

Valve apparatus and improved ram

The present invention relates to valves, and in particular to a ram and ram assembly for use in valves. The invention has particular but not exclusive application to wireline valves and has particular but not exclusive application to the hydrocarbon exploration and production industry. An embodiment of the invention is a blowout preventer (BOP) incorporating a ram assembly.

Background to the invention

The background to the invention and its embodiments will be described in the context of applications to the hydrocarbon exploration and production industry and to wireline valves. However, it will be apparent that the invention has utility in other types of industries and valves.

Specialised valves including blowout preventers (BOPs) are used in hydrocarbon wells to seal a wellbore at the wellhead against well pressure. A BOP is a large valve operable to be closed to seal the wellbore in the event of a well control incident, allowing the operator to gain control of the reservoir fluids. A BOP may also be used if it is required to seal a wireline or logging cable during well service or intervention operations. A conventional ram-type BOP is located at the wellhead, and consists of a pair of steel rams located on diametrically-opposed sides of the wellbore. The rams are typically actuated by hydraulic cylinders located on each side of the valve, although they may also be operated mechanically. To seal the wellbore, the rams are moved together to enter the wellbore and their innermost faces are brought together at the centre to seal against well pressure below.

To provide an effective seal, the rams comprise elastomeric seals mounted on the innermost faces, which typically are self-energising: after they are initially actuated by the hydraulics, a part of the ram is exposed to well pressure which forces it towards a closed position. A number of different ram and seal geometries have been proposed to provide an effective seal which adequately supports the elastomeric material, reducing the likelihood of extrusion due to the force of wellbore pressure. Complications in ram assembly design arise where

the valve is required to seal around a wireline which passes through the valve. A typical ram configuration for a wireline valve will include a corresponding pair of semi-circular recesses located in each ram, which are sized to allow wireline to extend through the valve without being damaged. It is desirable for the recess to

5 tightly accommodate the wireline, as this provides maximum steel backup for the elastomeric seals which seal against the wireline. Therefore a number of ram configurations have been proposed to guide a wireline to the location of the recess during actuation of the valve without damaging the wireline.

Figures 1A and 1B show a conventional ram design used in wireline valve applications. Figure 1A shows a left hand ram 10a, and Figure 1B shows a right hand ram 10b (referred to together as 10). Each ram 10 comprises a steel ram block 12 which is substantially cylindrical, and which in use is oriented with its longitudinal axis perpendicular to the main axis of the wellbore. Each ram 10

10 comprises a part-cylindrical recess 14 which extends across the ram 10 in the direction of the main wellbore axis. A seal assembly 16 includes a main seal block 18 with an inner face 20, and a U-shaped outer seal 22 for energising the seal from below.

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Each ram 10 is provided with a guide plate 24, which is secured into a recess of the ram block 12 by threaded fixings 26. Each guide plate 24 is shaped to

20 provide a pair of guide edges 28, which extend into the wellbore in use and are angled towards the centre of the wellbore and the recess 14. Each ram comprises a slot 30 corresponding to the position of the guide plate 24 in the opposing rams, into which the guide plate 24 moves when the rams are actuated to a closed position.

25 In use, a wireline (not shown in Figures 1A and 1B) extending between the rams 10 is guided by the guide edges 28 towards the recess 14. The guide edges 28 define an aperture through the valve which decreases in diameter as the rams 10 are brought together. When in the centre of the wellbore, the wireline can be located in the recess and the seal assembly 16 forms a tight seal around the

30 wireline.

Ram configurations of the type shown in Figures 1A and 1B have been successfully used for many years. However, there are some circumstances in which there is a risk of the wireline catching on a part of the ram assembly as it is closed. By way of example, a problem which can be experienced in some wellbore conditions is illustrated in Figures 2A to 2C. Figure 2A is a top view of a ram pair 11 formed from the conventional rams 10 of Figures 1A and 1B, and Figure 2B is an enlarged view of a central area of Figure 2A (the drawings show a cross-section through the wireline 40). Figure 2C is a section through line C-C' of Figure 2A. The drawings show the ram pair 11 in a partially closed condition, in which the wireline 40 is been guided towards the centre of the wellbore. An upper part of the wireline 40 is guided by the upper guide plate 24a (belonging to the left-handed ram 10a), while the guide plate 24b of the right-handed ram 10b guides a lower part of the wireline 40. The opposing forces on the wireline 40 from the guide plates 24a, 24b can in certain conditions cause the wireline to kink such that it is pushed by one guide plate against the face 20 of the seal assembly 16 on the opposing ram as shown in Figures 2A to 2C at 42. If the wireline 40 is pinched in this position, it can prevent the ram assembly 11 from fully closing and therefore the valve will not form a pressure tight seal. This may have serious consequences for the safety of wellbore operations. The above-described problem is exacerbated when there is little or no weight on the wireline 40, causing the wireline to be slack in the region passing through the ram assembly 11. Furthermore, the tendency for wirelines to kink in this manner is greater with modern wirelines formed from soft stainless steel, such as those used in sour gas well applications.

