DEVICE TO PREVENT PLASTIC END FLOW OF PACKERS

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9 Claims. (Cl. 166—264)

This invention relates generally to the art of packers for use in deep wells. More particularly, the invention is directed to a means for preventing the plastic flow of the packing material when subjected to high pressures.

It is the principal object of this invention to provide an expandable device to prevent the plastic flow of the packing element of a packer when set in a well bore. The invention also provides an expandable member for preventing the plastic flow of the packing element which may be fully expanded prior to the setting of the packer.

A preferred form of our invention is described in the following detailed specification and illustrated by way of example in the accompanying drawings, wherein:

Fig. 1 is an elevational view of a packer construction embodying the principles of our invention.

Fig. 2 is a sectional view of the packer shown in Fig. 1 and shows the packing elements in the unset or running-in position.

Fig. 3 is a partial section view showing the packer set in a well bore.

Fig. 4 is a sectional view taken on line 4—4 of Fig. 1.

Fig. 5 is a sectional view taken on line 5—5 of Fig. 3.

Fig. 6 is a perspective view illustrating the relationship between one of the upper and one of the lower wedge elements.

Referring to the drawings, wherein the same reference numerals are used to designate the same elements throughout the various views shown, 10 indicates an upper tubular member adapted to be connected to a well string (not shown) extending upwardly to the top of the well bore. An expandable packer, generally indicated at 12, is retained beneath the lower end of the tubular member 10 and the upper end of a lower tubular member 14. The lower tubular member 14 is adapted to be connected to a tail pipe (not shown) which either extends to the bottom of the well bore or is provided with setting slips in a manner well known in the art. A pin 14a is threaded into a transverse opening 14b in an upper wall portion of tubular member 14 and its free end is received by a longitudinal slot 15a cut into the outer wall of mandrel 15. The lower end 15b of slot 15a terminates short of the bottom of mandrel 15 so as to maintain elements 14 and 15 in their respective positions shown in Fig. 2 when the apparatus is lowered into the well bore.

A mechanism 11, for preventing plastic flow of the packer 12, is interposed between the upper tubular member 10 and the upper end of the packer 12. A similar mechanism 13 is interposed between the lower end of the packer 12 and the lower tubular member 14. A mandrel 15 is screwed into the lower end of the tubular member 10 and extends downwardly therefrom through the packer 12 and the mechanisms 11 and 13. The lower end of the mandrel 15 is slidable received within the upper end of the tubular member 14.

The upper mechanism for preventing plastic flow comprises a plurality of upper wedge members 16 surrounding the mandrel 15. Each of the wedges 16 has its base slidably secured adjacent the lower end surface of the member 10 by a stud 17 threaded into the lower end of the member 10 and having an enlarged head 18 slidably received in a dovetail slot 19 formed in the base of the wedge.

As best seen in Figs. 4, 5 and 6, the outer surface of each of the upper wedges 16 is arcuate, and as shown in Figs. 1, 3 and 6, the side surfaces 20 and 21 thereof converge downwardly. The side surfaces 20 and 21 also converge inwardly in the manner seen in Fig. 5. Referring now to Figs. 4 and 6, the upper inner corners 22 and 23 of each of the upper wedges 16 are chamfered along a radial plane to permit said wedges to lie closely adjacent each other when in their retracted position.

A plurality of lower wedge members 24 surround the mandrel 15 with the upper end of each interposed between the lower ends of adjacent upper wedge members 16. Each of the lower wedge members 24 is formed with upwardly converging side surfaces 25 and 26. A plurality of pins 27 are each fixed to a sleeve 28 threaded into a flange 29 bonded to the upper end of the packer 12. The pins 27 extend radially inwardly from the sleeve 28 and each terminates in a spherical ball 30 slidably received in a bore 31 in one of the lower wedges 24. The side surfaces 25 and 26 of the lower wedges 24 are each provided with a longitudinally extending dovetail slot 32 which slidably receives a dovetail key 33 projecting from the side surfaces 20 and 21 of each of the upper wedges 16. The lower plastic flow preventing assembly 13 is generally a duplicate of the upper assembly 11 but is inverted with respect thereto.

