Aram block is carried by ram holders in each of two ram assemblies in ram-receiving chambers within a blow-out preventer. One ram block is provided with a downwardly opening recess formed to accommodate a seal member on the lower side thereof but spaced from a diametrical open side of the ram block. The other ram block is provided with a shearing blade projecting from a diametrical open side of the second ram block holder and adapted to coact with the first ram block to shear a drill string and after the shearing action to sealingly engage the seal member of the first ram block when the rams are moved to the closed position.

18 Claims, 9 Drawing Figures
COMBINATION SHEARING AND SHUT-OFF RAM FOR BLOWOUT PREVENTER

BACKGROUND OF THE INVENTION

The present invention relates generally to blowout preventers forming a part of well drilling equipment as used, for example, in the drilling of oil wells and gas wells. Typical of such blowout preventers are those disclosed in the following U.S. Pats.: No. 2,969,838, granted Jan. 31, 1961 to Arthur E. Wilde, No. 3,561,526, granted Feb. 9, 1971 to Williams et al., and No. 3,590,920, granted July 6, 1971 to Orund et al.

Generally speaking, as is well known to those skilled in the art, instances arise wherein a drill string must be cut and/or sealed to prevent damage to the well and associated equipment. This is particularly true in offshore drilling operations.

Conventional devices for shearing a drill string and shutting off a well are effective but suffer the disadvantage of requiring manipulation of drill pipes to complete sealing of the well once the pipe has been cut. For example, in the embodiments of the patents cited above, at least the upper portion of the drill pipe remains in a flattened condition clamped between face seals of ram blocks after being sheared. In such position, the face seals of the ram are unable to mate until the cut drill pipe has been pulled from between the rams. The added manipulation required in order to move the drill pipe from between the rams poses a problem which can be particularly serious in emergency situations. Advantageously, the present invention overcomes the disadvantage of having to retrieve the upper portion of the cut drill pipe through the provision of a shearing blade arrangement wherein the blade itself acts to form a seal between the rams.

SUMMARY OF THE PRESENT INVENTION

The present invention is directed to an improvement in blowout preventers of the type having shearing and shut-off rams. The blowout preventer has a body member housing first and second ram assemblies, each ram assembly having a ram block holder and a ram block with a seal therebetween.

In the improvement of the present invention, one of the ram blocks is provided with a downwardly opening recess formed on the lower side thereof and spaced from a diametrical open side of the ram block. A seal member is disposed within the recess to sealingly engage a shearing blade member secured to and projecting from the opposed ram block holder of the other ram assembly. Consequently, it is not necessary that the faces of the two ram blocks of the respective ram block assemblies meet when the ram assemblies are closed since a seal is effected between the shearing blade of one ram block and the seal member in the recess of the other ram block. Thus the sheared drill pipe need not be manipulated or retrieved in order for the blowout preventer device to seal the well.

It is, therefore, an object of the present invention to provide an improved shearing and shut-off ram system for a blowout preventer for use in the drilling of wells. Yet a further object of the present invention is the provision of such an improved assembly wherein a drill pipe may be sheared and the well sealed by coaction of a shearing blade with a ram block seal to obviate manipulation of the drill pipe or rams to effect a complete closure.

A still further object of the present invention is the provision of such an improved blowout preventer device wherein the seal effected between a shearing blade and a seal member of an opposing ram block is strengthened by virtue of lateral movement of the shearing blade relative to the opposing ram block in order to compress the seal member that engages the shearing blade.

Other and further objects, features and advantages will be apparent in the following description of preferred embodiments of the invention, given for the purpose of disclosure and taken in conjunction with the accompanying drawings.

