operable system to equalize the pressure behind the back of each ram with the fluid pressure below the ram packers. The second communication system includes a selectively operable fluid communications system for equalizing fluid pressure between the back of each ram with the fluid pressure above the ram packers. As such, each selectively operable fluid control system includes a control unit connected to it for such "selective" operation.

[0024] All prior-art solutions rely on completely sealing-off the ram block within the horizontal bore and equalizing the pressure differential between the wellbore (above or below the ram blocks) and the volumes behind the ram blocks. These systems are relatively complicated and expensive, the pressure balancing passageways may be prone to plugging (e.g., by drilled cuttings in the drilling mud), and failure of certain pressure-equalizing valve components may provide an open conduit from the wellbore below the ram blocks to the wellbore above the ram blocks. More critically, if the pressure-equalization mechanisms fail (whether, for example, by plugged passageways or the failure of a valving component) while operating in a subsea stack, the cessation of drilling operations, killing the well, and pulling the entire subsea stack to the surface for repairs would likely be required. Therefore, it would be desirable to have a bidirectional sealing ram BOP which does not require pressure equalization passages or valving. Additionally, it would also be desirable to have a ram BOP capable of sealing against bidirectional pressure using the existing ram block seals of "legacy" ram BOPs.

SUMMARY OF INVENTION

[0024a] According to one aspect, there is provided a ram-type blowout preventer, comprising: a body; a vertical bore through the body; a horizontal bore through the body intersecting the vertical bore; a pair of ram blocks disposed in the horizontal bore on opposite sides of the body, wherein the ram blocks are configured to move along the horizontal bore to have controlled lateral movement to and from the vertical bore; a seal carrier disposed about the vertical bore between the body and adjacent to the horizontal bore; and a sealing device positioned between the body and the seal carrier; wherein the seal carrier is configured to be displaced along an axis of the vertical bore such that the seal carrier moves unbiased within a predetermined range along the vertical bore, and the sealing device is positioned further away from the axis of the vertical bore than a top seal of the at least one of the pair of ram blocks such that when a pressure from above the pair of ram blocks is applied, a net force is generated that pushes the seal carrier towards the pair of ram blocks.

[0024b] According to a further aspect, there is provided a ram-type blowout preventer, comprising: a body; a vertical bore through the body; a horizontal bore through the body intersecting the vertical bore; a pair of ram blocks disposed in the horizontal bore on opposite sides of the body, wherein the ram blocks are configured along the horizontal bore to have controlled lateral movement to and from the vertical bore; a seal carrier disposed at the intersection of the vertical bore and the horizontal bore; and a sealing device positioned between the body and the seal carrier; wherein the seal carrier is configured to be displaced along an axis of the vertical bore such as that the seal carrier moves unbiased within a predetermined range along the vertical bore, wherein the seal carrier is configured to be sealingly engaged with a top seal of at least one of the pair of ram blocks, and the sealing device is positioned further away from the axis of the vertical bore than a top seal of the at least one of the pair of ram blocks such that when a pressure from above the pair of ram blocks is applied, a net force is generated that pushes the Seal carrier towards the pair of ram blocks.

[0024c] According to another aspect, there is provided a ram-type blowout preventer, comprising: a body; a vertical bore through the body; a horizontal bore through the body intersecting the vertical bore; a pair of ram blocks disposed in the horizontal bore on opposite sides of the body, wherein the ram blocks are configured to move along the horizontal bore to have controlled lateral movement to and from the vertical bore; a seal carrier disposed at the intersection of the vertical bore and the horizontal bore; and a sealing device positioned between the body and the seal carrier; wherein the seal carrier is configured to be thrust into sealing engagement with at least one of the pair of ram blocks by fluid pressure above the ram blocks such that the seal carrier moves unbiased within a predetermined range along the vertical bore, and the sealing device is positioned further away from an axis of the vertical bore than a top seal of at least one of the pair of ram blocks such that when the fluid pressure from the pair of ram blocks is applied, a net force is generated that pushes the seal carrier towards the pair of ram blocks.

[0024d] According to yet another aspect, there is provided a method of actuating a ram-type blowout preventer, the method comprising: positioning a sealing device further away from an axis of a vertical bore of a body of the blowout preventer than a top seal of at least one of a pair of ram blocks such that when a pressure from above the pair of ram blocks is applied, a net force is generated that pushes a seal carrier towards the pair of ram blocks, wherein the seal carrier is configured to move unbiased within a predetermined range along the vertical bore; sealing a pair of ram blocks against one another proximate a wellbore axis by moving the pair of ram blocks along a horizontal bore formed in a body of the ram-type blowout preventer; and sealingly engaging a seal carrier with at least one of the pair of ram blocks from fluid pressure acting upon the ram blocks, wherein the seal carrier is configured to be sealingly displaced along the wellbore axis such that the seal carrier moves along the vertical bore formed in a body of the ram-type blowout preventer, the vertical bore intersecting the horizontal bore.

