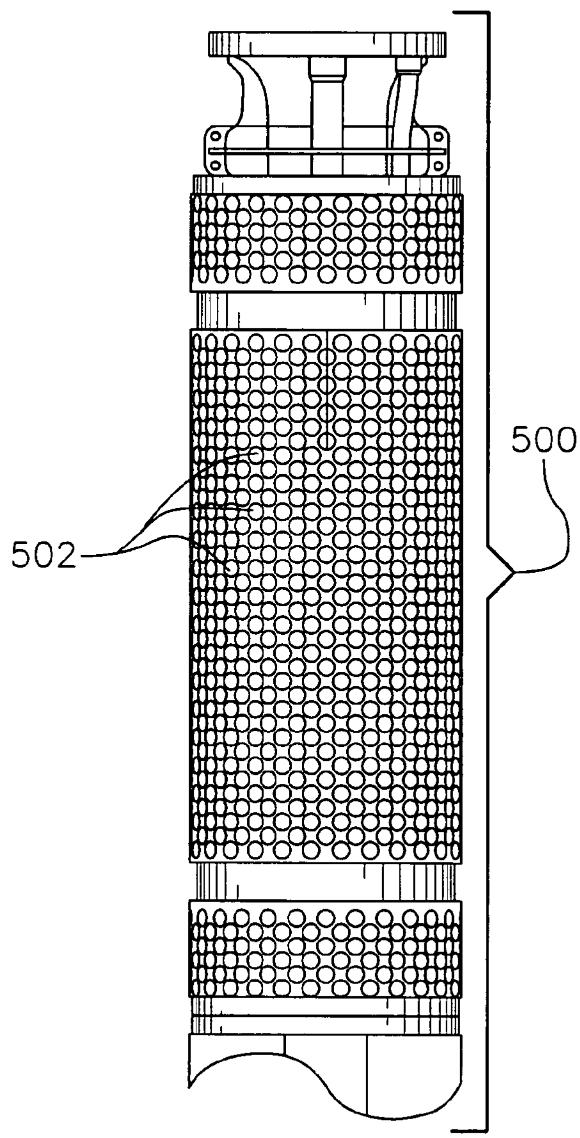
(52) **U.S. Cl.** **166/350**; 405/224.2

(57) **ABSTRACT**

An improved subsea riser for use in oil and gas drilling applications having a cylindrical floatation member adapted for attachment to a blow out preventer. The member may be configured with a plurality of generally evenly spaced dimples, indentations or protrusions about the circumference of the member to provide more streamlined water flow around the riser reducing turbulence and oscillations of the riser. The dimples, indentations or protrusions may be arranged in several ways including icosahedral, dodecahedral, octahedral and other polyhedral configurations.



