CASING STAND-OFF BAND FOR USE DURING THE RUNNING AND CEMENTING OF CASING IN WELLOBRES

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References Cited
UNITED STATES PATENTS
2,388,416 11/1945 Johnson ... 166/241
1,767,198 6/1930 Baker ... 166/241
3,397,917 8/1968 Grant et al. ... 308/4 A
3,410,613 11/1968 Kuus ... 308/4 A
2,659,439 11/1953 Baker ... 166/241
2,239,023 10/1941 Clark ... 308/4 A
2,378,738 6/1945 Smith ... 308/4 A
2,636,564 4/1953 Kluck ... 166/241

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The stand-off band of this invention is particularly useful when mounted on casing which must be run into deviated well bores to assure that the casing does not stick prior to reaching the desired setting depth and permits the casing to be reciprocated up and down, or rotated, during the cementing operation, in order to obtain more effective cementation of the casing. "Sticking" of the casing, a well known and recognized problem to persons familiar with the art of well drilling and completion, is caused in the majority of cases, by allowing the casing (or pipe) to contact the permeable walls of the wellbore, across which exists a differential pressure due to the hydrostatic pressure of the fluid in the annulus being greater than the native pressure in the porous formations which have been penetrated while drilling.

The stand-off band of this invention is useful on a string of casing having a plurality of joints of pipe, with at least some of the joints having an externally enlarged portion attached thereto, such as couplings. The stand-off band includes a rigid metal band mounted about one of the joints as a point intermediate the couplings. The band has an internal diameter larger than the outside diameter of the joint of pipe casing about which the band is mounted and smaller than the outside diameter of the couplings. In addition, the band has an outside diameter smaller than the wellbore in which the casing is being placed, with the band being further characterized by having a major portion of the exterior surface thereof in the form of a smooth cylinder. The band of this invention more effectively prevents the casing joints (on which it is installed) from contacting the walls of the wellbore than prior art devices because of its unlimited resistance to collapse from lateral forces (caused by crookedness of the drilled hole, intended deviation from vertical of the drilled hole, or a combination of the two), coupled with a superior bearing surface which will not dig into unconsolidated formations, as will prior art devices. The resulting effect of a series of these bands is to prevent the casing from sticking prematurely and permits the casing to be either reciprocated or rotated during the casing cementing operation, to assure more effective displacement of the mud fluid with cement.

1 Claim, 7 Drawing Figures
CASING STAND-OFF BAND FOR USE DURING THE RUNNING AND CEMENTING OF CASING IN WELLOBRES

BACKGROUND OF THE INVENTION

1. Field of the Invention
This invention relates to a casing stand-off band which is attached to the casing and is useful to facilitate the cementing of the casing in the wellbore.

2. Description of the Prior Art
In drilling wellbores, such as oil wells, it is normal procedure to drill the bore through the various formations to the desired depth and to hopefully reach a production formation. During such drilling, it will often be necessary to deviate the wellbore at an angle from the vertical. These deviations can take many forms, including a wellbore inclined at a uniform degree of deviation. Other wellbores may be drilled having an upper portion vertical and thereafter deviated such that the hole appears to be concave when viewed in cross section. Another method of deviation is to drill the initial portion at one angle of deviation and thereafter decrease the angle of deviation to the point that the bottom portion of the bore is vertical. This type of well, when viewed in cross section, might be characterized as being concave. Another type of deviated hole is a combination of the two previously described deviations. It has heretofore been determined that lateral forces exerted between the bore hole and the casing when it is being cemented are greatly increased by a magnitude of several times over that of vertically drilled holes.

During running of the well casing, it sometimes becomes stuck due to differential pressure as aforesaid. Also, during the cementing operation, it is customary to support the bottom of the casing string a small distance off the bottom of the hole. Thereafter, a cement slurry is pumped down the well casing and up through the annulus between the casing and the wellbore, thereby displacing drilling mud from the wellbore. It is also customary to reciprocate the casing up and down or to rotate the casing in the wellbore during the pumping of cement slurry to insure complete evacuation of drilling mud from the wellbore and to prevent the channelling of the cement slurry which would result in an inferior cementing job. In the event that the casing string should become stuck to the side of the wall, it is difficult, if not impossible, to continue the reciprocation or rotation of the casing, causing an inferior cementing job.