DESCRIPTION OF THE DRAWINGS

In the drawings forming a part of the disclosure herein, like character references designate like parts throughout the several views, wherein:

FIG. 1 is a partial elevation view, partly in cross section, showing a blowout preventer and ram assembly according to the present invention,

FIG. 2 is a view similar to that of FIG. 1 wherein the shearing and ram assembly has been actuated to cut a drill pipe within the blowout preventer,

FIG. 3 is a plan view of ram assemblies according to the present invention,

FIG. 4 is a cross-sectional view of the ram assemblies according to the present invention, taken along the line 4—4 of FIG. 3,

FIG. 5 is a view similar to that of FIG. 4 but showing the ram assemblies in a closed or engaged position,

FIG. 6 is a partial cross-sectional view of one embodiment of a seal member within the lower recess of a ram block,

FIG. 7 is a partial cross-sectional view of yet a further embodiment of such a seal,

FIG. 8 is a partial cross-sectional view of still another embodiment of a seal, and

FIG. 9 is a perspective view of ram assemblies of the blowout preventer of the present invention.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

With reference to FIG. 1, a double cellar control gate or blowout preventer 10 is illustrated having an upper shear ram assembly 12 and a lower pipe ram assembly 14. The discussion herein will relate primarily to the shear ram assembly 12 inasmuch as the pipe ram assembly 14 may be of conventional design well known to those skilled in the art.

With reference to FIG. 1 as well as to FIG. 2, the control gate has a body 16 with a vertical bore 18 therethrough for reception of a drill string 20. The body member 16 is provided with opposed ram-receiving chambers 22 and 24 in a plane normal to the bore 18.

Referring also to FIG. 9, a first ram assembly 26 is provided for insertion within one of the ram-receiving chambers such as the chamber 24. The first ram assembly 26 generally comprises a ram block holder 28 of semi-circular configuration having a substantially concentric, semi-circular, upwardly opening recess 30 on the upper side. Secured within the recess 30 is a semi-circular ram block 32. A seal member 34 is disposed along and between at least the circular portions of the ram block holder 28 and the ram block 32.

A second ram assembly 36 (as best shown in FIG. 9) is provided to be inserted within the ram-receiving
chamber 22. The second ram assembly 36 generally comprises a ram block holder 38 of semi-circular configuration similar to that of the ram block holder 28. A semi-circular ram block 40 is secured within a recess 42 of the holder 38, the recess 42 being similar to the recess 30 of the ram assembly 26. A shearing blade member 44 is secured to and is projectingly disposed along the diametrical open side of the ram block holder 38 and is adapted to coact with the ram block 32 of the first ram assembly 26 to shear a drill string and is further adapted after such shearing action to sealingly engage a seal member of the first ram assembly 26 as will be described hereafter. A seal member 46 is disposed along and at least between the circular portions of the holder 38 and the ram block 40.

With reference to FIGS. 3 and 4, the first ram assembly 26 includes a ram block holder 28 of semi-circular configuration having a substantially concentric, semi-circular, upwardly opening recess 30 on the upper side. A semi-circular ram block 32 is secured such as by a bolt 33 within the recess of the holder 28. The ram block 32 is provided with a downwardly opening recess 48 formed on its lower side but spaced from the diametrical open side 50 of the ram block 32.

Preferably, the ram block of the first ram assembly 26 is formed of two pieces secured together as shown in FIGS. 3 and 4, including the main ram block portion 32 and a face plate 52 secured to the main ram block portion 32 by a series of bolts 54. As best shown in FIG. 4, the face plate 52 coacts with the main portion of the ram block 32 in forming the recess 48. Consequently, in the downwardly opening, substantially longitudinal recess 48 formed on the lower side of the ram block 32, the wall 56 of the recess 48 nearest the diametrical open side 50 of the ram block 32 tapers outwardly and downwardly as shown.

A seal member 34 is disposed along and between at least the circular portions of the ram block holder 28 and the ram block 32 of the first ram assembly 26. The seal member 34 preferably is formed of resilient material such as rubber in a half-ring configuration as shown in FIG. 3 and has a half-ring reinforcing bar 58 embedded in the resilient material yet preferably exposed on one side 60 for engagement with the ram block 32.

