UNITARY BLADE SEAL FOR A SHEARING BLIND RAM IN A RAM TYPE BLOWOUT PREVENTER

BACKGROUND OF THE INVENTION

1. Field of the Invention

[0001] This invention relates to a unitary, i.e., one piece, blade seal for use in a shearing blind ram for a ram-type blowout preventer used in oil and gas drilling operations. Ram-type blowout preventers are part of a pressure control system used in oil and gas drilling operations to control unexpected well bore pressure spikes or kicks as they are commonly referred to in the industry.

[0002] The blowout preventer has a body with a vertical bore and a pair of laterally disposed opposing bonnet assemblies. Each bonnet assembly includes a piston which is laterally moveable within the bonnet assembly by pressurized hydraulic fluid. Replaceable sealing elements called packers are mounted on the ends of the pistons which extend into the blowout preventer bore. When these pistons are moved to a closed position, commonly referred to as "closing the blowout preventer" or "closing the rams", the vertical bore of the blowout preventer is sealed and the kick is contained. These packers are available in a variety of configurations designed to seal the blowout preventer bore when the opposing pistons are moved to their closed position. One type of packer has ends designed to seal around pipe of a specific size in the blowout preventer bore when the blowout preventer is closed. Other rams are designed to shear through a drill pipe section extending through the vertical bore and seal off the bore. It is this type, commonly referred to as blind shear rams and the blade seal to be used therein to which the present invention is directed.

[0003] These shearing blind rams face a formidable task. They must be able to shear through a piece of drill pipe in the blowout preventer bore and then seal against each other to contain the well bore pressure during a kick. The shearing blind rams must form a pressure tight seal during a kick until the well bore pressure can be controlled which can reach several thousand pounds per square inch. The shearing blind ram has various rubber seal elements attached to it to ensure a complete seal of the blowout preventer bore.

[0004] These seal elements, including the blade seal of the present invention, are exposed to tremendous well bore pressures. The blade seal of the current invention offers a substantial improvement by offering a simple, easy to manufacture blade seal that minimizes wear and tear of the elastomeric seal element with a pair of end caps to minimize extrusion of the seal element.

2. Description of Related Art

[0005] Various types of shearing blind rams with various blade seals have been shown and used.

[0006] U. S. Patent No. 3,766,979 to J. T. Petrick shows a well casing cutter uitilizing O rings to seal around the casing being cut.

[0007] The ram-type blowout preventer shown in U. S. Patent No. 3,817,326 to M. J. Meynier III discloses a blade seal with the rubber element bonded to a metal member.

[0008] U. S. Patent No. 4,081,027 to T. X. T. Nguyen. shows a shearing ram for hydrogen sulfide service utilizing a rubber element bonded to the shear ram to seal after shearing.

[0009] The wellhead shearing apparatus shown in U. S. Patent No. 4,341,264 to F. H. Cox et al. discloses a rubber element bonded in a recessed groove in a shearing ram to act as a blade seal.

[0010] U. S. Patent No. 4,347,898 to M. R. Jones shows a shear ram blowout preventer utilizing a rectangular seal in the lower face of the upper ram as a blade seal.

[0011] A shearing ram utilizing a pair of hardened points to aid in initiating the shearing action is shown in U. S. Patent No. 4,537,250 to J. N. Troxell, Jr. A plain rectangular seal acts as a blade seal.

[0012] The shear ram apparatus shown in U. S. Patent No. 4,540,046 to S. W. Granger et al. discloses a blade seal with the rubber element bonded to a metal member.

[0013] U. S. Patent No. 5,005,802 to D. J. McWhorter et al. shows a variable bore packer for a ram type blowout preventer.

[0014] U. S. Patent No. 5,360,061 to L. M. Womble shows a blowout preventer with tubing shear rams designed to control the shape of the sheared pipe end.

[0015] The shear ram apparatus shown in U. S. Patent No. 5,515,916 to T. D. Haley discloses a blade seal with the rubber element bonded to a metal member and a metal

insert in the rubber element to aid in sealing.