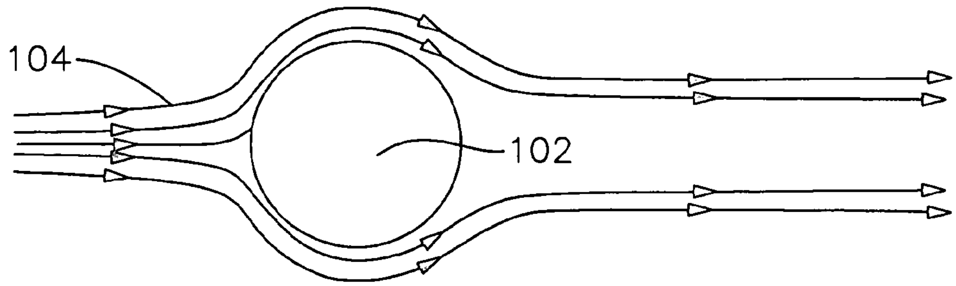


Fig. 1

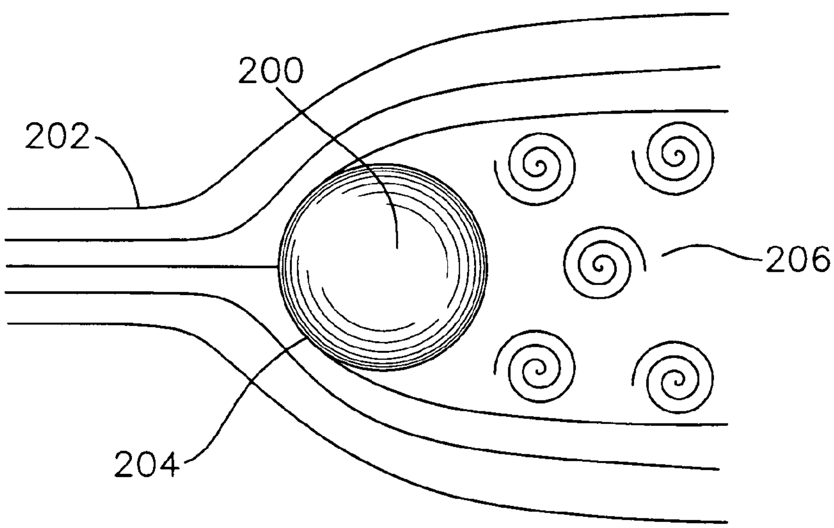


Fig. 2A

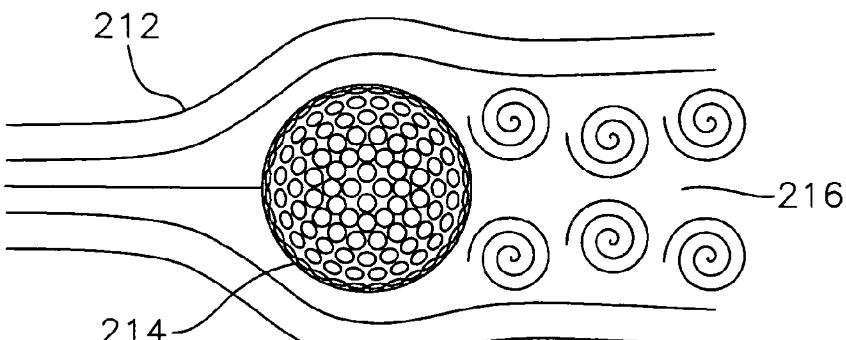


Fig. 2B

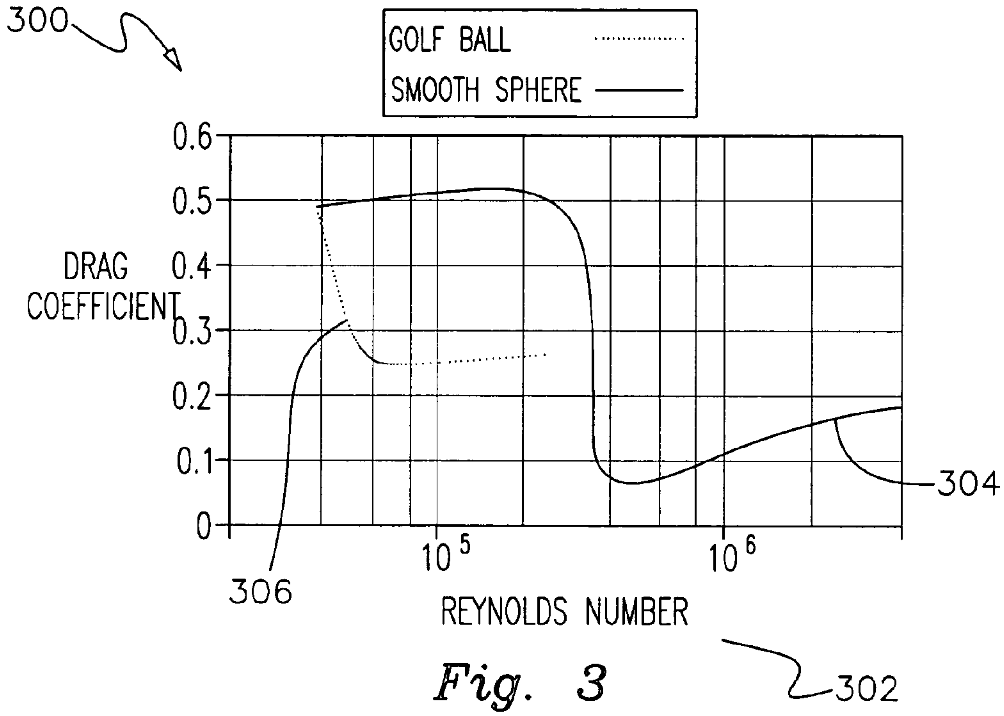


Fig. 3

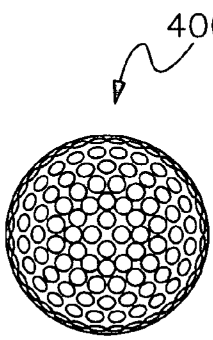


Fig. 4A

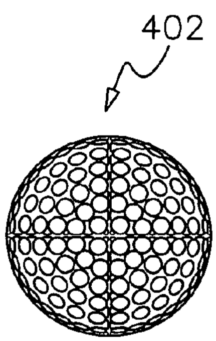


Fig. 4B

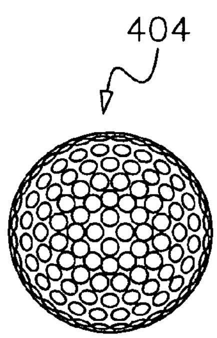


Fig. 4C

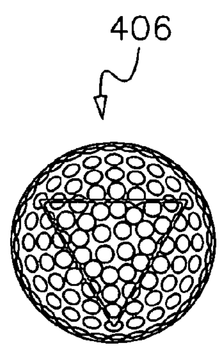


Fig. 4D

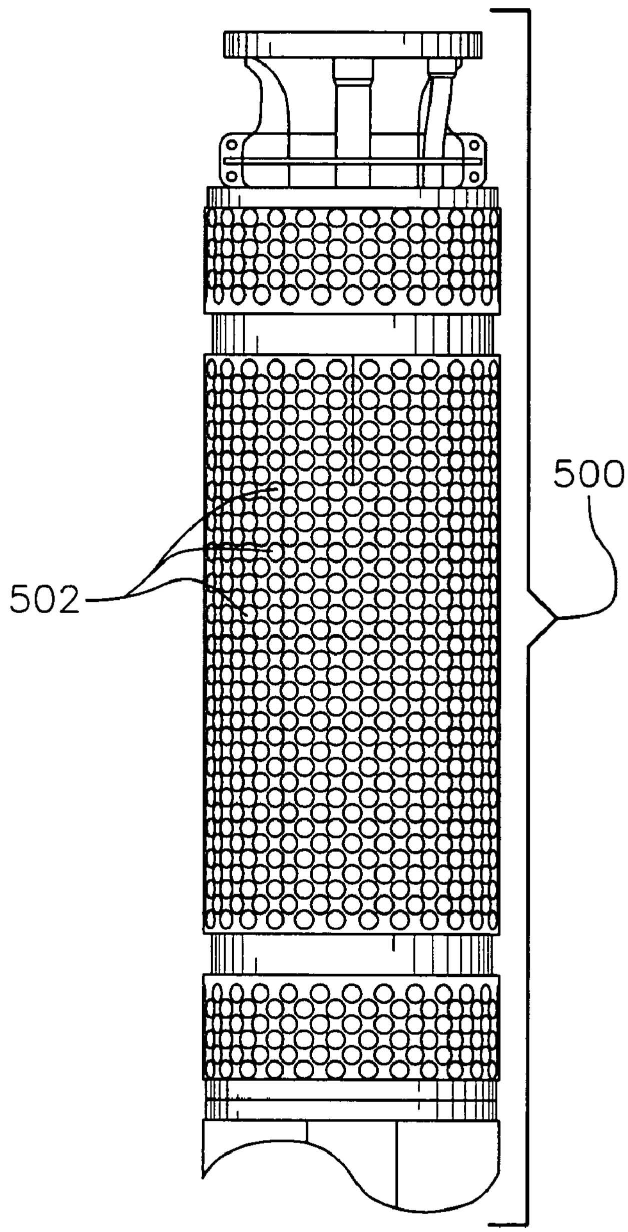


Fig. 5A

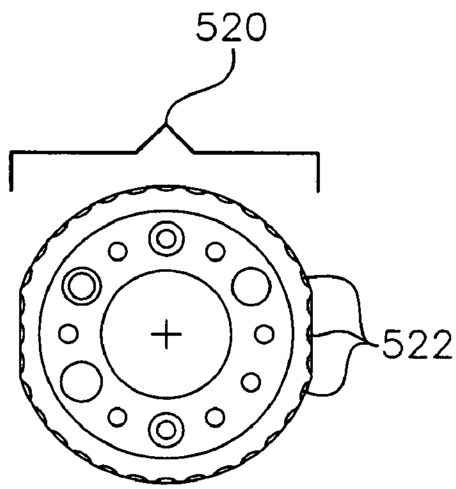


Fig. 5B

DIMPLED RISER FLOATATION MODULE

CROSS REFERENCE TO RELATED APPLICATIONS

[0001] This application takes priority from a provisional application for patent bearing Ser. No. 60/933,570 filed Jun. 7, 2008 entitled Dimpled Riser Floatation and is incorporated as if fully set forth herein.

STATEMENT REGARDING FEDERALLY SPONSORED RESEARCH OR DEVELOPMENT

[0002] Not Applicable

DESCRIPTION OF ATTACHED APPENDIX

[0003] Not Applicable

BACKGROUND OF THE INVENTION

[0004] This invention relates generally to the field of sub sea risers and more specifically to an improved dimpled floatation module. Offshore oil/gas drilling and production face hazards due to the exposure of submerged rig