[0025] E~~In one aspect, e~~mbodiments disclosed herein relate to a ram-type blowout preventer. The ram-type blowout preventer may comprises a body, a vertical bore through the body, a horizontal bore through the body intersecting the vertical bore, and a pair of ram blocks disposed in the horizontal bore on opposite sides of the body, in which the ram blocks are adapted for controlled lateral movement to and from the vertical bore. The ram-type blowout preventer may further includes a seal carrier disposed about the vertical bore between the BOP body and adjacent to the horizontal bore, in which the seal carrier is configured to be displaced along an axis of the vertical bore. The ram-type blowout preventer may further includes a sealing device positioned between the body and the seal carrier.

[0026] EIn another aspect, embodiments disclosed herein relate to a ram-type blowout preventer. The ram-type blowout preventer may includes a body, a vertical bore through the body, a horizontal bore through the body intersecting the vertical bore, and a pair of ram blocks disposed in the horizontal bore on opposite sides of the body, in which the ram blocks are adapted for controlled lateral movement to and from the vertical bore. The ram-type blowout preventer may further includes a seal carrier disposed at the intersection of the vertical bore and the horizontal bore, in which the seal carrier is configured to be displaced along an axis of the vertical bore and to be sealingly engaged with a top seal of the at least one of the pair of ram blocks. The ram-type blowout preventer may further includes a sealing device positioned between the body and the seal carrier.

[0027] Further, in another aspect, embodiments disclosed herein relate to a ram-type blowout preventer. The ram-type blowout preventer may includes a body, a vertical bore through the body, a horizontal bore through the body intersecting the vertical bore, and a pair of ram blocks disposed in the horizontal bore on opposite sides of the body, in which the ram blocks are adapted for controlled lateral movement to and from the vertical bore. The ram-type blowout preventer may further includes a seal carrier disposed at the intersection of the vertical bore and the horizontal bore, in which the seal carrier is configured to be thrust into sealing engagement with at least one of the pair of ram blocks by fluid pressure . above the ram blocks. The ram-type blowout preventer further may includes a sealing device positioned between the body and the seal carrier.

[0028] Further, in yet another aspect, embodiments disclosed herein relate to a method of actuating a ram-type blowout preventer. The method may includes sealing a pair of ram blocks against one another proximate a wellbore axis and sealingly engaging a seal carrier with the pair of ram assemblies from fluid pressure acting upon the ram assemblies. The seal carrier may beis configured to be sealingly displaced along the wellbore axis.

[0029] Other aspects and advantages of the embodiments disclosed herein will be apparent from the following description and the appended claims.

CLAIMS

What is claimed is:

I A ram-type blowout preventer, comprising:

a body;

a vertical bore through the body;

a horizontal bore through the body intersecting the vertical bore;

a pair of ram blocks disposed in the horizontal bore on opposite sides of the body, wherein the ram blocks are adapted for controlled lateral movement to and from the vertical bore;

a seal carrier disposed about the vertical bore between the body and adjacent to the horizontal bore; and

a sealing device positioned between the body and the seal carrier;

wherein the seal carrier is configured to be displaced along an axis of the vertical bore.

2. The ram-type blowout preventer of claim 1, wherein the seal carrier is configured to sealingly engage a top seal of at least one of the pair of ram blocks.

3. The ram-type blowout preventer of claim 2, wherein a pressure seal area of the seal carrier is larger than a pressure seal area of the ram blocks.

4. The ram-type blowout preventer of claim 1, wherein the seal carrier comprises a sleeve portion and a flange portion.

5. The ram-type blowout preventer of claim 4, wherein the sealing device is disposed upon the sleeve portion.

6. The ram-type blowout preventer of claim 1, wherein the sealing device comprises at least one of an o-ring and molded rubber.

7. The ram-type blowout preventer of claim 1, further comprising a trash seal disposed adjacent the seal carrier.

8. The ram-type blowout preventer of claim 1, wherein the seal carrier is positioned above an axis of the horizontal bore.

9. The ram-type blowout preventer of claim 1, wherein the seal carrier is positioned below an axis of the horizontal bore.

10. A ram-type blowout preventer, comprising:

a body;

a vertical bore through the body;

a horizontal bore through the body intersecting the vertical bore;

a pair of ram blocks disposed in the horizontal bore on opposite sides of the body, wherein the ram blocks are adapted for controlled lateral movement to and from the vertical bore;

a seal carrier disposed at the intersection of the vertical bore and the horizontal bore; and

a sealing device positioned between the body and the seal carrier;

wherein the seal carrier is configured to be displaced along an axis of the vertical bore;

wherein the seal carrier is configured to be sealingly engaged with a top seal of at least one of the pair of ram blocks.