A second seal member 62 is disposed within the downwardly opening recess 48 of the ram block 32, the seal member 62 being of a configuration substantially conforming to the configuration of the recess 48. Preferably, the seal member 62 is formed of a resilient material such as rubber and is at least as long as the shearing blade member 44 of the second ram assembly 36 as shown in FIG. 3. It is also preferred that the resilient portion of the seal 62 be formed integrally with the first seal member 34 to insure against fluid leakage between the ram block 32 and the holder 28. The seal member 62 is mounted within the recess 48 so as normally to be substantially flush with the lower surface 64 of the ram block 32. An elongate (approximately as long as the resilient material) metal supporting plate 66 is molded by suitable means in the strip of resilient material forming the seal 62, the supporting plate 66 being adapted to pressingly engage the shearing blade 44 when the ram assemblies 26 and 36 are moved to the closed position as will be explained.

As best shown in FIG. 4, a portion 68 of the resilient material forming the seal 62 is disposed between the elongate metal supporting plate 66 and the wall 56 of the recess 48 adjacent the diametrical open side 50 of the ram block 32. The function of the seal member 62 so formed will be explained hereafter.

Continuing with respect to FIG. 4, the lower edge 70 of the face plate 52 forming a part of the ram block 32 forms a shearing blade to coact with the shearing blade member 44 of the second ram assembly 36 when the ram assemblies 26 and 36 are moved to the closed position as shown in FIG. 5. Thus, an advantage of a separate face plate 52 secured to the ram block 32 rather than forming the face plate 52 integrally in unibody construction of the ram block 32 is that the face plate 52 may be unbolted from the main portion of the ram block 32. The dull edge 70 may thus be sharpened or a new face plate 52 added as part of the ram block 32.

Continuing now with respect to FIGS. 3 and 4, the second ram assembly 36 is provided with a ram block holder 38 of semi-circular configuration having a substantially concentric, semi-circular, upwardly opening recess 42 on the upper side thereof. A semi-circular ram block 40 is secured, such as by a bolt 41 or other suitable means, within the recess 42 of the ram block holder 38. A shearing blade member 44 is secured such as by means of a plurality of bolts 72 to and along the diametrical open side of the ram block holder 38. The shearing blade member 44 is adapted to coact with the ram block 32 (and more particularly the lower edge 70 thereof) of the first ram assembly 26 to shear a drill string (i.e., the well string 20 of FIGS. 1 and 2) and is further adapted after such shearing action to sealingly engage the seal member 62 of the first ram assembly 26 when the ram assemblies 26 and 36 are moved to the closed position. In such position, a recess 84 (as best shown in FIG. 9) accommodates the sheared pipe 20 as shown in FIG. 2. A seal member 46 similar to that of the seal member 36 is disposed along and between the circular ports of the holder 38 and the block 40.

The ram block holders 28 and 38 of the ram block assemblies 26 and 36, respectively, are provided with means for actuating the assemblies closely toward and openly away from each other within the chambers 22 and 24 of the body member 16 as shown in FIGS. 1 and 2. While the actuating means are not shown in the drawings, it will be understood by those skilled in the art that means may include hydraulic systems as are well known. In addition, the actuating means includes slots 74 formed in the ram block holders 28 and 38 in order to engage suitable piston means as will become apparent to those skilled in the art. As shown in FIG. 9, the slots 74 are formed within arcuate shaped extensions 76 of the ram block holders 28 and 38.

With reference primarily to FIG. 4, discussion being pertinent also to FIGS. 5 and 6, it is preferred that the upwardly opening recess 30 on the upper side of the ram block holder 28 of the first ram assembly 26 forms and is formed about an upwardly extending longitudinal protuberance 76 along the diametrical open side of the ram block holder 28. As shown in the best detail in FIG. 6, the protuberance 76 matingly engages surfaces 7 and 80 of the downwardly opening recess 48 of the ram block 32. This construction in effect allows a dovetailing of structural members to provide extra support for compressingly engaging the seal member 62 disposed within the recess 48 which is substantially parallel to but spaced from the diametrical open side or face 50 of the ram block 32. The elongate resilient strip por-
tion of the seal 62 is suitably mounted within the recess 48 such that it engages the protuberance 76 of the ram block holder 28 on at least one side and engages the recess 48 on at least another side. As shown in FIG. 6, the wall 56 of the recess 48 nearest the diametrical open side 50 of the ram block 32 tapers outwardly and downwardly and the elongate resilient strip portion of the seal 62 is of a configuration conforming to the surfaces of the recess that it contacts.