Other examples of ram configurations for wireline valve applications are disclosed in US 6,676,103, US 4,506,858, and US 3,692,316. None of the previously proposed designs address the problem of a guide on one ram causing the wireline to contact the seal face on the opposing ram. In addition, the previously proposed wireline guiding ram assemblies have lack of inherent structural strength, due to the assembly of the ram blocks and guiding members, and the removal of steel to form corresponding recesses. In high pressure environments, many conventional ram assemblies have a tendency to splay or

distort when holding wellbore pressure. The prior art ram configurations are also complex to manufacture.

US 2,883,141 discloses a blowout preventer designed for sealing around a pipe. The disclosed ram includes flat faces on its inner end and a sealing strip portion.

5 The sealing strip portion has a face with upper and lower edges which form oppositely disposed acute angles with respect to a plane perpendicular to the longitudinal axis of the ram body. The face is contoured for uniform sloping outwardly from a recess and with increasing angularity with respect to the axis of the recess. The arrangement of US 2,883,141 is disadvantageous as it is highly
10 complex to machine and manufacture. Furthermore, the configuration has large exposed faces of flowable material oriented in a downward or upward orientation, which is prone to damage and/or extrusion during operations.

It is amongst the aims and objects of the invention to provide a wireline valve apparatus and/or a ram assembly for a wireline valve which at least mitigates one
15 or more disadvantages of the previously proposed designs. Another object of the invention is to provide a wireline valve apparatus and/or a ram assembly for a wireline valve which provides improved reliability in a wider range of wellbore and operational conditions.

Further aims and objects of the invention will become apparent from reading the
20 following description.

Summary of the invention

According to a first aspect of the invention there is provided a valve comprising:

a valve body defining a throughbore having a throughbore axis;

a first ram comprising a first seal face and a second ram comprising a second
25 seal face, wherein the first and second rams are disposed on opposing sides of the throughbore on a ram axis and are actuable to be moved along the ram axis to bring the seal faces together;

a channel defined by the first and/or second seal faces configured to accommodate a tubular member in a sealing position when the first and second seal faces are brought together;

5 wherein the first and second seal faces are oriented in a plane which is parallel to the throughbore axis and which is inclined with respect to the ram axis.

In this context, "inclined" means at an angle not equal to 90 degrees. One part of each of the seal faces may therefore be inclined at a positive acute angle to the ram axis, and another part of each of the seal faces may be inclined at a negative acute angle to the ram axis. (Using an alternative definition for the same
10 orientation, the plane of the seal faces may be defined with respect to a plane which is perpendicular to the ram axis. In this case, the seal faces are oriented in a plane which intersects a plane perpendicular to the ram axis on a line which is parallel to the throughbore axis.)

15 Preferably the first seal face is a part of a first seal assembly carried by the first ram, and the second seal face is part of a second seal assembly carried by the second ram.

Preferably also the seal face extends across the whole diameter of the throughbore.

20 Advantageously the angle of inclination of the first and second seal faces is between around 90 and 150 degrees preferably around 120 degrees.

The first and second rams may further comprise corresponding guide surfaces for guiding a tubular member towards the sealing position.

25 On at least one of the first and second rams a portion of the guide surface may be relieved or profiled away from the sealing position in the direction of the ram axis.

The first ram may provide a first guide surface and the second ram may comprise a first guide surface a portion of which is relieved or profiled away from the sealing position in an area corresponding to the first guide surface of the first ram.

5 The second ram may comprise a second guide surface and the first ram may comprise a second guide surface a portion of which is relieved or profiled away from the sealing position in an area corresponding to the second guide surface of the second ram.

10 The guide surface on one side of at least one ram may be relieved or profiled away from the plane in an area adjacent to the sealing position, up to an outer edge of the ram.

In use, a portion of the first or second seal faces may form a guide surface for guiding a tubular member towards the sealing position.

15 Each ram may have a guide surface, one side of which lies on one side of the sealing position and a second side lies on an opposing side of the sealing position, and on the first side, the guide surface on the first ram may extend forward of the sealing position along the ram axis.

20 Each ram may have a first side on one side of the sealing position and a second side on an opposing side of the sealing position, and on one of the first and second sides, the guide surface of a ram may also be on a be oriented in a plane which is parallel to the throughbore axis and which is inclined with respect to the ram axis. Preferably the guide surface of the ram may be inclined in an opposing direction to the angle of inclination of the plane of the seal face.