components to underwater sea currents. With the present invention production disruptions from strong underwater currents can be mitigated by reducing turbulence about the riser and oscillations which can disrupt production and potentially lead to catastrophic failure of the submerged rig components.

BRIEF SUMMARY OF THE INVENTION

[0005] The primary advantage of the invention is to provide a floatation that is more hydrodynamic.

[0006] Another advantage of the invention is to provide reduced drag on the riser column.

[0007] Another advantage of the invention is that it will require less tension to keep the riser vertical and therefore reduce the load on the rig.

[0008] Another advantage of the invention is that it will possibly reduce the number of tensioners required on the rig itself.

[0009] In accordance with a preferred embodiment of the invention, there is shown a riser having a generally cylindrical member adapted for attachment to a blow out preventer from the drilling platform or rig to provide a conduit on a oil field installation and a plurality of generally evenly spaced dimples about the circumference of the member, wherein the dimples extend along a predetermined longitudinal dimension of the member.

[0010] In accordance with another preferred embodiment of the invention, there is shown a riser having a generally cylindrical member adapted for attachment to a blow out preventer from the drilling platform or rig to provide a conduit on a oil field installation and a plurality of generally evenly spaced indentations about the circumference of the member, wherein the indentations extend along a predetermined longitudinal dimension of the member.

[0011] In accordance with another preferred embodiment of the invention, there is shown a riser having a generally cylindrical member adapted for attachment to a blow out preventer from the drilling platform or rig to provide a conduit on a oil field installation and a plurality of generally evenly spaced protrusions about the circumference of the member, wherein the protrusions extend along a predetermined longitudinal dimension of the member

[0012] Other objects and advantages of the present invention will become apparent from the following descriptions, taken in connection with the accompanying drawings, wherein, by way of illustration and example, an embodiment of the present invention is disclosed.