11. The ram-type blowout preventer of claim 10, wherein a pressure seal area of the seal carrier is larger than a pressure seal area of the ram blocks.

12. The ram-type blowout preventer of claim 10, wherein the seal carrier comprises a sleeve portion and a flange portion and the sealing device is disposed upon the sleeve portion.

13. A ram-type blowout preventer, comprising:

a body;

a vertical bore through the body;

a horizontal bore through the body intersecting the vertical bore;

a pair of ram blocks disposed in the horizontal bore on opposite sides of the body, wherein the ram blocks are adapted for controlled lateral movement to and from the vertical bore;

a seal carrier disposed at the intersection of the vertical bore and the horizontal bore; and

a sealing device positioned between the body and the seal carrier;

wherein the seal carrier is configured to be thrust into sealing engagement with at least one of the pair of ram blocks by fluid pressure above the ram blocks.

14. The ram-type blowout preventer of claim 13, wherein the seal carrier is configured to be thrust into sealing engagement with a top seal of the at least one of the pair of ram blocks.

15. The ram-type blowout preventer of claim 13, wherein a pressure seal area of the seal carrier is larger than a pressure seal area of the ram blocks.

16. The ram-type blowout preventer of claim 13, wherein the seal carrier comprises a sleeve portion and a flange portion, and the sealing device is disposed upon the sleeve portion.

17. A method of actuating a ram-type blowout preventer, the method comprising:

sealing a pair of ram blocks against one another proximate a wellbore axis; and

sealingly engaging a seal carrier with at least one of the pair of ram blocks from fluid pressure acting upon the ram blocks, wherein the seal carrier is configured to be sealingly displaced along the wellbore axis.

18. The method of claim 17, wherein the seal carrier sealingly engages with a top seal of the at least one of the pair of ram blocks.

19. The method of claim 17, wherein a pressure seal area of the seal carrier is larger than a pressure seal area of the ram blocks.

What is claimed is:

1. A ram-type blowout preventer, comprising:

a body;

a vertical bore through the body;

a horizontal bore through the body intersecting the vertical bore;

a pair of ram blocks disposed in the horizontal bore on opposite sides of the body, wherein the ram blocks are configured to move along the horizontal bore to have controlled lateral movement to and from the vertical bore;

a seal carrier disposed about the vertical bore between the body and adjacent to the horizontal bore; and

a sealing device positioned between the body and the seal carrier;

wherein the seal carrier is configured to be displaced along an axis of the vertical bore such that the seal carrier moves unbiased within a predetermined range along the vertical bore, and

the sealing device is positioned further away from the axis of the vertical bore than a top seal of the at least one of the pair of ram blocks such that when a pressure from above the pair of ram blocks is applied, a net force is generated that pushes the seal carrier towards the pair of ram blocks.

2. The ram-type blowout preventer of claim 1, wherein the seal carrier is configured to sealingly engage a top seal of at least one of the pair of ram blocks and the seal carrier has a sleeve portion and a flange portion, the flange portion being configured to limit a travel of the seal carrier along the vertical bore by contacting the body.

3. The ram-type blowout preventer of claim 2, wherein a pressure seal area of the seal carrier is larger than a pressure seal area of the ram.

4. The ram-type blowout preventer of claim 1, wherein the seal carrier comprises a sleeve portion and a flange portion.

5. The ram-type blowout preventer of claim 4, wherein the sealing device is disposed upon the sleeve portion.

6. The ram-type blowout preventer of claim 1, wherein the sealing device comprises at least one of an o-ring and molded rubber.

7. The ram-type blowout preventer of claim 1, wherein the seal carrier is positioned above an axis of the horizontal bore.

8. The ram-type blowout preventer of claim 1, wherein the seal carrier is positioned below an axis of the horizontal bore.

9. The ram-type blowout preventer of claim 1, wherein the body comprises:

a recess portion configured to accommodate the seal carrier, the recess portion having a shoulder that prevents the seal carrier to move more than a predetermined distance upwards along the axis of the vertical bore,

wherein, if an upper pressure is applied from above the pair of ram blocks in the vertical bore, the upper pressure determines the seal carrier to move downwards along the axis of the vertical bore towards the pair of ram blocks to sealingly engage the top seal of at least one of the pair of ram blocks,

if a lower pressure is applied from below the pair of ram blocks in the vertical bore, the lower pressure determines the pair of ram blocks to move upwards along the axis of the vertical bore towards the seal carrier to sealingly engage the top seal with the seal carrier while the seal carrier is stopped from moving upwards by the shoulder of the recess portion, and thus

the seal carrier sealingly engages the top seal of the at least one of the pair of ram blocks either when the upper pressure is applied to the blowout preventer or when the lower pressure is applied to the blowout preventer such that the blowout preventer is operational in a dual-direction.