There have heretofore been developed and used a number of devices to be attached to the casing in order to attempt to alleviate certain of the aforesaid problems. One type of device has been described as a rigid type centralizer, such as that shown in FIG. 2 of the drawing. However, rigid type centralizers of the prior art are usually comprised of rigid bars which tend to dig or gouge into the wellbore formation and thereby impede the reciprocation or rotation of the casing, reduce the bearing surface of the centralizer against the wellbore, increase chances of the casing sticking to the wellbore and therefore result in poor cementing jobs. Another type of centralizer is sometimes referred to as the flexible type centralizer, such as that shown in FIG. 3. Flexible centralizers do not provide adequate support for the larger lateral forces encountered in the aforesaid deviation type boreholes, without collapsing.

SUMMARY OF THE INVENTION
It is therefore an object of this invention to provide an improved casing stand-off band which will overcome the aforesaid problems.

Briefly stated, the invention of this application is for a casing stand-off band for use on a string of casing having a plurality of joints of pipe, with at least some of the joints having an externally enlarged portion attached thereto, such as couplings. The stand-off band includes a rigid metal band mounted about one of the joints at a point intermediate the couplings. Each of the bands has an internal diameter larger than the outside diameter of the joint of pipe about which the band is mounted and smaller than the outside diameter of the couplings. Each of the bands has an outside diameter smaller than the wellbore in which the casing is to be placed. Further, each of the bands is characterized by having a major portion of the exterior surface thereof in the form of a cylinder. Preferably, the outside diameter of the band is greater than the outside diameter of the couplings. The exterior surface of the band is preferably tapered radially inward at each axial end thereof to provide a streamlined configuration. The band is preferably mounted for relative sliding movement on the casing between the couplings to facilitate the aforesaid reciprocation of the casing.

As a result, there is provided by this invention a casing stand-off band which provides a positive stand-off of the casing from the wellbore, which band will withstand unlimited lateral forces, and which will thereby permit wider spacing than conventional spring type (or flexible) centralizers, and which will not damage or otherwise dig into the wellbore, as is the case with prior art rigid centralizers. The band of this invention also prevents casing sticking during running-in as well as during the cementing operation.

BRIEF DESCRIPTION OF THE DRAWINGS
Reference to the drawings will further explain the invention wherein:

FIG. 1 is a schematic central sectional view of a portion of a deviated wellbore showing a casing suspended therein on which is mounted a stand-off band of this invention.

FIG. 2 is a side elevation perspective view (generally from the side) illustrative of a prior art rigid type centralizer discussed above.

FIG. 3 is a perspective view generally from the side showing a flexible type centralizer of the prior art type discussed above.

FIG. 4 is a perspective view of one embodiment of the invention shown mounted on a conventional casing joint.

FIG. 5 is generally a sectional view of the stand-off band taken along line 5-5 of FIG. 4.

FIG. 6 is a perspective view showing an alternate embodiment of the stand-off band of this invention.

FIG. 7 is a cross-sectional view of the stand-off band shown in FIG. 6 taken generally along line 7-7.

DESCRIPTION OF THE PREFERRED EMBODIMENTS
Referring to FIG. 1, a section of an open wellbore has been designated by the numeral 11. A casing string 12 is generally shown suspended therein, and is comprised of a plurality of casing joints 13 connected by couplings
14. A stand-off band 15 is shown mounted on one of the joints 13 between two of the couplings 14. As stated above, the stand-off band 15 of this invention is particularly useful in cementing casing in deviated boreholes, such as that shown in FIG. 1, wherein lateral forces between the casing string 12 and the wellbore are greatest.