BRIEF DESCRIPTION OF THE DRAWINGS

[0013] The drawings constitute a part of this specification and include exemplary embodiments to the invention, which may be embodied in various forms. It is to be understood that in some instances various aspects of the invention may be shown exaggerated or enlarged to facilitate an understanding of the invention.

[0014] FIG. **1** is a schematic diagram illustrating fluid flow around a sphere.

[0015] FIG. **2**A is a schematic diagram of fluid flow about a smooth sphere and resulting turbulence.

[0016] FIG. **2**B is a schematic diagram of fluid flow about a dimpled sphere and resulting reduced turbulence.

[0017] FIG. **3** is a curve depicting drag resulting from flow about a smooth and nonsmooth surfaced sphere.

[0018] FIGS. **4**A, **4**B, **4**C, and **4**D are plan views of exemplary dimpled configurations.

[0019] FIG. **5**A is plan view of a floatation module according to a preferred embodiment of the invention.

[0020] FIG. **5**B is a side elevational view of a floatation module according to a preferred embodiment of the invention.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0021] Detailed descriptions of the preferred embodiment are provided herein. It is to be understood, however, that the present invention may be embodied in various forms. Therefore, specific details disclosed herein are not to be interpreted as limiting, but rather as a basis for the claims and as a representative basis for teaching one skilled in the art to employ the present invention in virtually any appropriately detailed system, structure or manner.

[0022] Offshore oil/gas drilling and production face hazards due to the exposure of submerged rig components to underwater sea currents. Critical among these components are the marine risers, consisting of a series of long steel pipes of circular cross-section, used for deep-water extraction of oil and/or natural gas. These long cylindrical structures, exposed to strong sea currents, induce the flow around them to separate and initiate vortex shedding—whereby vortices of opposite sign are shed synchronously from the aft of the structure. The resultant lift and drag forces create turbulence about the riser and floatation mechanism and excite forced oscillations of the cylinder. To mitigate such vibrations the current invention seeks to reduce turbulence about the floatation module. Increasing development costs and increasingly hostile field environments, demand more robust, reliable, and refined designs and tools. This invention addresses the need by reducing drag and turbulence about the floatation module as described herein.

[0023] To reduce drag around the floatation module, the present invention places golf ball like dimples about the periphery of the floatation module. A variety of dimple configurations are feasible as more fully described below. The dimples reduce drag and wear caused by moving water by creating turbulence in the water around the floatation module.

Surface dimples force the water to hug the floatation module more closely, so instead of flowing past it, the water follows the curvature of the floatation module around to the back. The result is a smaller wake and less drag.

[0024] The most common dimple patterns are icosahedral, dodecahedral, and octahedral. The icosahedral pattern is based on a polyhedral with 20 identical triangular faces, much like a 20-sided die. Similarly, a dodecahedral is based on a polyhedral with 12 identical faces in the shape of pentagons. The octahedral is based on an eight-sided polyhedral with triangular faces. As a general rule, the more dimples something has, the less drag and better fluid dynamic properties as these properties apply to any fluid with some viscosity including aerodynamic and hydrodynamic applications.

[0025] The size, shape and depth of the dimples may also affect performance. Hexagonal and pentagonal shapes have been found to further reduce the drag. Shallow dimples on a golf ball, for example, generate more spin on a golf ball than deep dimples, which increases lift and causes the ball to rise and stay in the air longer and roll less. Deep dimples generate less spin on a golf ball than shallow dimples, which decrease lift and causes the ball to stay on a low trajectory, with less air time and greater roll. Small dimples generally give the ball a lower trajectory and good control in the wind, where as large dimples give the ball a higher trajectory and longer flight time.

[0026] The dimples have a fluid dynamic (hydrodymanic or aeordynamic) effect. Water or air moving over the over the subject surface causes friction, which in turn produces negative pressure behind the object, called drag. "Laminar drag" over a smooth surface separates out much quicker than "turbulent drag" over a dimpled surface. This produces less pressure, and the air or water moves more easily around the subject surface.