10. A ram-type blowout preventer, comprising:

a body;

a vertical bore through the body;

a horizontal bore through the body intersecting the vertical bore;

a pair of ram blocks disposed in the horizontal bore on opposite sides of the body, wherein the ram blocks are configured along the horizontal bore to have controlled lateral movement to and from the vertical bore;

a seal carrier disposed at the intersection of the vertical bore and the horizontal bore; and

a sealing device positioned between the body and the seal carrier;

wherein the seal carrier is configured to be displaced along an axis of the vertical bore such as that the seal carrier moves unbiased within a predetermined range along the vertical bore,

wherein the seal carrier is configured to be sealingly engaged with a top seal of at least one of the pair of ram blocks, and

the sealing device is positioned further away from the axis of the vertical bore than a top seal of the at least one of the pair of ram blocks such that when a pressure from above the pair of ram blocks is applied, a net force is generated that pushes the Seal carrier towards the pair of ram blocks.

11. The ram-type blowout preventer of claim 10, wherein a pressure seal area of the seal carrier is larger than a pressure seal area of the ram blocks.

12. The ram-type blowout preventer of claim 10, wherein the seal carrier comprises a sleeve portion and a flange portion and the sealing device is disposed upon the sleeve portion.

13. A ram-type blowout preventer, comprising:

a body;

a vertical bore through the body;

a horizontal bore through the body intersecting the vertical bore;

a pair of ram blocks disposed in the horizontal bore on opposite sides of the body, wherein the ram blocks are configured to move along the horizontal bore to have controlled lateral movement to and from the vertical bore;

a seal carrier disposed at the intersection of the vertical bore and the horizontal bore; and

a sealing device positioned between the body and the seal carrier;

wherein the seal carrier is configured to be thrust into sealing engagement with at least one of the pair of ram blocks by fluid pressure above the ram blocks such that the seal carrier moves unbiased within a predetermined range along the vertical bore, and

the sealing device is positioned further away from an axis of the vertical bore than a top seal of at least one of the pair of ram blocks such that when the fluid pressure from the pair of ram blocks is applied, a net force is generated that pushes the seal carrier towards the pair of ram blocks.

14. The ram-type blowout preventer of claim 13, wherein the seal carrier is configured to be thrust into sealing engagement with a top seal of the at least one of the pair of ram blocks.

15. The ram-type blowout preventer of claim 13, wherein a pressure seal area of the seal carrier is larger than a pressure seal area of the ram blocks.

16. The ram-type blowout preventer of claim 13, wherein the seal carrier comprises a sleeve portion and a flange portion, and the sealing device is disposed upon the sleeve portion.

17. A method of actuating a ram-type blowout preventer, the method comprising:

positioning a sealing device further away from an axis of a vertical bore of a body of the blowout preventer than a top seal of at least one of a pair of ram blocks such that when a pressure from above the pair of ram blocks is applied, a net force is generated that pushes a seal carrier towards the pair of ram blocks, wherein the seal carrier is configured to move unbiased within a predetermined range along the vertical bore;

sealing a pair of ram blocks against one another proximate a wellbore axis by moving the pair of ram blocks along a horizontal bore formed in a body of the ram-type blowout preventer; and

sealingly engaging a seal carrier with at least one of the pair of ram blocks from fluid pressure acting upon the ram blocks, wherein the seal carrier is configured to be sealingly displaced along the wellbore axis such that the seal carrier moves along the vertical bore formed in a body of the ram-type blowout preventer, the vertical bore intersecting the horizontal bore.

18. The method of claim 17, further comprising:

sealingly engaging the seal carrier with the top of the at least one of the pair of ram blocks when an upper pressure is applied from above the pair of ram blocks in the vertical bore, the upper pressure determining the seal carrier to move downwards along an axis of the vertical bore towards the pair of ram blocks to sealingly engage the top seal of at least one of the pair of ram blocks,

determining the pair of ram blocks to move upwards, if a lower pressure is applied from below the pair of ram blocks in the vertical bore, along the axis of the vertical bore towards the seal carrier to sealingly engage the top seal with the seal carrier while the seal carrier is stopped from moving upwards by a shoulder of a recess portion of the body, and thus

sealingly engaging the seal carrier with the top seal of the at least one of the pair of ram blocks either when the upper pressure is applied to the blowout preventer or when the lower pressure is applied to the blowout preventer such that the blowout preventer is operational in a dual-direction.

19. The method of claim 17, wherein a pressure seal area of the seal carrier is larger than a pressure seal area of the ram blocks.