25 The seal face of a ram may be inclined in an opposing sense to the guide surface by substantially the same amount.

The relieved portion of the guide surface may be oriented in a plane which is parallel to the throughbore axis and which is inclined with respect to the ram axis.

- 5 In this aspect all of the inward surfaces of the rams may be inclined with respect to the ram axis. Furthermore, all inward surfaces of the rams may be oriented in a plane which is parallel to the throughbore axis.

- 10 The arrangement of this aspect of the invention has the advantage of efficiently using all surfaces of the ram body. Those surfaces which are not functioning as guide surfaces extend away from the sealing position to reduce the risk of contact with the tubular member.

Preferably the first and second rams are substantially identical.

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Advantageously the valve may be a blowout preventer for a hydrocarbon well.

According to a second aspect of the invention there is provided an apparatus for a valve, the apparatus comprising:

- 20 a ram configured to be disposed adjacent to a throughbore in a valve, the throughbore having a throughbore axis, wherein the ram comprises a ram axis and is actuatable to be moved along the ram axis into the throughbore;
- wherein the ram comprises a seal face oriented in a plane which is parallel to the throughbore axis and which is inclined with respect to the ram axis.
- 25 Preferably, the ram comprises a recess in the seal face which at least partially defines a channel for accommodating a tubular member.

Preferably, the seal face is a part of a seal assembly of the ram, and the seal face may extend across the ram assembly.

5 The ram is preferably configured to co-operate with a second ram, which may comprises a second seal face oriented in a plane which is parallel to the throughbore axis and which is inclined with respect to the ram axis. The first and/or second rams may together form a channel defined by the first and/or second seal faces configured to accommodate a tubular member in a sealed condition when the first and second seal faces are brought together. The apparatus may comprise a pair of rams.

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Embodiments of the second aspect of the invention may comprise preferred or optional features of the first aspect of the invention or vice versa.

15 According to a third aspect of the invention there is provided a method of operating a valve comprising a valve body defining a throughbore having a throughbore axis, the method comprising:

providing a first ram comprising a first seal face and a second ram comprising a second seal face, wherein the first and second rams are disposed on opposing sides of the throughbore on a ram axis and wherein the first and second seal faces are oriented in a plane which is parallel to the throughbore axis and which is inclined with respect to the ram axis. ;

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actuating the first and second rams to move along the ram axis into the throughbore;

bringing the seal faces together while guiding a tubular member into a channel defined by the first and/or second seal faces to accommodate a tubular member in a sealing position;

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Embodiments of the third aspect of the invention may comprise preferred or optional features of the first or second aspects of the invention or vice versa.

According to a fourth aspect of the invention there is provided a valve comprising:

5 a first ram comprising a first seal face and a second ram comprising a second seal face, wherein the first and second rams are disposed on opposing sides of the throughbore on a ram axis and are actuatable to be moved along the ram axis to bring the seal faces together;

and a channel defined by the first and/or second seal faces configured to accommodate a tubular member in a sealing position when the first and second seal faces are brought together;

10 wherein the first and second rams comprise corresponding guide surfaces for guiding a tubular member towards the sealing position;

and wherein on at least one of the first and second rams, a portion of the guide surface is relieved or profiled away from the sealing position.

15 Preferably, the first ram provides a first guide surface and the second ram comprises a guide surface, a portion of which is relieved or profiled away from the sealing position in an area corresponding to the first guide surface.

20 Preferably, the second ram provides a second guide surface and the first ram comprises a corresponding guide surface, a portion of which is relieved or profiled away from the sealing position in an area corresponding to the second guide surface.

25 The guide surface may be relieved or profiled away from the sealing position outside of the channel position (or adjacent to the sealing position) so that before a tubular member is at the sealing position, the seal face is clear of the wireline.

This minimises the chance of the tubular member contacting a surface on which it may snag or be pinched before it is in the sealing position.

5 Preferably, the tubular member is prevented from coming into contact with a surface of the ram or seal face other than a guiding surface of the ram, before the ram is at the sealing position. This may be achieved by relieving or profiling all surfaces which are not functioning as guide surfaces, away from the sealing position. Surfaces of the ram may be inclined, either to provide a guide surface, or to be relieved or profiled away from the sealing position.

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Each ram may comprise a first side on one side of the sealing position and a second side on an opposing side of the sealing position.

15 Preferably, a portion of the guide surface is relieved or profiled away from a plane which is perpendicular to the ram axis. Preferably, a portion of the guide surface on one side of the ram is profiled away from the plane in an area adjacent to the sealing position (which may be the centre of the ram), and may be relieved or profiled away from the sealing position up to an outer edge of the ram.