[0027] Dimples create a turbulent boundary layer as fluid (e.g. air or water) flows past the surface of the floatation module. This allows fluid to "hug" the surface further around the floatation module as it passes, reducing the size of its wake and, consequently, its drag. For this reason a surface with dimples of the right depth is more aerodynamic than a smooth surface.

[0028] FIG. **1** shows a dimpled sphere (shown here as a golf ball) **102** traveling through a low viscosity medium such as air or water creating an equivalent fluid flow **104**, in this case streaming air. As later described the fluid flow **104** more closely follows the countour of the sphere **102** since the surface is non smooth.

[0029] FIG. **2**A and FIG. **2**B show the boundary layer which is the thin layer of air next to the ball. FIG. **2**A shows a smooth ball **200** in a fluid flow **202** which produces a continuous, laminar boundary layer **204**. Since the fluid flow **202** slides off the smooth ball **200** rather than following the ball's hemisphere surface opposite the fluid flow **202** a large area of turbulant air or wake **206** is created behing the ball **200**. FIG. **2**B shows a dimpled ball **210**. Rather than flowing in a continuous, laminar boundary layer, it has a microscopic pattern of fluctuations and randomized fluid flow **212**. In short, a turbulent boundary layer **214** has better tires; meaning that the fluid flow **212**, in this example, air grabs portions of the dimpled ball **210** and slows down the rotation almost like a well-treaded tire gripping against a road. The fluid flow **212** conforms to the ball's hemisphere surface opposite the direction of the fluid flow **212** creating a much smaller area of turbulant air or wake **216** behind the ball. Air travels around the ball further before separating, creating a smaller wake **216** and much less drag while the spinning motion warps the airflow to generate lift.

[0030] FIG. **3** graphically depicts the phenomenon described above which gives a dimpled golf ball only about half the drag of a smooth one. The Y axis of the graph shows the drag coefficient scale **300** and the X axis shows a logarithmic Reynolds number scale **302**. A perfectly smooth golf ball with no dimples would travel about 130 yards when hit with a driver by a good player due to the lower drag coefficient to Reynolds number relationship depicted as the smooth sphere line **304**. On the other hand, a ball with well-designed dimples, struck the same way, will travel about 290 yards due to the higher drag coefficeint to Reynolds number relationship depicted as the golf ball line **306**.

[0031] Dimple design has changed significantly over time, from random patterns, to formal rows, to interstitial designs. The depth, shape and number have all been varied and tested. With regard to the number of dimples, as one increases the number of dimples, the smaller they must be to fit on the chosen surface area. Eventually, as the number increases, the dimples get smaller and the surface becomes almost smooth—and will perform likewise. So a compromise is the answer.

[0032] It has generally been found that less than about 300 dimples is too few, and more than about 500 is too many is typical in the case of a standard golf ball. Most balls on the market today have thus converged to the middle ground with between 350 and 450 dimples. FIGS. **4**A, **4**B, **4**C and **4**D show exemplary designs and layouts. FIGS. **4**A and **4**B a ball with 392 dimples in an Octahedral layout **400** and **402**. The octahedral is based on an eight-sided polyhedral with triangular faces. FIGS. **4**C and **4**D show a ball with 432 dimples in an icosahedral layout **404** and **406**. As described herein the icosahedral pattern is based on a polyhedral with 20 identical triangular faces, much like a 20-sided die.

[0033] A similar density of dimples would be advantageous about the periphery of the floatation module as shown in FIG. **5**A. FIG. **5**A shows a cross sectional plan view of a floatation module **500** with a plurality of surface depressions or dimples **502** positioned about the surface in a manner to effect the maximum reduction of drag. As shown in FIG. **5**B, a partial side elevational view of a floatation module **520**, there are numerous dimples **522** positioned about the surface of the floatation module. The surface dimples **502** and **522** break up the flow of water around the floatation module and create a turbulence that reduces drag on the floatation module **500** and **520**. This greatly reduces the wear and tear on the floatation module and as described herein may reduce turbulence and vibration of the floatation module, and the riser.