With reference to FIG. 7, another embodiment of the first ram assembly 26 is shown wherein the ram block holder 28 does not have a protuberance. Thus, as shown in FIG. 7, the ram block holder 28 simply supports the ram block 32 and the recess 48 alone accommodates the seal member 62.

FIG. 8 illustrates yet another embodiment of the first ram assembly wherein the seal member 62 is provided with a supporting plate 66 that is flush with the sealing surface 68 of the resilient portion of the seal member 62. In such embodiment, lateral movement of the protuberance 76 of the holder 28 relative to the block 32 forces the resilient portion of the seal member 62 into engagement with the shearing blade 44 of the second ram assembly 36.

With respect to FIGS. 4, 5, 6 and 7, slightly varying embodiments of the elongate metal supporting plate 66 are shown wherein in each instance the plate 66 is nevertheless embedded or molded in the strip of resilient material forming the bulk of the strip member 62. In each embodiment, the metal supporting plate 66 is adapted to pressingly engage the shearing blade member 44 of the second ram assembly 36 when the ram assemblies 26 and 36 are moved to the closed position. As shown in FIG. 5, when the metal supporting plate 66 engages the shearing blade 44, the resilient material of the seal member 62 is forced into compressive engagement with the upper surface of the shearing blade 44, the compressive forces being indicated by the arrow 82 shown in FIG. 5. Such compressive action greatly strengthens the seal between the seal member 62 and the shearing blade 44 insuring against leakage of any well fluid upwardly between the ram assemblies 26 and 36. A seal 85 may be provided within an appropriate recess within the ram block 40 to insure against leakage between the shearing blade 44 and the ram block 40, the seal 85 preferably being integrally formed with the seal member 66.

Referring once again to the seal members 34 and 46 of the first and second ram assemblies 26 and 36, respectively, the seal members 34 and 46 are provided with half-ring reinforcing bars 58 preferably formed of steel which are molded in the semi-circular or half-ring strips of resilient material that form the seals 34 and 46. The primary function of the half-ring reinforcing bars 58 is to restrict and control squeeze imposed on the seals 34 through limited movement of the ram blocks 32 and 40 within the ram block holders 28 and 38, respectively, when the ram assemblies 26 and 36 are closed. Thus, the seal members 34 and 46 effectively seal against fluid leakage between the ram blocks and ram block holders of the ram assemblies 26 and 36, as well as between ram assemblies 26 and 36 and the upper inside face of ram chambers 32 and 40. The sealing function is accomplished without the resilient material of the seal members 34 and 46 excessively "creeping" or otherwise working out of the space between the ram blocks and the ram block holders.

In operation, when it is desired to actuate the blowout preventer or control gate apparatus of the present invention, the pipe ram assembly 14 is moved into engagement with the drill pipe or well string 20 as shown in FIGS. 1 and 2. The ram assemblies 26 and 36 which are in the open position as shown in FIG. 1 are moved to the closed position as shown in FIG. 2. During the closing operation, the shearing blade 44 of the holder 38 and the face 50 (FIG. 4) of the ram block 32 move toward each other to flatten the pipe 20 as shown in FIG. 2. As the pipe 20 is flattened, it is cut by the blade 44 in shearing coaction with the lower edge 70 (FIG. 4) of the ram block 32 which also forms a shearing blade.

As the closing movement of the ram assemblies 26 and 36 continues, the shearing blade member 44 gradually engages the bottom side of the supporting plate 66 of the seal member 62 as best shown in FIG. 5. When the fully closed or engaged position of the ram assemblies 26 and 36 is reached as shown in FIG. 5, the supporting plate 66 is lifted upward thereby generating a squeeze of the resilient or rubber portion of the seal 62 which results in increased compression (as shown by the arrow 82 in FIG. 5) of the rubber in the sealing area designated by the reference character 68 in FIGS. 4 and 5.