20 Preferably, there are no surfaces parallel to a plane perpendicular to the ram axis.

The valve may be a blowout preventer for a hydrocarbon well.

Embodiments of the fourth aspect of the invention may comprise preferred or optional features of the first to third aspects of the invention or vice versa.

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According to a fifth aspect of the invention there is provided an apparatus for a valve, the apparatus comprising:

a ram configured to be disposed adjacent to a throughbore in a valve, the throughbore having a throughbore axis, wherein the ram comprises a ram axis and is actuatable to be moved along the ram axis into the throughbore;

5 wherein the ram comprises a seal face, the seal face comprising a recess which at least partially defines a channel for accommodating a tubular member;

and wherein at least a portion of the seal face is relieved or profiled away from the recess,

10 The seal face may be a part of a seal assembly of the ram assembly, and the seal face may extend across the ram assembly. Preferably, the seal face is relieved or profiled away from the recess on one side of the recess.

15 The ram is preferably configured to co-operate with a second ram, which may comprise a seal face, wherein at least a portion of the seal face is relieved or profiled away from the recess, The first and/or second rams may together form a channel defined by the first and/or second seal faces configured to accommodate a tubular member in a sealing position when the first and second seal faces are brought together. The apparatus may comprise a pair of rams.

20 Embodiments of the fifth aspect of the invention may comprise preferred or optional features of the first to fourth aspects of the invention or vice versa.

25 According to a sixth aspect of the invention there is provided a method of operating a valve comprising a valve body defining a throughbore having a throughbore axis, the method comprising:

providing a first ram comprising a first seal face and a second ram comprising a second seal face, wherein the first and second rams are disposed on opposing sides of the throughbore on a ram axis;

5 actuating the first and second rams to move along the ram axis into the throughbore;

bringing the seal faces together while guiding a tubular member into a channel defined by the first and/or second seal faces to accommodate a tubular member in a sealing position;

10 wherein on at least one of the first and second rams, a portion of the seal face is relieved or profiled away from the sealing position.

The method may comprise guiding a tubular member towards the sealing position by a guide surface comprising a portion of at least one of the first or second seal faces.

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Embodiments of the sixth aspect of the invention may comprise preferred or optional features of the first to fifth aspects of the invention or vice versa.

20 According to a seventh aspect of the invention there is provided a tubular member valve comprising:

a first ram comprising a first seal face and a second ram comprising a second seal face, wherein the first and second rams are disposed on opposing sides of the throughbore on a ram axis and are actuatable to be moved along the ram axis to bring the seal faces together;

25 and a channel defined by the first and/or second seal faces configured to accommodate a tubular member in a sealing position when the first and second seal faces are brought together;

wherein a portion of the first or second seal faces forms a guide surface for guiding a tubular member towards the sealing position.

5 Preferably, the portion of the second seal face opposes the first guide surface, such that the first and second guide surfaces together act to guide a tubular member towards the sealing position. The sealing position (i.e. the position of the channel when the first and second seal faces are brought together) is preferably the centre of the throughbore. Therefore the first and second guide surfaces may guide a tubular member into the centre of the throughbore.

10 Preferably, the portion of the first or second seal faces which forms a guide surface for the tubular member is outside of the channel at the sealing position. It may be adjacent to the channel at the sealing position.

Embodiments of the seventh aspect of the invention may comprise preferred or optional features of the first to sixth aspects of the invention or vice versa.

15 According to a eighth aspect of the invention there is provided an apparatus for a valve, the apparatus comprising:

a ram configured to be disposed adjacent to a throughbore in a valve, the throughbore having a throughbore axis, wherein the ram comprises a ram axis and is actuable to be moved along the ram axis into the throughbore;

20 wherein the ram comprises a seal face, the seal face comprising a recess which at least partially defines a channel for accommodating a tubular member in a sealing position;

and wherein at least a portion of the seal face forms a guide surface for guiding a tubular member towards the recess.

25 In this context, the guide surface is outside of the recess which partially defines the channel; the guide surface is configured to move towards the recess so that when closed, the tubular member is received in the channel.

Preferably, the seal face is a part of a seal assembly of the ram, and the seal face may extend across the ram.

The ram assembly is preferably configured to co-operate with a second ram, which may comprise a second seal face oriented in a plane which is parallel to the throughbore axis and which is inclined with respect to the ram axis. The first and/or second rams may together form a channel defined by the first and/or second seal faces configured to accommodate a tubular member in a sealing position when the first and second seal faces are brought together. The apparatus may comprise a pair of rams.

Embodiments of the eighth aspect of the invention may comprise preferred or optional features of the first to seventh aspects of the invention or vice versa.