[0034] In an alternative embodiment, small protrusions may be symmetrically placed about the circumference of the riser, each having a pattern of dimples on the protrusions. In this way, the protrusions act as small spheroids with dimples to achieve the overall purpose of breaking up laminar flow and creating turbulences that produce enhanced hydrodynamic effects. The protrusions may be of any of a variety of sizes shapes to achieve the desired goal.

[0035] This solution can be used in a variety of subsea applications where significant water flow is a problem and through the present invention can be reduced thus extending the life of undersea equipment. As with a golf ball, by optimizing the number and formation of the dimples, drag can be reduced and the erosive effects of water flow about the floatation is reduced.

[0036] While the invention has been described in connection with a preferred embodiment, it is not intended to limit the scope of the invention to the particular form set forth, but on the contrary, it is intended to cover such alternatives, modifications, and equivalents as may be included within the spirit and scope of the invention as defined by the claims.

I claim:

1. A riser comprising:

a generally cylindrical member adapted for attachment to a blow out preventer from the drilling platform or rig to provide a conduit on a oil field installation; and

a plurality of generally evenly spaced dimples about the circumference of said member, wherein said dimples extend along a predetermined longitudinal dimension of said member.

2. A riser as claimed in claim wherein said dimples are arranged in an icosahedral pattern based on a polyhedral with identical triangular faces.

3. A riser as claimed in claim **1** wherein said dimples are arranged in a dodecahedral pattern based on a polyhedral with identical pentagonal faces.

4. A riser as claimed in claim **1** wherein said dimples are arranged in a octahedral pattern based on a polyhedral with identical triangular faces.

5. A riser as claimed in claim **1** wherein said dimples are indented in a predetermined amount relative to the radius of the outer annulus of said member.

6. A riser comprising:

a generally cylindrical member adapted for attachment to a blow out preventer from the drilling platform or rig to provide a conduit on a oil field installation;

and a plurality of generally evenly spaced indentations about the circumference of said member, wherein said indentations extend along a predetermined longitudinal dimension of said member.

7. A riser as claimed in claim **6** further comprising dimples arranged in an symmetrical pattern on the surface of said indentation.

8. A riser as claimed in claim **6** further comprising:

dimples arranged in an symmetrical pattern on the surface of said indentations;

said dimples arranged in an icosahedral pattern based on a polyhedral with identical triangular faces.

9. A riser as claimed in claim **6** further comprising:

dimples arranged in an symmetrical pattern on the surface of said indentations;

said dimples arranged in an a dodecahedral pattern based on a polyhedral with identical pentagonal faces.

10. A riser as claimed in claim **6** further comprising:

dimples arranged in an symmetrical pattern on the surface of said indentations;

said dimples arranged in an a octahedral pattern based on a polyhedral with identical triangular faces.

11. A riser comprising:

a generally cylindrical member adapted for attachment to a blow out preventer from the drilling platform or rig to provide a conduit on a oil field installation; and

a plurality of generally evenly spaced protrusions about the circumference of said member, wherein said protrusions extend along a predetermined longitudinal dimension of said member.

12. A riser as claimed in claim **11** further comprising:

dimples arranged in an symmetrical pattern on the surface of said protrusions.

13. A riser as claimed in claim **11** further comprising:

dimples arranged in an symmetrical pattern on the surface of said protrusions;

said dimples arranged in an icosahedral pattern based on a polyhedral with identical triangular faces.

14. A riser as claimed in claim **11** further comprising:

dimples arranged in an symmetrical pattern on the surface of said protrusions;

said dimples arranged in an a dodecahedral pattern based on a polyhedral with identical pentagonal faces.

15. A riser as claimed in claim **11** further comprising:

dimples arranged in an symmetrical pattern on the surface of said protrusions;

said dimples arranged in an a octahedral pattern based on a polyhedral with identical triangular faces.

* * * * *