[0016] U. S. Patent No. 5,713,581 to D. W. Carlson et al. shows a blade seal of nitrile rubber with uniformly dispersed synthetic, non-cellulosic fibers to aid in preventing seal rollover.

[0017] U. S. Patent No. 6,158,505 to R. Araujo shows a blade seal design utilizing a pair of tapered blade seal elements to effectuate sealing.

SUMMARY OF THE INVENTION

[0018] The blade seal for a shearing blind ram of the present invention is designed for use in a standard ram-type blowout preventer used in oil and gas drilling operations. The blowout preventer has a body with an axial bore, a pair of opposing bonnet assemblies and a pair of opposing rams laterally moveable within the bonnet assemblies by a pressurized fluid source to control flow of well fluids through the blowout preventer body axial bore. The blade seal includes an elongate member having a generally semi-circular cross section with a curved upper surface and a substantially flat lower surface. The flat lower surface has a pair of laterally extending sides that taper outwardly and have a metal outer cap bonded thereto. The metal outer caps form an acute angle that engages a complementary groove formed in the upper ram of the shearing blind ram assembly. The opposing lower ram has a upwardly facing surface that seals against the blade seal after the pipe is sheared.

[0019] A principal object of the present invention is to provide a unitary blade seal for use in shearing blind rams that has an improved life cycle and fits in existing blowout preventers.

[0020] These with other objects and advantages of the present invention are pointed out with specificness in the claims annexed hereto and form a part of this disclosure. A full and complete understanding of the invention may be had by reference to the accompanying drawings and description of the preferred embodiments.

BRIEF DESCRIPTION OF THE DRAWINGS

[0021] These and other objects and advantages of the present invention are set forth below and further made clear by reference to the drawings, wherein:

[0022] FIGURE 1 is a perspective view with a cutaway section of a shearing blind ram assembly utilizing the blade seal of the present invention installed in a typical ram-type blowout preventer used in oil and gas drilling operations.

[0023] FIGURE 2 is an exploded view of the shearing blind ram assembly.

[0024] FIGURE 3 is a partially exploded view of the upper ram of a shearing blind ram assembly shown in an inverted position.

[0025] FIGURE 4 is a perspective view of the blade seal of the present invention.

[0026] FIGURE 5 is an elevation view showing the shearing blind ram assembly after closing of the blowout preventer and the blade seal sealing between the upper and lower rams.

DESCRIPTION OF THE PREFERRED EMBODIMENT

[0027] With reference to the drawings, and particularly to **FIGURE 1**, an isometric view of a ram type blowout preventer **10** used in oil and gas drilling operations is shown. The ram type blowout preventer **10** includes a body or housing **12** with a vertical bore **14** and laterally disposed ram guideways **16**. Bonnet assemblies **18** are mounted to the body **12** with bolts **20** and aligned with laterally disposed guideways **16**. Each bonnet assembly **18** includes an actuation means **22**, including a piston **24** and connecting rod **26**. While only one guideway **16** and actuation means **22** is shown, it is understood by those of ordinary skill in the art that there is a pair of opposed guideways **16** and actuation means **22**. Each connecting rod **26** is connected to a shearing blind ram assembly **28**. Shearing blind ram assembly **28** includes a blade seal **30** of the present invention. Actuation means **22** allows ram and shearing blind ram assembly **28** to be reciprocated within guideways **16**.

[0028] Shearing blind ram assembly **28** is shown in an exploded view in **FIGURE 2** to aid in understanding the relationship between the parts. Shearing blind ram assembly **28** includes lower ram **32** and upper ram **34**. Lower ram **32** includes top seal **36** and side seals **38** that seal against guideways **16**. Lower ram **32** includes shear blade **40** positioned on its leading edge and seal surface **42**. Upper ram **34** includes top seal **44** and side seals **46** that seal in guideways **16** in a manner similar to lower ram **32**. Blade seal **30** is positioned on the lower face of upper ram **34**.