In the operation of the device, the parts are assembled in the relationship shown in Fig. 2 and the device is lowered into the well. When the desired location is reached, the slips (not shown) on the tail pipe connected to tubular member 14 are set in a manner well known in the art and downward pressure is exerted on the well string 10. Referring now to the upper assembly 11 for preventing plastic flow (the action of the lower assembly 13 being identical), the tubular member 10 is forced downwardly relative to the flange 29, thus forcing the upper wedge members 16 downwardly between the lower wedge members 24. Since a greater circumferential distance is required to contain the wedge members 16 and 24 when thus intermeshed, each of the wedge members is moved radially outwardly to the position illustrated in Figs. 3 and 5. When the wedges 16 and 24 are extended as shown in Figs. 3 and 5, the outer surfaces thereof form a continuous circle filling the bore to its full diameter and the upper and lower surfaces thereof lie in a common plane to provide a solid abutment against which the elastomer packing element is adapted to seat in the manner shown in Fig. 3. After the assemblies 11 and 13 have been extended, additional downward pressure on the tubular member 10 will move the assembly 11 downwardly relative to the assembly 13 to expand the packer 12 to the position illustrated in Fig. 3.

When it is desired to remove the packer from the well, it is merely necessary to pull up on the tubular member 10 and the parts will again assume the positions illustrated in Fig. 2.

While we have shown and described a construction showing a plastic flow preventing device at both the upper and lower ends of the expandable packer, it is within the scope of the invention that only one such device may be necessary at either the upper or lower end of the packer depending on the type of service for which the packer is designed.

While we have shown and described the preferred form of our invention, it is obvious that various changes may be made therein by those skilled in the art, without departing from the spirit of the invention as defined in the appended claims.
Having thus described our invention, what we claim and desire to secure by Letters Patent is:

1. In a well packer, an elastomer packing element, an assembly for preventing plastic end flow at one end of said packing element comprising a first member fixed to one end surface of said packing element and having a first horizontal abutment surface formed thereon, a second member spaced vertically from said first member and having a second horizontal abutment surface formed thereon in opposed relation to said first abutment surface, a first set of arcuate wedge members mounted with their wide ends in sliding engagement with said first abutment surface, a second set of arcuate wedge members mounted with their wide ends in sliding engagement with said second abutment surface and their narrow ends interposed between the narrow ends of said first arcuate wedge members, and means for moving said first and second members vertically relative to one another, whereby movement of said first and second abutment surfaces toward one another moves said wedge members together longitudinally to thereby force said wedge members radially outwardly.

2. In a well packer for insertion into a well string and including an elastomer packing element adapted to be compressed and laterally expanded, an assembly for preventing plastic end flow at one end of said packing element comprising a first flange member adapted to be fixed to an end surface of said packing element, said first member having a first flat surface, a second member spaced longitudinally from said first member and having a second flat surface formed thereon opposing and in parallelism with said first surface, a first set of arcuate wedge members having longitudinally converging side faces mounted with their wide ends in sliding engagement with said first surface, a second set of arcuate wedge members having longitudinally converging side faces mounted with their wide ends in sliding engagement with said second surface and their narrow ends slidably interposed between the narrow ends of said first arcuate wedge members, and means for moving said first member and second member toward one another to move said wedge members together longitudinally to thereby force said wedge members radially outwardly.

3. In a well packer, an elastomer packing element, an assembly for preventing plastic end flow at one end of said packing element comprising a first member fixed to one end surface of said packing element and having a first horizontal abutment surface formed thereon, a second member spaced vertically from said first member and having a second horizontal abutment surface formed thereon in opposed relation to said first abutment surface, a first set of arcuate wedge members having side faces which converge both longitudinally and radially inwardly mounted with their wide ends in sliding engagement with said first abutment surface, a second set of arcuate wedge members having side faces which converge both longitudinally and radially inwardly mounted with their wide ends in sliding engagement with said second abutment surface and their narrow ends interposed between the narrow ends of said first arcuate wedge members, and means for moving said first and second members vertically relative to one another, whereby movement of said second abutment surface toward said first abutment surface moves said wedge members radially outwardly into close proximity with the bore wall.

4. In a well packer, an elastomer packing element, an assembly for preventing plastic end flow at one end of said packing element comprising a first member fixed to one end surface of said packing element and having a first horizontal abutment surface formed thereon, a second member spaced vertically from said first member and having a second horizontal abutment surface formed thereon, a first set of arcuate wedge members having side faces which converge both longitudinally and radially inwardly mounted with their wide ends in sliding engagement with said first abutment surface, a second set of arcuate wedge members having side faces which converge both longitudinally and radially inwardly mounted with their wide ends in sliding engagement with said second abutment surface and their narrow ends interposed between the narrow ends of said first arcuate wedge members, and means for moving said first and second members vertically relative to one another, whereby movement of said second abutment surface toward said first abutment surface moves said wedge members radially outwardly into close proximity with the bore wall.