As shown in FIG. 4, a bore 35 is provided within the ram block holder 28 to accommodate the bolt 33 that securely engages the ram block 32. A similar bore 43 is provided within the ram block holder 38 to accommodate the bolt 41. The bores 35 and 43 are sufficiently larger than the bolts 33 and 41, respectively, to allow limited lateral movement of the ram blocks 32 and 40 relative to the ram block holders 28 and 38, respectively. With regard to FIG. 6, upon closure of the ram assemblies, such lateral movement will create a gap between the protuberance 76 of the holder 28 and the surface 78 of the ram block 32, the gap not being shown in the drawings.

It should be noted that additional compression of the rubber or resilient portion of the seal member 62 as indicated by the arrow 82 in FIG. 5 takes place due to limited lateral movement of the ram block 32 in the ram block holder 28 upon closing engagement of the ram assembly 26 with the assembly 36. Because of this limited lateral movement, the rubber or resilient portion of the seal 62 is squeezed between the protuberance 76 of the holder 28 and the surface 78 of the ram block 32, also as shown in FIG. 6. The tapered surface 56 in effect projects the squeezing thrust toward the sealing area 68 of the seal 62. The increased compression of the resilient portion of the seal 62 strengthens or tightens the sealing contact of the seal member 62 in the sealing area 68 of the seal 62 when it engages the upper surface of the shearing blade 44 as shown in FIG. 5.

After the drill pipe has been sheared, as shown in FIG. 2, the closing motion of the ram assemblies 26 and 36 continues until the face 50 of the ram block 32 meets and abuts the divided face 82 of the ram block 40 as best shown in FIG. 9. As shown in FIG. 5, the blade 44 will then be in the position indicated by the dotted outline 44a. In the closed position, the upper portion of the cut drill pipe 20 as shown in FIG. 2 is pushed between the ram block 32 and 40 into a recess 84 of the ram block 40, the recess 84 of the ram block 40 being best shown in FIG. 9. Thus, the drill pipe 20
need not be raised or otherwise manipulated in order for the ram assemblies 26 and 38 to effect a complete seal within the control gate body. Also as may be seen in FIG. 2, the lower portion of the cut drill pipe may move to a position between the shearing blade 44 and the ram block holder 28, again obviating any necessity of manipulation of the cut drill pipe to effect a seal.

The present invention, therefore, is well adapted to carry out the objects and attain the ends and advantages mentioned as well as others inherent therein. While a presently preferred embodiment of the invention has been given for the purpose of disclosure, numerous changes in the detail of construction and the combination, shape, size and arrangement of parts may be resorted to without departing from the spirit and scope of the invention as hereinafter claimed.

What is claimed is:

1. A blowout preventer including,
   a. a body member having a bore therethrough for reception of a drill string and having opposed ram-receiving chambers in a plane normal to said bore, b. a first ram assembly in one of said ram-receiving chambers, the first ram assembly comprising,
   i. a ram block holder having an upwardly opening recess therein along but spaced from an open side of said ram block, ii. a first seal member disposed between the holder (b)(i) and the ram block (b)(ii), and iii. a second seal member disposed within the downwardly opening recess of the ram block (b)(ii), and c. a second ram assembly in the other of said ram-receiving chambers, the second ram assembly comprising,
   i. a ram block holder having an upwardly opening recess on the upper side, ii. a ram block secured within the recess of the holder (b)(i), iii. a shearing blade member secured to and projectively disposed along an open side of the ram block holder (c)(i) adapted to coact with the ram block (b)(ii) of the first ram assembly (b) to shear a drill string and further adapted after said shearing action to sealingly engage the second seal member (b)(iv) of the first ram (b), when the rams (b) and (c) are moved to the closed position, and iv. a seal member disposed between the holder (c)(i) and the block (c)(ii), and d. means for actuating said ram assemblies consisting toward and opening away from each other in the chambers thereof normal to the bore of the body member (a).

2. The invention of claim 1 wherein the lower edge of the open side of the ram block (b)(ii) forms a shearing blade to coact with the shearing blade member (c)(iii) of the second ram assembly (c) when the rams (b) and (c) are moved to the closed position.

3. The invention of claim 1 wherein the second seal member (b)(iv) of the first ram assembly (b) extends at least the length of the open side of the ram block (b)(ii).