Referring now to FIG. 2, one type of prior art centralizer which has been used in cementing operations, but which has not been fully successful, is shown. The FIG. 2 centralizer is generally referred to as a rigid type centralizer and has been designated with the numeral 20. It is comprised of an upper collar 21 and a lower collar 22, each of which is mounted about a section of the casing 23. The collars 21 and 22 are joined by a plurality of axially extending rigid bars 24. Collars 21 and 22 are normally rigidly attached to casing 23 by set screws or the like and, therefore, rigid type centralizer 20 moves up and down with casing 23 during reciprocation thereof, which is normally carried out during a cementing operation. As a result of this reciprocation of casing 23, rigid bars 24 tend to dig into the wellbore formation and create additional friction, which increases the difficulty of continuing the reciprocation operation. In addition, the rigid bars 24, when buried in the wellbore formation, present less bearing surface to support lateral thrust of the casing against the wellbore, which also facilitates differential pressure sticking of the casing against the side of the wellbore. As stated above, this problem of sticking of the wellbore becomes increasingly important in deviated wellbores where the magnitude of lateral thrust is on the order of many times greater than that occasioned in straight vertical wellbores.

FIG. 3 shows a typical flexible type centralizer 30 having an upper collar 31 and a lower collar 32, each of which generally surrounds a casing 33 and may be rigidly attached thereto by set screws, or by using centralizers with hinged end bands and latching same around the casing couplings. Collars 31 and 32 are joined by a plurality of axially extending bowed springs 34 which normally contact the wellbore surface to thereby maintain casing 33 in a central position. However, springs 34 do not provide adequate support against a large lateral thrust and also impede reciprocation of the casing 33 up and down since they, too, tend to imbibe themselves in the wellbore wall.

The stand-off band of this invention is particularly useful when mounted on casing which must be run into deviated wellbores to assure that the casing does not stick prior to reaching the desired setting depth and permits the casing to be reciprocated up and down, or rotated, during the cementing operation, in order to obtain more effective cementation of the casing. "Sticking" of the casing, a well known and recognized problem to persons familiar with the art of well drilling and completion, is caused in the majority of cases, by allowing the casing (or pipe) to contact the permeable walls of the wellbore, across which exists a differential pressure due to the hydrostatic pressure of the fluid in the annulus being greater than the native pressure in the porous formations which have been penetrated while drilling. The band of this invention more effectively prevents the casing joints (on which it is installed) from contacting the walls of the wellbore than prior art devices because of its unlimited resistance to collapse from large lateral forces (caused by crookedness of the drilled hole, intended deviation from vertical of the drilled hole, or a combination of the two), coupled with a superior bearing surface which will not dig into unconsolidated formations, as will prior art devices. The resulting effect of a series of these bands is to prevent the casing from sticking prematurely and permits the casing to be either reciprocated or rotated during the casing cementing operation, to assure more effective displacement of the mud fluid with cement.

Referring now to FIGS. 4 and 5, one embodiment of the stand-off band of this invention will be described. Stand-off band 40 is shown mounted on a casing joint 41 immediately below a coupling 42. Both the upper and lower end of band 40 is tapered at the points designated by the numerals 43 and 44 to provide a streamlined effect to the stand-off band 40.

It will be observed that band 40 has a slightly larger ID than the OD of casing joint 41. Further the ID of stand-off band 40 is less than the OD of coupling 42. The result is that coupling 42 and the coupling in the casing string therebelow act as two enlarged portions in the casing string which restrict the movement of band 40 therebetween. In other words, band 40 in the preferred embodiment is permitted to move freely up and down relative to casing joint 41, between the couplings 42.

Typical dimensions for band 40 will now be given for illustrative purposes. For example, casing joint 41 might be 7 inches OD and coupling 42 approximately 7 inches ID. Band 40 will normally have a 1/16 inch radial clearance for an overall ID 1/8 inch greater than the OD of casing joint 41, with the result that it can slide freely on casing 41. The radial thickness of stand-off band 40 may be on the order of 9/16 inch, with the OD of band 40 being smaller than the diameter of the wellbore so that cement may be pumped therepast in the annulus. The radial thickness of coupling 42 may be on the order of 0.328 inch, such that the OD of coupling 42 will be less than the OD of band 40. The OD of band 40 will normally be less than the ID of the spider at the wellhead to permit passage of the bands therethrough.