[0029] Referring to **FIGURE 3**, upper ram **34** is shown inverted from its position of **FIGURE 2** to better illustrate the positioning of blade seal **30** therein. A trapezoidal or "dove tail" shaped groove **48** are machined in lower face **50** of upper ram **34**. Trapezoidal or "dove tail" shaped groove **48** extends the full width of upper ram **34**.

[0030] As best seen in **FIGURE 4**, blade seal **30** includes a generally elongate member **52** formed of molded rubber or other suitable elastomeric material having a generally semi-circular cross section **54**. Semi-circular cross section **54** has a curved upper surface **56** and substantially flat lower surface **58**. Flat lower surface **58** has a pair of laterally extending sides **60** that taper outwardly from semi-circular cross section **54**. Outer caps **62** are bonded to laterally extending sides **60** in a manner well known to those of ordinary skill in the art. Outer caps **62** are formed of metal or similarly suitable stiff material and positioned at an acute angle for engagement with complementary trapezoidal or "dove tail" shaped groove **48** in upper ram **34** to ensure blade seal **30** is held securely in position.

[0031] A typical sequence of operation is as follows. With shearing blind ram assembly **28** installed in blowout preventer **10**, the rams are closed. This causes pipe **64** to be sheared and lower face **50** of upper ram **34** and seal surface **42** of lower ram **32** to slide over one another in close fitting relationship. Continued movement causes seal surface **42** of lower ram **32** to contact and seal against curved upper surface **56** of blade seal **30** as best seen in **FIGURE 5**. Top seals **36** and **44** and side seals **38** and **46** also seal against guideways **16** to ensure a complete seal of the vertical bore **14** after shearing.

[0032] The construction of my unitary blade seal for a shearing blind ram will be readily understood from the foregoing description and it will be seen that I have provided a unitary blade seal that has an improved life cycle and fits in existing blowout preventers. Furthermore, while the invention has been shown and described with respect to certain preferred embodiments, it is obvious that equivalent alterations and modifications will occur to others skilled in the art upon the reading and understanding of the specification. The present invention includes all such equivalent alterations and modifications, and is limited only by the scope of the appended claims

CLAIMS

1. A ram-type blowout preventer for oil and gas drilling operations including a shearing blind ram, comprising:

a body with a vertical bore;

a pair of opposing bonnet assemblies laterally disposed in said body;

a pair of opposing shearing blind rams laterally moveable within said bonnet assemblies;

a blade seal for sealing against an opposing shearing blind ram disposed in one of said shearing blind rams, said blade seal having a generally semi-circular cross section;

said generally semi-circular cross section having a curved upper surface and a lower surface, said lower surface having a pair of laterally extending sides, said pair of laterally extending sides each having a outer cap; and,

said blade seal is molded of rubber or other suitable elastomeric material.

2. A ram-type blowout preventer for oil and gas drilling operations including a shearing blind ram according to Claim 1, wherein:

each of said pair of laterally extending sides taper outwardly from said semi-circular cross section.

3. A ram-type blowout preventer for oil and gas drilling operations including a shearing blind ram according to any preceding Claim, wherein:

said outer caps are bonded to said laterally extending sides.

4. A ram-type blowout preventer for oil and gas drilling operations including a shearing blind ram according to Claim 3, wherein:

said outer caps are formed of metal.

5. A ram-type blowout preventer for oil and gas drilling operations including a shearing blind ram according to Claim 3 or 4, wherein:

said outer caps bonded to said laterally extending sides to form an angle for engagement with a complementary groove formed in said shearing blind ram.

6. A ram-type blowout preventer for oil and gas drilling operations including a

shearing blind ram according to Claim 5, wherein:

said curved upper surface of said generally semi-circular cross section extends above said outer caps.

7. A ram-type blowout preventer for oil and gas drilling operations including a shearing blind ram according to Claim 6, wherein:

said angle for engagement with a complementary groove is an acute angle.