4. The invention of claim 1 wherein the first seal member (b)(iii) and (c)(iii) each comprise, a half-ring strip of resilient material, and a half-ring reinforcing bar molded in the resilient material yet exposed on one side for engagement with the ram blocks (b)(ii) and (c)(ii) respectively.

5. The invention of claim 1 wherein the second seal member (b)(iv) disposed within the downwardly opening recess of the ram block (b)(ii) comprises, a strip of resilient material at least as long as the shearing blade member (c)(iii) and mounted within said recess so as to be substantially flush with the lower surface of the ram block (b)(ii), and an elongate metal supporting plate embedded in the strip of resilient material and adapted to pressingly engage the shearing blade member (c)(iii) when the ram assemblies (b) and (c) are moved to the closed position.

6. A blowout preventer including,
   a. a body member having a bore therethrough for reception of a drill string and having opposed ram-receiving chambers in a plane normal to said bore, b. a first ram assembly in one of said ram-receiving chambers, the first ram assembly comprising,
   i. a ram block holder of semi-circular configuration having a substantially concentric semi-circular upwardly extending recess on the upper side formed about and forming an upwardly extending longitudinal protuberance along the diametrical open side of the holder, ii. a semi-circular ram block secured within the recess of the holder (b)(i), said ram block having a downwardly opening, substantially longitudinal recess formed on the lower side thereof, a portion of the recess matingly engaging the protuberance of the holder (b)(i), iii. a first seal member disposed along and between at least the circular portions of the holder (b)(i) and the block (b)(ii), and iv. a second seal member disposed within the recess of the lower side of the ram block (b)(ii) substantially parallel to but spaced form the diametrical open side of the block (b)(ii), and engaging the protuberance of the ram block holder (b)(i), c. a second ram assembly in the other of said ram-receiving chambers, the second ram assembly comprising,
   i. a ram block holder of semi-circular configuration having a substantially concentric, semi-circular, upwardly opening recess on the upper side, ii. a semi-circular ram block secured within the recess of the holder (b)(i), iii. a shearing blade member secured to the ram block holder (c)(i) so as to laterally project beyond the diametrical open side of the ram block holder (c)(i) and adapted to coact with the ram block (b)(ii) of the first ram (b) to shear a drill string and further adapted after said shearing action to sealingly engage the seal member (b)(iv)
of the first ram (b) when the rams (b) and (c) are moved to the closed position, and
iv. a seal member disposed along and between at least the circular portions of the holder (c)(i) and the block (c)(ii), and
d. means for actuating said ram assemblies closely toward and opening away from each other in the rams thereof normal to the bore of the body member (a).
8. The invention of claim 7 wherein the lower edge of the diametrical open side of the ram block (b)(ii) forms a shearing blade to coact with the shearing blade member (c)(iii) of the second ram assembly (c) when the ram assemblies (b) and (c) are moved to the closed position.
9. The invention of claim 7 wherein the second seal member (b)(iv) of the first ram assembly (b) extends at least the length of the diametrical open side of the ram block (b)(ii).
10. The invention of claim 7 wherein the first seal members (b)(iii) and (c)(iii) each comprise, a half-ring strip of resilient material, and a half-ring reinforcing bar embedded in the resilient material yet exposed on one side for engagement with the ram block.
11. The invention of claim 7 wherein the second seal member (b)(iv) disposed within the recess of the lower side of the ram block (b)(ii) comprises, an elongate resilient strip member at least as long as the shearing blade (c)(iii) and mounted within said recess such that it engages the protuberance of the ram block holder (b)(i) on at least one side and the recess of the ram block (b)(ii) on at least another side, and
an elongate metal supporting plate embedded longitudinally in the resilient strip member and adapted to pressingly engage the shearing blade member (c)(iii) when the rams (b) and (c) are moved to the closed position.
12. The invention of claim 11 wherein a portion of the resilient material of the second seal member (b)(iv) is disposed between the elongate metal supporting plate and the edge of the diametrical open side of the ram block (b)(ii) and is adapted to compressively engage the upper surface of the shearing blade member (c)(iii) when the rams (b) and (c) are moved to the closed position.