According to a ninth aspect of the invention there is provided a method of operating a valve comprising a valve body defining a throughbore having a throughbore axis, the method comprising:

providing a first ram comprising a first seal face and a second ram comprising a second seal face, wherein the first and second rams are disposed on opposing sides of the throughbore on a ram axis;

actuating the first and second rams to move along the ram axis into the throughbore to bring the seal faces together;

guiding a tubular member into a channel defined by the first and/or second seal faces to accommodate a tubular member in a sealing position

wherein the tubular member is guided by a guide surface formed by a portion of the first or second seal faces.

Embodiments of the ninth aspect of the invention may comprise preferred or optional features of the first to eighth aspects of the invention or vice versa.

Brief description of the drawings

There will now be described, by way of example only, embodiments of the invention with respect to the following drawings, of which:

Figures 1A and 1B are respectively perspective views of conventional left handed and right handed rams with wireline guiding plates;

Figures 2A, 2B and 2C are respectively upper, enlarged and sectional views of a pair of rams of Figures 1A and 1B in a partially closed position when guiding a wireline;

5 Figures 3A, 3B and 3C perspective and exploded perspective views of a ram assembly in accordance with a first embodiment of the invention;

Figure 4 is a perspective view of a pair of ram assemblies of Figures 3A to 3C;

Figures 5A, 5B are respectively upper, cross-sectional and perspective views of the pair of rams of Figure 4 in a partially closed position when guiding a wireline;

10 Figure 6 is a perspective view of a pair of rams according to an alternative embodiment of the invention.

Detailed description of preferred embodiments

Referring firstly to Figures 3A to 3C, and Figure 4 there is shown a ram, generally depicted at 100, according to a first embodiment of the invention. The ram 100 is designed to be incorporated in a wireline valve such as a blowout preventer (BOP). Figures 3A and 3B are perspective views of the same ram 100 from different positions, and Figure 3C is an exploded view of the components of the ram 100. It will be noted that the ram 100 is not "handed" and therefore a pair of identical rams 100 may be used to form a co-operating ram pair, shown generally at 101 in Figure 4. In Figure 4 the rams 100a and 100b and their respective components are distinguished by the suffixes "a" and "b".

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The ram 100 comprises a ram body 102 which has a generally cylindrical form with a longitudinal ram axis R. The ram body 102 is formed from steel, although other materials may be suited in specific applications, as would be appreciated by one skilled in the art. The ram body 102 comprises a lateral slot 104 which extends across the width of the body and divides the ram body 102 into an upper portion 110 and a lower portion 120. Foremost parts (in the direction of the ram axis R towards the centre of a ram pair) of the upper and lower portions function as upper and lower guide members 111, 121 for a wireline, as will be described in more detail below.

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The upper portion 110 presents a face 112 in the longitudinal direction of the ram body 102 which is inclined to the longitudinal ram axis R. The face 112 comprises a forward surface portion 114 and a rearward surface portion 115, oriented in parallel surface planes which are offset to one another. The surface planes are inclined to a plane which is perpendicular to the longitudinal ram axis by an acute angle. However, the surface planes are also substantially parallel to a second direction T orthogonal to the ram axis R (which is the axis of a throughbore in the assembled valve). The offset surfaces of the rams allow them to be brought together closer than the position in which the seal faces first contact one another, allowing the seal elements to be compressed together.

The lower portion 120 of the ram body has a similarly configured face 122, with two surface portions 124, 125 in parallel but off-set planes. The planes are also inclined to a plane parallel to the longitudinal ram axis R. However, the angle of inclination is an acute angle in the opposite direction to the inclination of the surfaces 114, 115 of the upper portion 120. In this embodiment, the upper portion 110 of the ram body and the lower portion of the ram body 120 are inclined at the same angle in opposite senses. However, in other embodiments, the inclination angles may differ from one another.

The slot 104 is shaped to receive an inner seal assembly 130 which is formed from an elastomeric seal member 132, backed up by upper and lower steel plates 134, 135. Bores 136 are located in upper and lower surfaces of the ram body 102 and are aligned with bores 137 in the inner seal assembly 130, to receive inner seal retaining screws 138.

The ram body 102 also comprises a channel 106 for an outer seal member 108. The channel and outer seal member 108 extend over an upper surface of the ram body 102, and axially along the body to abut a rear surface of the inner seal assembly 130. The outer seal member 108 is formed from an elastomeric material. In use, the inner seal assembly 130 and the outer seal member 108 together form a self energising seal which is energised by wellbore pressure from below.