8. A shearing blind ram assembly for a ram-type blowout preventer used in oil and gas drilling operations, comprising:

an upper ram and a lower ram;

said upper ram and said lower ram including top seals and side seals for sealing in a guideway of a ram-type blowout preventer;

a blade seal positioned on the lower face of said upper ram;

said lower ram including a seal surface for engagement with said blade seal when said shearing blind ram assembly is closed;

said blade seal having a generally semi-circular cross section;

said generally semi-circular cross section having a curved upper surface and a lower surface, said lower surface having a pair of laterally extending sides, said pair of laterally extending sides each having a outer cap; and,

said blade seal is molded of rubber or other suitable elastomeric material.

9. A shearing blind ram assembly for a ram-type blowout preventer used in oil and gas drilling operations according to Claim 8 wherein:

each of said pair of laterally extending sides tapering outwardly from said semi-circular cross section.

10. A shearing blind ram assembly for a ram-type blowout preventer used in oil and gas drilling operations according to Claim 8 or 9, wherein:

said outer caps are bonded to said laterally extending sides.

11. A shearing blind ram assembly for a ram-type blowout preventer used in oil and gas drilling operations according to Claim 10, wherein:

said outer caps are formed of metal.

12. A shearing blind ram assembly for a ram-type blowout preventer used in oil and gas drilling operations according to Claim 11, wherein:

said outer caps bonded to said laterally extending sides to form an angle for engagement with a complementary groove formed in said shearing blind ram.

13. A shearing blind ram assembly for a ram-type blowout preventer used in oil and gas drilling operations according to Claim 12, wherein:

said curved upper surface of said generally semi-circular cross section extends above said outer caps.

14. A shearing blind ram assembly for a ram-type blowout preventer used in oil and gas drilling operations according to Claim 13, wherein:

said angle for engagement with a complementary groove is an acute angle.

15. A blade seal for a shearing blind ram for a ram-type blowout preventer used in oil and gas drilling operations, comprising:

an elongate member having a generally semi-circular cross section;

said generally semi-circular cross section having a curved upper surface and a lower surface, said lower surface having a pair of laterally extending sides, said pair of laterally extending sides each having a outer cap; and,

said elongate member is molded of rubber or other suitable elastomeric material.

16. A blade seal for a shearing blind ram for a ram-type blowout preventer used in oil and gas drilling operations according to Claim 15, wherein:

each of said pair of laterally extending sides tapering outwardly from said semi-circular cross section.

17. A blade seal for a shearing blind ram for a ram-type blowout preventer used in oil and gas drilling operations according to Claim 15, wherein:

said outer caps are bonded to said laterally extending sides.

18. A blade seal for a shearing blind ram for a ram-type blowout preventer used in oil and gas drilling operations according to Claim 17, wherein:

said outer caps are formed of metal.

19. A blade seal for a shearing blind ram for a ram-type blowout preventer used in oil and gas drilling operations according to Claim 18, wherein:

said outer caps bonded to said laterally extending sides to form an angle for engagement with a complementary groove formed in said shearing blind ram.

20. A blade seal for a shearing blind ram for a ram-type blowout preventer used in oil and gas drilling operations according to Claim 19, wherein:

said curved upper surface of said generally semi-circular cross section extends above said outer caps.

21. A blade seal for a shearing blind ram for a ram-type blowout preventer used in oil and gas drilling operations according to Claim 20, wherein:

said angle for engagement with a complementary groove is an acute angle.

22. A shearing blind ram assembly substantially as hereinbefore described having reference to the accompanying figures.

23. A blade seal for a shearing blind ram substantially as hereinbefore described having reference to the accompanying figures.

ABSTRACT OF THE DISCLOSURES

UNITARY BLADE SEAL FOR A SHEARING BLIND RAM IN A RAM TYPE BLOWOUT PREVENTER

A unitary blade seal for a shearing blind ram of a ram-type blowout preventer is disclosed and includes an elongate member having a generally semi-circular cross section with a curved upper surface and a lower surface. The lower surface has a pair of laterally extending sides that taper outwardly and have a metal outer cap bonded thereto. The metal outer caps form an acute angle that engages a complementary groove formed in the upper ram of the shearing blind ram assembly.

Fig. 1