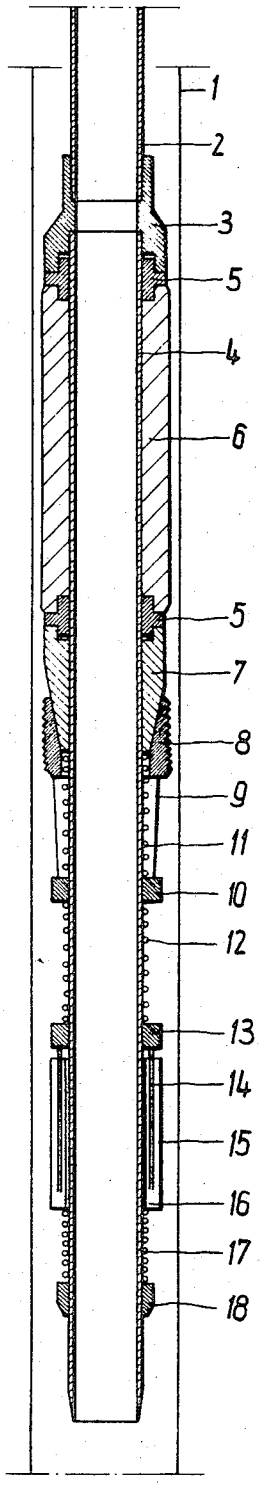
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PACKER THERMALLY TRIPPED

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PACKER THERMALLY TRIPPED

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ABSTRACT OF THE DISCLOSURE

A packer for controlling the flow of fluids in boreholes, which is adapted to be thermally activated. The packer is provided with a plurality of fixing wedges, which are operatively connected to means containing an expandable fluid. When the temperature in the borehole rises, the last mentioned fluid expands, thereby activating the fixing wedges and transferring them into a position in which they are pressed against the walls of the casing. The packer is further provided with tubing, coaxial with the borehole, by means of which the packer is suspended in the borehole. This tubing expands under the influence of the rising temperature in the borehole, caused by the circulation of hot fluid, such as steam, through the tubing and casing in the borehole. The expanding tubing finding the packer in a fixed position, causes a packing, operatively connected thereto, to bulge out and thereby tightly close the annular space between the tubing and the casing in the borehole. The means containing an expandable fluid, as well as the tubing with its packing, are constructed and arranged so that the fixing wedges first are fixed in position and then the packing is made to bulge out by the expanding tubing.

The thermal methods employed for stimulating oil recovery in oil sands, generally comprise the use of hot fluids (solvents, hot water or steam); which is injected into the oil sands.

The injection is performed usually through the tubing string, which is provided at its end with a packer which insulates and protects the well casing from the direct contact with the injected hot fluids.

The use of the packer in some oil field operations is absolutely necessary because, on the one hand, it increases the thermal recovery efficiency due to the fact that the hot fluid, having a higher velocity in the tubing, reaches the sand with a higher temperature, and on the other hand, because it insulates the well casing thereby protecting it from high temperature variations, which, due to the expansions and contractions induced in the well casing, are liable to cause its failure.

The shortcomings that most of the known packers present, are that for their setting it is necessary to work up and down the tubing string. Due to this operation there is induced an elongation due to the thermal expansion in the tubing, which can induce an excessive and uncontrolled pressure on the packer, thereby causing its failure.

The fact that after the thermal stimulation in the well has been completed, the packer remains generally in place constitutes another important shortcoming, especially when the production operation requires (after the thermal stimulation) to have a communication between the casing and tubing (i.e. by gas-lift or pumping wells, where the gas is produced together with the oil).

In order to eliminate these shortcomings, we have designed a packer which can be tripped by the heat effect, and which can close the annular space between the tubing and casing, due to the pressure exerted upon the packer gaskets by the tubing elongation caused by the thermal expansion.

The various features of novelty which characterize the invention are pointed out with particularity in the claims annexed to and forming a part of this specification. For a better understanding of the invention, its operating advantages and specific objects attained by its use, reference should be had to the accompanying drawings and descriptive matter, in which there is illustrated and described a preferred embodiment of the invention.

The thermally tripped packer comprises a tubular body **4** which has at its lower end a stop ring **18** secured to the body **4**. There is mounted a spring **17**, adjacent to the stop ring **18**. An annular cylindric vessel **15**, filled with mercury **16**, and in which there are submerged 4 pistons **14**, is linked to a ring **13**, and is with the latter freely slidably mounted along the central body **4**. A spring **12**, on which is freely resting a ring **10** is mounted above the ring **13** and abuts thereagainst 3 slips **8** with the arms **9** are connected to the ring **10**; above the ring **10** is mounted a spring **11**, on which is resting a frustum of a cone **7** on which are wedged the slips **8**.

Above this frustum of a cone **7** is mounted the rubber gasket **6** placed between two metallic rings **5** and finally, the coupling **3** which joins the packer to the tubing.

