

Since downhole conditions can be extreme, certain packers need to be able to withstand the stresses induced by relatively high differential pressures and high temperatures found within such wellbore environments. The assignee of the present disclosure discovered that when using larger packer type tools, or when using packer type tools in higher temperature and/or higher differential pressure environments, such as those having nominal diameters exceeding six (6) inches, temperatures exceeding 250°F, or differential pressures exceeding 10,000 psi, there was a possibility for the segmented packer element back-up shoes, also referred to as back-up rings, to allow the packer element to extrude through gaps that are formed between the packer OD and the tubing or casing ID when the packer element was activated. Upon certain conditions, the larger OD packer elements, and smaller OD packer elements upon being subjected to elevated pressures and temperatures, were subject to being extruded through these gaps thereby possibly damaging the packer element and possibly jeopardizing the integrity of the seal between the wellbore and the packer element. Also, in the high expansion field, the risk of unwanted extrusion is even higher. This is where the back-up rings are not able to provide much resistance to extrusion of the elastomeric element between the large gap formed between the OD of the packer and the tubing or casing ID given the substantial differences in these diameters in such applications.

Thus, there remains a need in the art for packers having back-up elements that prohibit, or at least significantly reduce, unwanted extrusion of packer elements into the annulus formed between the tubing string and wellbore.

SUMMARY OF INVENTION

According to a first aspect of the present invention, there is provided an annular sealing assembly, comprising: a mandrel; an expandable element disposed around the mandrel having a generally tubular shape and oppositely disposed longitudinal ends; a generally ring-shaped guide ramp disposed around the mandrel adjacent one of the longitudinal opposite ends of the expandable element; a back-up element having a plurality of pivoting blades circumferentially secured in a ring, the back-up element being disposed around the mandrel adjacent the generally ring-shaped guide ramp and being capable of radially expanding and contracting upon longitudinal movement along, and engagement with, the generally ring-shaped guide ramp; and a guide ring disposed around the mandrel adjacent the back-up element, the guide ring being capable of guiding the back-up element longitudinally along the generally ring-shaped guide ramp and providing structural support to the base of the expandable back-up element.

According to a second aspect of the present invention, there is provided a method of sealing an annulus between a mandrel and a tubing string, comprising: expanding an expandable element disposed around the mandrel until it contacts an inner diameter of the tubing string; expanding a back-up element disposed adjacent to the expandable element from a retracted position to an expanded position, the back-up element having a plurality of pivoting blades circumferentially secured in a ring, the pivoting blades in the expanded position coming in contact with the inner diameter of the tubing string and preventing the expandable element from extruding outward into the annulus beyond the back-up element, wherein the pivoting blades of the back-up element ride along a generally ring-shaped guide ramp disposed around the mandrel on opposite ends of the expandable element thereby moving them from a retracted position to an expanded position, wherein the back-up element is moved around the guide ramp by a guide ring disposed around the mandrel adjacent to the back-up element.

WHAT IS CLAIMED IS:

1. An annular sealing assembly, comprising:

a mandrel;

an expandable element disposed around the mandrel having a generally tubular shape and
5 oppositely disposed longitudinal ends;

a generally ring-shaped guide ramp disposed around the mandrel adjacent one of the
longitudinal opposite ends of the expandable element;

a back-up element having a plurality of pivoting blades circumferentially secured in a
ring, the back-up element being disposed around the mandrel adjacent the generally ring-shaped
10 guide ramp and being capable of radially expanding and contracting upon longitudinal
movement along, and engagement with, the generally ring-shaped guide ramp; and

a guide ring disposed around the mandrel adjacent the back-up element, the guide ring
being capable of guiding the back-up element longitudinally along the generally ring-shaped
guide ramp and providing structural support to the base of the expandable back-up element.

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2. The annular sealing assembly according to claim 1, further comprising:

a second generally ring-shaped guide ramp disposed around the mandrel adjacent the
other longitudinal end of the expandable element;

a second back-up element having a plurality of pivoting blades circumferentially secured
20 in a ring, the second back-up element being disposed around the mandrel adjacent the second
generally ring-shaped guide ramp and being capable of radially expanding and contracting upon
longitudinal movement along, and engagement with, the second generally ring-shaped guide
ramp; and

a second guide ring disposed around the mandrel adjacent the second back-up element,
25 the second guide ring being capable of guiding the back-up element longitudinally around the
second generally ring-shaped guide ramp.