The inner seal assembly 130 defines a seal face 140 which comprises a recess 142. The recess 142 is part-cylindrical and extends in a direction perpendicular to the ram axis R (and when assembled in the valve, parallel to the axis T of a throughbore of the valve). The recess 142 at least partially accommodates a wireline passing through the valve, and when a pair of rams 101 is brought together, the corresponding recesses 142 together form a channel for a wireline. Here it should be noted that the shoulders 116 and 126 between the surfaces of the upper and lower portions of the ram are offset from the centre of the ram (in opposite directions). This provides a continuation of the recess 142 and the channel for the wireline when the rams are brought together.

When the inner seal assembly 130 is located in the slot 104, a forward part 144 of the seal face is substantially flush and aligned with the surface 114. Together, the forward part 144 of the seal face and the surface 114 form a guide surface for a wireline, as will be described in more detail below. A rearward part 145 of the seal face 140 on the other side of the ram is in the same inclined plane as the surface 114 and the forward part 144 of the seal face. The seal face is oriented in a plane which is parallel to the throughbore axis and which is inclined with respect to the ram axis by between about 90 degrees to 150 degrees, more preferably around 120 degrees and therefore the sealing face is proud of the surface 115.

The ram 100 includes an arrangement of prongs 148 and sockets 149 which co-operate with corresponding sockets and prongs on an opposing ram to provide increased resistance to distortion and/or splaying when the rams are brought together.

Operation of the rams of this embodiment of the invention will now be described with reference to Figures 5A and 5B of the drawings. The pair of rams 101 is incorporated into a wireline valve body (not shown), disposed on either side of a throughbore defined by the valve body. Typically the throughbore will be oriented substantially vertically, and in the case of blowout preventers, will form a part of a blowout preventer stack at the wellhead. Actuators will be connected up to the rams to allow them to be moved from a position in ram recesses (in which they

do not enter the throughbore) into the throughbore to seal the valve. Typically the actuators will be hydraulic actuators operated from a remote location, although in some application mechanical or electrical actuators may be used.

5 Figures 5A, 5B and 5C show a ram pair 101 in a partially-closed position around a wireline 40. Figure 5A is an upper view of the rams 101 (with throughbore valve body not shown), and is sectional through the wireline 40. Figure 5B is a section through line B-B' of Figure 5A, and Figure 5C is a perspective view.

10 The rams 100a and 100b have been actuated to move into the throughbore. The upper guide member 111a overlaps with the lower guide member 121b, and the upper guide member 111b overlaps with the lower guide member 121a to create an aperture through the valve which decreases in size. The wireline 40 is guided towards the recesses 142 which will form a channel through the ram pair 101 at the centre of the throughbore when the rams are brought together. In the position shown in Figure 5A, the wireline 40 is guided to the centre by a guide surface formed by the surface 114a of the ram body 102a and the forward part 144a of the seal face 140a, acting in co-operation with the surface 124b of the lower guide member 121b. It will be appreciated that a wireline 40 positioned in the opposing part of the aperture would be similarly guided by corresponding parts of the ram pair on the opposite side. As the wireline 40 is guided, it remains in contact with the upper and lower guide members 111a, 121b, and is oriented straight through the ram pair 101. The arrangement provides an extensive guiding surface for the wireline, reducing the tendency of the wireline to bend or kink. Furthermore, as an additional feature of the present invention should the wireline bend or kink due to the force of one guiding surface on the first ram, the opposing guiding surface on the second ram is relieved (or profiled away) from the said guiding surface on the first ram to reduce the risk of snagging or pinching the wireline between the guiding surface and the opposing ram before the wireline is located at the recess. This improved centralisation of a wireline reduces the risk of valve failure to due improper closure and sealing of the rams.

25 It will be appreciated that, in an alternative embodiment of the invention, the seal assembly 130 may be configured to be aligned with the lower portion of the ram

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body, instead of being alignment with the upper portion of the ram body as in the embodiment of Figure 3. In either case however, the seal faces of the first and second rams are oriented in a plane which is parallel to the throughbore axis and which is inclined with respect to the ram axis,

5 Figure 6 shows a ram pair 201 in accordance with a further alternative embodiment of the invention. The ram pair 201 and individual rams 200a, 200b (together 200) are similar to the ram pair 101 in form and function, and will be understood from Figures 3 to 5 and the accompanying text. Like parts are indicated by like reference numerals incremented by 100. In Figure 4 the rams
10 100a and 100b and their respective components are distinguished by the suffixes "a" and "b".

The rams 200 differ from the rams 100 in that the surfaces of the upper and lower portions are oriented in the same surface plane. As with ram 100, the surface plane is inclined to a plane which is perpendicular to the longitudinal ram axis by
15 an acute angle, and is substantially parallel to a second direction T orthogonal to the ram axis R. The faces are inclined at the same angle (in the same sense) as one another, and together function as a guiding surface for the wireline. The seal face 280 is, as before, in a plane which is inclined to the main ram axis R and which is parallel to the throughbore axis T. However, the seal face 280 is inclined
20 in the opposite sense to the surface plane of the upper and lower portions preferably but not exclusively by the same angle. In a preferred embodiment the angle of inclination is between around 90 and 150 degrees, more preferably around 120 degrees. A foremost portion of the sealing assembly 230 is received in corresponding space in the opposing ram.