The packer operates as follows: when the temperature is raised in the casing due to thermal stimulation in the borehole, the vessel **15** which contains the mercury, is heated also. The mercury, having a caloric expansion coefficient of 1.826% at a temperature difference of 100° C., pushes the pistons **14** upwardly, and together with them, the slips **8** along the truncated cone body **7**; when the slips **8** are touching the well casing **1**, they are wedged and stop the body **7** in a fixed position in the casing **1**; the tubing **4** continues, however, to expand under the heat effect and presses, by means of the coupling piece **3** upon the rubber gasket **6**, which, consequently, expands and seals the annular space between its outer periphery and the walls of the casing **1**.

The packer remains set and sealed all the time during the thermal stimulation of the well. After the thermal treatment is ended, the tubing **4** returns to its normal temperature, consequently shrinks and comes back to the state it was in right after being lowered into the well, that is before starting the afore-described operation.

In case the packer of this invention is used for other operations than thermal stimulation, it can be tripped by using the temperature rise due to the geothermal gradient. For this purpose, the ring **10** is provided with two shear pins, whose diameter is related to the depth where the packer is to be set.

The expansion that takes place in the mercury chamber of the vessel **15**, increases gradually as the packer is lowered into the well, and when the corresponding temperature at the desired depth is reached, the pressure caused by the thermal expansion is great enough to shear the shearing pins of the slips **8**, and the slips **8** are then pushed up and engage on the packer truncated cone.

Generally, the dimensions of the shear pins will be chosen so that their shearing will take place about 20–30 meters below the packer setting place in the well. In this way, the packer can be pulled up after the slips **8** are tripped and set to the fixed point at will.

Advantages

The thermally tripped packer ensures a perfect seal of the annular space between clasing **1** and tubing **4**, during well treatments and at the moment when the thermal treatment is ended, the tubing **4** comes back to is normal temperature and length, and the packer is automatically released establishing the communcation between the tubing **4** and the annular space.

The packer release can be achieved also by using only

the temperature rise caused by the geothermic gradient, but under these conditions, the packer is set like the older types of packers and remains definitively set.

This new type of packer presents also another advantage over the older types of known packers, because its tripping is simpler and more reliable, working up and down the tubing string in order to set it is eliminated.

Although our invention has been illustrated and described with reference to the preferred two embodiments thereof, we wish to have it understood that it is in no way limited to the details of such embodiments but is capable of numerous modifications within the scope of the appended claims.

We claim:

1. A packer for sealing the passage between the walls of a borehole casing and a tubing suspended therein in response to temperature changes in said casing, comprising, in combination,

fluid storage means operatively mounted on said tubing;

an expandable fluid stored in said fluid storage means;

wedge means reciprocally movably mounted between said casing and tubing and operatively connected to said fluid storage means, said fluid storage means being adapted to move said wedge means from an inactive position in which said wedge means do not engage the walls of said casing to an active position, wherein said wedge means do engage the walls of said casing, thereby holding the adjacent portion of said tubing in position relative to said casing, when the temperature in said casing rises to a first predetermined level;

and packing means operatively mounted between said tubing and said casing, adjacent to said wedge means, and defining said passage in said casing, said tubing expanding a predetermined amount when the temperature in said casing rises to a second predetermined level, thereby causing said packing means to seal said passage.

2. The packer for sealing the passage between the walls of a bore-hole casing and a tubing suspended therein, as set forth in claim **1**, wherein said expandable fluid stored in said fluid storage means is mercury.

3. The packer for sealing the passage between the walls of a bore-hole casing and a tubing suspended therein, as set forth in claim **1**, wherein said fluid storage means comprise an annular cylindrical vessel mounted around said tubing in co-axial relationship thereto, piston means operatively mounted in said annular cylindrical vessel and operatively connected to said wedge means.

4. A packer for sealing the passage between the walls of a bore-hole casing and a tubing suspended therein, as set forth in claim **3**, including support means secured to said tubing below said annular cylindrical vessel, first coil spring means mounted around said tubing between said support means and said annular cylindrical vessel to provide a springy support for the latter.

5. A packer for sealing the passage between the walls of a bore-hole casing and a tubing suspended therein, as set forth in claim **3**, including second coil spring means mounted around said tubing between said piston means and said wedge means, an annular frusto-conical member coaxially mounted slidably on said tubing, and third coil spring means mounted around said tubing between said annular frusto-conical member and said wedge means urging the latter means away from said frusto-conical member, thereby said wedge means are automatically returned to said inactive position when the temperature in said casing has dropped below said first predetermined level.

6. A packer for sealing the passage between the walls of a bore-hole casing and a tubing suspended therein, as set forth in claim **5**, wherein said wedge means comprise a plurality of slips adapted to slide over the outer periphery of said frusto-conical member, and a ring member coaxially slidably mounted over said tubing and operatively connected to said plurality of slips, said second coil means abutting against said ring member.

7. A packer for sealing the passage between the walls of a bore-hole casing and a tubing suspended therein, as set forth in claim **6**, including a coupling member mounted on said tubing and being adapted to cooperate with said packing means.

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