3. The annular sealing assembly according to claim 2, wherein the mandrel is a
section of production string.

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4. The annular sealing assembly according to claim 2, wherein the expandable
element comprises a material selected from the group consisting of an elastomer, a rubber, a
fluid filled bag, metallic elements or other expandable sealing element and combinations thereof.

5 5. The annular sealing assembly according to claim 3, wherein generally ring-shaped guide ramps comprise a first ring having a flat surface oriented in an axial direction, a second ring having a flat surface oriented in a radial direction, the flat surface of the first ring being formed generally perpendicular to the flat surface of the second ring, and a plurality of ramps formed between the first and second rings.

 6. The annular sealing assembly according to claim 5, wherein each of the ramps projects radially outward from the first ring and taper radially and axially.

 7. The annular sealing assembly according to claim 6, wherein a flat surface is formed between adjacent ramps.

10 8. The annular sealing assembly according to claim 2, wherein the plurality of pivoting blades in each of the back-up elements have an outer diameter which is less than an outer diameter of the expandable element and an inner diameter which conforms to an outer diameter of the mandrel when the pivoting blades are in the retracted position.

15 9. The annular sealing assembly according to claim 2, wherein the plurality of pivoting blades in each of the back-up elements have an outer diameter which conforms to an inner diameter of a section of tubing string into which the annular sealing assembly may be placed when the pivoting places are in the expanded position.

20 10. The annular sealing assembly according to claim 8, wherein the plurality of pivoting blades in each of the back-up elements are formed of two sets of blades which are connected to and pivot relative to each other and the blades in the first set alternate in their placement around the circumference of the back-up elements with the blades in the second set and wherein blades in the first set are offset circumferentially from the blades in the second set.

 11. The annular sealing assembly according to claim 10, wherein the blades of the first set are connected to and pivot relative the blades of the second set in at least one location.

25 12. The annular sealing assembly according to claim 11, wherein one of the two guide rings is fixed to the mandrel and other one is allowed to move axially along the mandrel.

 13. The annular sealing assembly according to claim 11, wherein both of the guide rings are allowed to move axially along the mandrel.

14. A method of sealing an annulus between a mandrel and a tubing string, comprising:

expanding an expandable element disposed around the mandrel until it contacts an inner diameter of the tubing string;

5 expanding a back-up element disposed adjacent to the expandable element from a retracted position to an expanded position, the back-up element having a plurality of pivoting blades circumferentially secured in a ring, the pivoting blades in the expanded position coming in contact with the inner diameter of the tubing string and preventing the expandable element from extruding outward into the annulus beyond the back-up element, wherein the pivoting
10 blades of the back-up element ride along a generally ring-shaped guide ramp disposed around the mandrel on one longitudinal end of the expandable element thereby moving them from a retracted position to an expanded position, wherein the back-up element is moved around the guide ramp by a guide ring disposed around the mandrel adjacent to the back-up element.

15. The method according to claim 14, further comprising expanding a second back-up element disposed adjacent to the expandable element on the side opposite the other back-up element from a retracted position to an expanded position, the second back-up element having a plurality of pivoting blades circumferentially secured in a ring, the blades in the expanded position coming in contact with the inner diameter of the tubing string and preventing the expandable element from extruding outward into the annulus beyond the second back-up
20 element.

16. The method according to claim 15, wherein the pivoting blades of the second back-up element ride along a second generally ring-shaped guide ramp disposed around the mandrel on the other longitudinal end of the expandable element thereby moving them from a retracted position to an expanded position.

25 17. The method according to claim 16, wherein the second back-up element is moved around the second guide ramp by a second guide ring disposed adjacent to the second back-up element.

18. The method according to claim 17, wherein at least one of the guide rings moves axially along the mandrel.

30 19. The method according to claim 15, wherein the plurality of pivoting blades in each of the back-up elements are formed of two sets of blades which are connected to and pivot

relative to each other as the back-up elements move from the retracted position to the expanded position.

20. The method according to claim 15, wherein the plurality of pivoting blades in each of the back-up elements expand to an outer diameter which conforms to an inner diameter of a section of tubing string into which the expandable element is placed when the back-up elements are expanded to the expanded position.
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