25 Although not shown in this embodiment, guiding prongs and sockets may be provided on the rams similarly as with the embodiment described above.

In use, the rams 200a and 200b are actuated to move into the throughbore. The upper and lower guide members 261a, 271a overlap with foremost portion 231b of the assembly 230b, and the upper and lower guide members 261b, 271b
30 overlap with foremost portion 231a of the assembly 230a. This creates an aperture through the valve which decreases in size. The wireline 40 is guided

towards the recesses 242 which will form a channel when the rams are brought together. As the wireline 40 is guided, it remains in contact with the guiding surfaces, and is oriented straight through the ram pair 201. As with the previous embodiment, should the wireline bend or kink due to the force of one guiding surface, the opposing guiding surface is relieved (or profiled away) from the guiding surface to reduce the risk of snagging or pinching the wireline between the seal face and the opposing ram.

An additional advantage of embodiments of the present invention is the integral strength of the individual rams and the ram pair when they are brought together. Previously proposed wireline guiding ram assemblies have lack of inherent structural strength, due to the material of the rams being removed to form corresponding recesses in the rams. With a conventional ram pair, when the rams come together, spaces between the rams allow the rams to splay or distort when holding wellbore pressure. The embodiments of the present invention provide a ram pair which, when the rams are located together, form a structure which is almost a solid block of material. This improves reliability of operation and minimise distortion and/or splaying of the ram assemblies in high pressure applications. The rams of the present invention are also relatively straightforward to manufacture.

The invention provides a valve comprising a valve body defining a throughbore having a throughbore axis, a first ram comprising a first seal face and a second ram comprising a second seal face. The first and second rams are disposed on opposing sides of the throughbore on a ram axis and are actuable to be moved along the ram axis to bring the seal faces together. A channel is defined by the first and/or second seal faces configured to accommodate a tubular member in a sealing position when the first and second seal faces are brought together. The first and second seal faces are oriented in a plane which is parallel to the throughbore axis and which is inclined with respect to the ram axis. In another aspect of the invention the first and second rams comprise corresponding guide surface for guiding a tubular member towards the sealing position and on at least one of the first and second rams, a portion of the guide surface is relieved or

profiled away from the sealing position. In another aspect a seal face forms a part of the guiding surface.

Various modifications may be made within the scope of the invention as herein intended, and embodiments of the invention may include combinations of
5 features other than those expressly claimed. In particular, although the embodiments show components of the ram on either side of the ram axis oriented in the same or parallel planes, this is not an essential feature of the invention (unless context requires otherwise). For example, the foremost portion of the upper part of the ram body and the rearmost portion of the upper part of
10 the ram body may be inclined to the ram axis at different respective angles. Corresponding portions on opposing rams may be formed to corresponding angles, and therefore the rams in a pair may not be identically shaped.

In another variation to the described embodiments, the guiding surfaces on either side of the front face of the ram may lie in the same rather than parallel planes as
15 described above, these embodiments providing the same advantages of surrounding the wireline by guiding surface in an increasingly reducing aperture to encourage the wireline towards the recesses.

In another variation to the described embodiments, different portions of a guiding surface may be inclined at different angles. Further alternative embodiments
20 may comprise curved or curvilinear guiding surfaces, with the opposing rams formed in corresponding shapes. Combinations of these arrangements are within the scope of the invention. Combinations of features other than those expressly claimed herein are within the scope of the invention.

Whilst the present invention has been described with reference to the guiding of
25 a wireline, it will be appreciated by the skilled person that other tubular members such as a pipe or cable may similarly be guided to a sealing positioning the valve.

CLAIMS

1. A valve comprising:

a valve body defining a throughbore having a throughbore axis;

5 a first ram comprising a first seal face and a second ram comprising a second seal face, wherein the first and second rams are disposed on opposing sides of the throughbore on a ram axis and are actuatable to be moved along the ram axis to bring the seal faces together;

a channel defined by the first and/or second seal faces configured to
10 accommodate a tubular member in a sealing position when the first and second seal faces are brought together;

wherein the first and second seal faces are oriented in a plane which is parallel to the throughbore axis and which is inclined with respect to the ram axis.
- 15 2. The valve as claimed in claim 1, wherein the first seal face is a part of a first seal assembly carried by the first ram, and the second seal face is part of a second seal assembly carried by the second ram.
3. The valve as claimed in claim 1 or 2, wherein the seal face extends across the whole diameter of the throughbore.
- 20 4. The valve as claimed in any preceding claim, wherein the angle of inclination of the first and second seal faces is between around 90 and 150 degrees.
5. The valve as claimed in any preceding claim wherein the first and second rams further comprise corresponding guide surfaces for guiding a wireline towards the sealing position.
- 25 6. The valve as claimed in claim 5, wherein on at least one of the first and second rams, a portion of the guide surface is relieved or profiled away from the sealing position in the direction of the ram axis.