Referring now to FIGS. 6 and 7, an alternate embodiment of the invention will be described. There, stand-off band 50 is shown mounted on a similar casing joint 51 connected by couplings 52 to adjacent joints. Stand-off band 50 is generally comprised of an intermediate collar 54 and upper and lower collars 55 and 56, respectively, of reduced diameter. Upper collar 55 is joined to intermediate collar 50 by a tapered portion 57, and lower collar 56 is joined to intermediate collar 50 by another tapered portion 58. It will be observed that the external configuration of stand-off band 50 is quite similar to that of stand-off band 40. That is, each is characterized by having a major portion of the exterior surface thereof in the form of a smooth cylinder. The smooth cylindrical configuration presents a wide surface for contacting with the wellbore and thereby resisting a greater amount of lateral force. It is to be understood that stand-off band 50 may be constructed of metal or the like of sufficient weight and strength to resist any contemplated lateral pressure thereagainst. By having the central portion hollowed out, as shown, it is lighter and less expensive to manufacture than stand-off band 40. Other than that, the stand-off bands 40 and 50 perform identical functions. Further, stand-off
band 50 would have similar OD and ID measurements to stand-off band 40.

The axial length of the external cylindrical portions of stand-off bands 40 and 50 is selected to give sufficient bearing surfaces to support any lateral forces that might be contemplated in the wellbore. Stand-off bands 40 and 50 have many advantages which will be enumerated hereinafter.

Stand-off bands of this invention are designed to offer unlimited resistance to lateral forces, permitting wider spacing than conventional spring-type centralizers through the high force sections of holes, such as deviated portions of wellbores that are typically encountered in offshore locations.

The stand-off bands of this invention, by being mounted for relative sliding movement on the casing joints between casing couplings or stop rings or other enlarged portions, reduce the over-all drag on the casing string during the reciprocation of the casing during the cementing operation.

The stand-off bands of this invention provide more favorable bearing surfaces against the soft formations that may be present in a wellbore than is true of conventional centralizers, either rigid or spring type.

While running the stand-off bands of this invention into the wellbore along with the casing, the stand-off bands ride ahead of the casing collars, thereby providing a streamlining effect to reduce the drag on the casing as it is lowered in the wellbore. The same streamlining effect is also present to reduce drag during reciprocation of the casing, as aforesaid.

Installation of the stand-off bands of this invention is quite easy and is accomplished by slipping each of the bands on the pin end of a casing joint immediately prior to the stabbing of that joint.

Spacing programs for stand-off bands of this invention are simplified because of the increased efficiency of the bands and the greater simplicity of the installation.

Further modifications and alternative embodiments of the invention will be apparent to those skilled in the art in view of this description. Accordingly, this description is to be construed as illustrative only and is for the purpose of teaching those skilled in the art the manner of carrying out the invention. It is to be understood that the form of the invention herewith shown and described is to be taken as the presently preferred embodiment. Various changes may be made in the shape, size and arrangement of parts. For example, equivalent elements or materials may be substituted for those illustrated and described herein, parts may be reversed and certain features of the invention may be utilized independently of the use of other features, all as would be apparent to one skilled in the art after having the benefit of this description of the invention.

What is claimed is:

1. In a casing stand-off band for mounting on a string of casing which is to be run into and cemented in a wellbore and reciprocated or rotated during the cementing operation and wherein said casing has a plurality of lengths of pipe connected by couplings having outside diameters larger than said lengths, the combination comprising:
   a rigid unitary band adapted for mounting about one of said lengths of pipe at a point intermediate said couplings connected thereto, said band having an internal diameter larger than the outside diameter of said length of pipe about which said band is mounted and smaller than the outside diameter of said couplings, and said band having an outside diameter smaller than the wellbore in which said casing is to be placed and greater than the outside diameter of said couplings, said band being further characterized by having the major portion of the exterior surface thereon in the form of a smooth cylinder, and with the exterior surface of said band tapered radially inwardly at each axial end thereof, to provide a streamlined configuration; whereby fluid can be pumped past said band in said wellbore and whereby said band provides resistance to collapse from lateral forces and a more effective bearing surface which will not dig into the wellbore wall and which prevents casing sticking during running in and during the cementing operation when the casing is moved in the wellbore.

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