5. In a well packer, an elastomer packing element, an assembly for preventing plastic end flow at one end of said packing element comprising a first member fixed to one end surface of said packing element and having a first horizontal abutment surface formed thereon, a second member spaced vertically from said first member and having a second horizontal abutment surface formed thereon in opposed relation to said first abutment surface, a first set of arcuate wedge members having side faces which converge both longitudinally and radially inwardly mounted with their wide ends in sliding engagement with said second abutment surface and their narrow ends interposed between the narrow ends of said first arcuate wedge members, and means for moving said first and second members vertically relative to one another, whereby movement of said second abutment surface toward said first abutment surface moves said wedge members radially outwardly into close proximity with the bore wall.
said second set of wedges in sliding relation with said second abutment surface, longitudinally extending dovetail slots in the slide faces of each of said first set of wedge members, a dovetail key extending outwardly from the side faces of each of said second set of wedges, each of said keys being slidably received in one of said slots, and means for moving said first and second members vertically relative to one another, whereby movement of said second abutment surface toward said first abutment surface moving said wedge members together longitudinally will force said wedge members radially outwardly into close proximity with the bore wall.

7. In a well packer for insertion into a well string, an annular elastomer packing element adapted to be compressed and expanded laterally, a tubular member at either end of said packing element axially aligned therewith, and a pair of assemblies for preventing plastic end flow of said packing element when compressed each received between one of said tubular members and the adjacent end surface of said packing element, said assemblies each including a pair of opposing parallel flat surfaces carried by said packing element and respective tubular member, a first set of arcuate wedge members having axially converging side faces mounted with their wide ends in sliding engagement with one of said flat surfaces, a second set of arcuate wedge members having axially converging side faces mounted with their wide ends in sliding engagement with the other of said flat surfaces and their narrow ends slidably interposed between the narrow ends of said first arcuate wedge members, and means for moving said tubular members relative to one another whereby movement of said wedge members together axially to thereby force said wedge members radially outwardly.

8. In a well packer for insertion into a well string, an annular elastomer packing element adapted to be compressed and expanded laterally, a tubular member at either end of said packing element axially aligned therewith, and a pair of assemblies for preventing plastic end flow of said packing element when compressed each received between one of said tubular members and the adjacent end surface of said packing element, said assemblies each including an annular flange secured to said packing element and providing a first flat surface and an opposing parallel flat surface provided by the adjacent tubular member, a first set of arcuate wedge members having side faces which converge both axially and radially inwardly mounted with the wide ends thereof in sliding engagement with one of said flat surfaces, a second set of arcuate wedge members having side faces which converge both axially and radially inwardly mounted with the wide ends thereof in sliding engagement with the other of said flat surfaces and the narrow ends thereof slidably interposed between the narrow ends of said first arcuate wedge members, and means for moving said tubular members relative to one another whereby movement toward one another moves said wedge members together axially and forces said wedge members radially outwardly.

9. In a well packer, an annular elastomer packing element adapted to be compressed into engagement with a bore wall, a tubular member at either end of said packing element axially aligned therewith, and a pair of assemblies for preventing plastic end flow of said packing element when compressed each received between one of said tubular members and the adjacent end surface of said packing element, said assemblies each including an annular flange fixed to said packing element and providing a first flat surface, and an opposing parallel flat surface provided by the adjacent tubular member, a first set of arcuate wedge members having side faces which converge both axially and radially inwardly mounted with the wide ends thereof in sliding engagement with one of said flat surfaces, a second set of arcuate wedge members having side faces which converge both axially and radially inwardly mounted with the wide ends thereof in sliding engagement with the other of said flat surfaces and the narrow ends thereof slidably interposed between the narrow ends of said first arcuate wedge members, and means for guiding the motion of said wedge members in radial paths, and means for moving said tubular members axially relative to one another whereby movement toward one another forces said wedge members radially outwardly into close proximity with the bore wall.

References Cited in the file of this patent

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CERTIFICATE OF CORRECTION  

Patent No. 2,850,101  

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It is hereby certified that error appears in the printed specification of the above numbered patent requiring correction and that the said Letters Patent should read as corrected below. 

Column 5, line 3, for "slide faces" read -- side faces --; column 6, line 22, for "including" read -- including --.  

Signed and sealed this 16th day of December 1958.  

(SEAL)  
Attest:  
KARL H. AXLINE  
Attesting Officer  

ROBERT C. WATSON  
Commissioner of Patents