7. The valve as claimed in claim 6, wherein the first ram provides a first guide surface and the second ram comprises a first guide surface a portion of which is relieved or profiled away from the sealing position in an area
5 corresponding to the first guide surface of the first ram.
8. The valve as claimed in claim 7, wherein the second ram comprises a second guide surface and the first ram comprises a second guide surface a portion of which is relieved or profiled away from the sealing position in an area corresponding to the second guide surface of the second ram.
- 10 9. The valve as claimed in claim 8, wherein the guide surface on one side of at least one ram is relieved or profiled away from the plane in an area adjacent to the sealing position, up to an outer edge of the ram.
10. The valve as claimed in any preceding claim, wherein in use, a portion of the first or second seal faces forms a guide surface for guiding a wireline towards
15 the sealing position.
11. The valve as claimed in claim 5 or any of claims 6-10 when dependent upon claim 5, wherein each ram has a guide surface, one side of which lies on one side of the sealing position and a second side lies on an opposing side of the sealing position, and on the first side, the guide surface on the first ram extends
20 forward of the sealing position along the ram axis.
12. The valve as claimed in any of claims 5 or 6-11 when dependent upon claim 5, wherein each ram has a first side on one side of the sealing position and a second side on an opposing side of the sealing position, and on one of the first and second sides, the guide surface of a ram is inclined in an opposing sense to
25 the seal face.
13. The valve as claimed in claim 12, the seal face of a ram is inclined in an opposing sense to the guide surface by substantially the same amount.

14. The valve as claimed in claim 6 or any of claim 7-13 when dependent upon claim 6, wherein the relieved portion of the guide surface is oriented in a plane which is parallel to the throughbore axis and which is inclined with respect to the ram axis.
- 5 15. The valve as claimed in any preceding claim, wherein all inward surfaces of the rams are inclined with respect to the ram axis.
16. The valve as claimed in any preceding claim, wherein all inward surfaces of the rams are oriented in a plane which is parallel to the throughbore axis.
- 10 17. The valve as claimed in any preceding claim, wherein the first and second rams are substantially identical.
18. The valve as claimed in any preceding claim, wherein the valve is a blowout preventer for a hydrocarbon well.
19. An apparatus for a valve, the apparatus comprising:
- 15 a ram configured to be disposed adjacent to a throughbore in a valve, the throughbore having a throughbore axis, wherein the ram comprises a ram axis and is actuable to be moved along the ram axis into the throughbore;
- wherein the ram comprises a seal face oriented in a plane which is parallel to the throughbore axis and which is inclined with respect to the ram axis.
- 20 20. The apparatus as claimed in claim 19, wherein the ram comprises a guide surface for guiding a tubular member towards the sealing position.
21. The apparatus as claimed in claim 20, wherein a portion of the guide surface is relieved or profiled away from the sealing position in the direction of the ram axis.
- 25 22. The apparatus as claimed in any of claims 19-21, further comprising a recess in the seal face which at least partially defines a channel for accommodating a tubular member.

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23. The apparatus as claimed in any of claims 19-22, wherein the seal face is a part of a seal assembly of the ram, and the seal face extends across the ram assembly.

5 24. The apparatus as claimed in any of claims 19-22, wherein the ram a first side on one side of the sealing position and a second side on an opposing side of the sealing position, and on one of the first and second sides, the guide surface of a ram is inclined in an opposing sense to the seal face.

25. The apparatus as claimed in any of claims 19 to 24, wherein the apparatus comprises a pair of rams.

10 26. The apparatus as claimed in claim 25, wherein the pair of rams is substantially identical.

27. A method of operating a valve comprising a valve body defining a throughbore having a throughbore axis, the method comprising:

15 providing a first ram comprising a first seal face and a second ram comprising a second seal face, wherein the first and second rams are disposed on opposing sides of the throughbore on a ram axis and wherein the first and second seal faces are oriented in a plane which is parallel to the throughbore axis and which is inclined with respect to the ram axis.

20 actuating the first and second rams to move along the ram axis into the throughbore;

bringing the seal faces together while guiding a tubular member into a channel defined by the first and/or second seal faces to accommodate a tubular member in a sealing position.