13. The invention of claim 12 wherein, in the downwardly opening, substantially longitudinal recess formed on the lower side of the ram block (b)(ii), the wall of the recess nearest the diametrical open side of the ram block (b)(ii) tapers outwardly and downwardly, and the elongate resilient strip member is of a configuration substantially conforming to said recess.
14. In a blowout preventing having a body member having a bore therethrough for reception of a drill string and having opposed ram-receiving chambers in a plane normal to said bore, a first ram assembly in one of said ram-receiving chambers, the first ram assembly comprising,
i. a ram block holder of semi-circular configuration,
ii. a semi-circular ram block,
iii. a first seal member disposed along and between at least the circular portions of the holder (b)(i) and the block (b)(ii),
c. a second ram assembly in the other of said ram-receiving chambers, the second ram assembly comprising,
i. a ram block holder of semi-circular configuration having a substantially concentric, semi-circular upwardly opening recess on the upper side, ii. a semi-circular ram block secured within the recess of the holder (b)(i), iii. a shearing blade member secured to the ram block holder (c)(i), and
iv. a seal member disposed along and between at least the circular portions of the holder (c)(i) and the block (c)(ii), and
d. means for actuating said ram assemblies closely toward and opening away from each other in the chambers thereof normal to the bore of the body member (a),
the improvement in the first ram assembly wherein,
e. in the ram block holder (b)(i), a concentric semi-circular, upwardly opening recess on the upper side is formed about and forms an upwardly extending longitudinal protuberance along the diametrical open side of the holder,
f. in the ram block (b)(ii), the ram block being secured within the recess of the holder (b)(i), said ram block has a downwardly opening, substantially longitudinal recess formed on the lower side thereof, a portion of the recess matingly engaging the protuberance of the holder (b)(i), and
g. a second seal member is disposed within the recess of the lower side of the ram block (b)(ii) substantially parallel to but spaced from the diametrical open side of the ram block (b)(ii) and engaging the protuberance of the ram block holder (b)(i), and
the improvement in the second ram assembly wherein,
h. the shearing blade member (c)(iii) is secured to the ram block holder (c)(i) so as to laterally project beyond the diametrical open side of the ram block holder (c)(i) and is adapted to coact with the ram block (b)(ii) of the first ram assembly (b) to shear a drill string and further adapted after said shearing action to sealingly engage the second seal member (g) of the first ram assembly (b), when the ram assemblies (b) and (c) are moved to the closed position.
15. The invention of claim 14 wherein the diametrical open sides of the ram block (c)(ii) and the ram block holder (b)(i) are recessed to accommodate a sheared drill string.
16. The invention of claim 14 wherein the second seal member (g) disposed within the recess of the lower side of the ram block (b)(ii) comprises, an elongate resilient strip member at least as long as the shearing blade (c)(iii) and mounted within said recess such that it engages the protuberance of the ram block holder (b)(i) on at least one side and engages the recess of the ram block (b)(ii) on at least another side, and
an elongate metal supporting plate embedded and adapted to pressingly engage the shearing blade member (c)(iii) when the ram assemblies (b) and (c) are moved to the closed position, a portion of the strip of resilient material being disposed between the elongate metal supporting plate and the edge of the diametrical open side of the ram block (b)(ii) and being adapted to compressingly engage the upper surface of the shearing blade member.
(c)(iii) when the rams (b) and (c) are moved to the closed position.
17. The invention of claim 16 wherein, in the downwardly opening substantially longitudinal recess (f) formed on the lower side of the ram block (b)(ii), the wall of the recess (f) nearest the diametrical open side of the ram block (b)(ii) tapers outwardly and downwardly, and the elongate resilient strip member is of a configuration substantially conforming to said recess.
18. The invention of claim 16 wherein the ram blocks (b)(ii) and (c)(ii) are secured to the ram block holders (b)(i) and (c)(i), respectively by means providing limited lateral movement of the ram blocks relative to the ram block holders such that force may be exerted by the protuberance of the ram block holder (b)(i) against the second seal member (g).

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