ABSTRACT

A sucker rod guide includes a pair of vanes, offset from one another by 180°, with each vane wrapping approximately 180° around the rod guide. The vanes wrap around the body of the guide, and are neither spiral nor helical because the surfaces of the vanes extending radially outwardly from the body of the rod guide define two dimensional planar surfaces, i.e. flat planes. The vane thickness varies from a maximum at each end of the vane to a minimum at a midway point along the vane. This shape assists in moving fluid up the production tubing when the guide is applied to a rotary system, such as a progressive cavity pump. This shape also enhances the erodable volume of the vanes at the extremities, while providing a less inhibiting path for the flow of fluid in reciprocating applications.
ROD GUIDE WITH WRAPPING VANES

FIELD OF THE INVENTION

[0001] The present invention relates generally to the field of sucker rod guides and scrapers for removing paraffin and other extraneous materials from the interior wall of production tubing. Tubing and protecting the tubing and sucker rod couplings from excessive wear. More particularly, the present invention relates to a sucker rod guide with a pair of helical vanes along a portion of the length of the guide and fluid flow channels between the vanes.

BACKGROUND OF THE INVENTION

[0002] Various types of rod guides and scrapers have been devised to remove paraffin and other material from the interior wall of production tubing. Many rod guides include a cylindrical body molded onto a sucker rod and one or more vanes projecting radially from the body. In some cases, one or more vanes are substantially straight (i.e. parallel to the axis of the rod), and in other cases the vanes are slanted (i.e. inclined at an angle relative to the axis of the rod). In still other cases, the vanes may be helical (i.e. spiraling relative to the axis of the rod). The space between the vanes, or between the slanted vanes, defines a flow path for production fluid past the rod guide.

[0003] Most rod guides today are manufactured from a polymeric material. Rod guides may be secured in various ways to the sucker rod. In one application, the rod guide is molded onto the sucker rod and is thus immobile relative to the sucker rod. In other applications, the sucker rod includes an open seam which is opened in order to affix the rod guide to the sucker rod.

[0004] As described in U.S. Pat. No. 7,731,885 to Abdo, for many applications, a rod guide provided with spiraling vanes is preferred over a straight or slanted vane guide, since more of the circumference of the tubing may be cleaned by a single spiraling guide compared to a single straight-vane guide in a reciprocating rod application. Spiraling rod guide vanes shown and described by Abdo included a forward portion spiraling in a forward direction and a backward portion spiraling in a backward direction rotatably opposite the forward direction. This arrangement creates a tortuous path, however, and causes high fluid drag forces to fluid passing between the rod guide and the interior surface of the production tubing.

[0005] U.S. Pat. No. 5,277,254 discloses a helical rod guide for use with a progressing cavity pump rod. The helical guide may employ either one or two lead vanes. U.S. Pat. No. 6,182,754 discloses a helical scraper for a reciprocating sucker rod. Each of the two vanes extends 180° about the body, with the ends of a flow channel between the vanes being parallel to the body of the sucker rod. U.S. Pat. No. 6,439,311 discloses a method of retarding sand buildup by employing helical vanes which are affixed to connective rods by shrink couplings. Other patents of interest include U.S. Pat. Nos. 5,680,534, 5,941,312, 6,065,537, 6,290,475, and 6,484,882, and Canadian Patents 2,260,710 and 2,291,394.

[0006] The disadvantages of the prior art are overcome by the present invention, and an improved rod guide and method of molding a rod guide are hereinafter disclosed.

SUMMARY OF THE INVENTION

[0007] The present invention addresses these and other shortcomings in the art by providing a pair of vanes, offset from one another by 180°, and each vane wrapping approximately 180° around the rod guide. Vanes in the art that are shown and described in the references above have been variously described as “spiral” or “helical”. The vanes in the present invention are neither spiral nor helical because the surfaces of the vanes extending radially outwardly from the body of the rod guide define two-dimensional planar surfaces, i.e flat planes, while the corresponding surfaces of the vanes shown and described in the art define curvilinear planes.

[0008] Thus, the vane thickness in the present invention varies from a maximum at each end of the vane to a minimum at a midway point along the vane. This shape assists in moving fluid up the production tubing when the guide is applied to a rotary system, such as a progressive cavity pump. This shape also enhances the erodable volume of the vanes at the extremities, while providing a less inhibited path for the flow of fluid in reciprocating applications.

[0009] These and other features and advantages of this invention will be readily apparent to those skilled in the art.

BRIEF DESCRIPTION OF THE DRAWINGS

[0010] So that the manner in which the above recited features, advantages and objects of the present invention are attained and can be understood in detail, more particular description of the invention, briefly summarized above, may be had by reference to embodiments thereof which are illustrated in the appended drawings.

[0011] FIG. 1 is a front perspective view of a sucker rod with a rod guide of the present invention molded thereon coupled to a down-hole pump.

[0012] FIG. 2 is a section view of the rod guide molded to a sucker rod.

[0013] FIG. 3 is a front perspective view of the rod guide.

[0014] FIG. 4 is a side perspective view of the rod guide of FIG. 3 rotated by 90°.

[0015] FIG. 5 is an end view of the sucker rod and rod guide of FIG. 3.

[0016] FIG. 6 is a section view of the rod guide taken along section lines 6-6 of FIG. 4.

DETAILED DESCRIPTION OF A PREFERRED EMBODIMENT

[0017] FIG. 1 depicts a presently preferred embodiment of a rod guide 10 with wrapping vanes 11, in accordance with the teachings of the present invention. While only one rod guide is depicted, it is understood that many such rod guides, spaced apart, will be used in operation. The rod guide 10 is preferably molded onto a sucker rod 12, although the rod guide may be firmly affixed to the sucker rod in any manner now known or later developed. A pump 14 is coupled to the bottom end of the sucker rod 12 in a manner well known in the art. The pump 14 is positioned within a casing 16 is pump fluids from the region surrounding the pump 14, up the casing, around the various rod guides 10, to the surface (not shown).

[0018] The plurality of rod guides are specifically adapted to operate within one of a number of standard casing diameters. Thus, there is a design clearance between the vanes 11 and an interior surface 18 of the casing. This keeps the sucker rod centralized within the casing and prevents the sucker rod from rubbing against the interior surface of the casing. The sucker rod, the rod guides, and the pump are coaxially aligned along an axis 20.
FIG. 2 illustrates a cross section of a rod guide 10. The rod guide 10 defines two wrapping vanes 11, as previously described. Each vane 11 has an upper angled edge 22 and a lower angled edge 24. The angled edges 22 and 24 reduce hydrodynamic resistance to fluid flow by the rod guide. A conical end cap 26 tapers from the upper angled edge 22 down to the sucker rod. Similarly, a conical end cap 28 tapers from the lower angled edge 24. Note that the angled edge 22 provides a straight, non-wrapping vane segment between the end of the wrapping vane 11 and the conical end cap 26, and the angled edge 24 provides a straight, non-wrapping vane segment between the end of the wrapping vane 11 and the conical end cap 28.

FIGS. 3 through 6 provide details of the structure of the rod guide with wrapping vanes of this invention. FIG. 3 illustrates a front view of the rod guide, while FIG. 4 shows the rod guide rotated by 90°. FIG. 3 most clearly shows a feature of this invention, i.e., a flat, two-dimensional surface 30 on one side of a vane 11 and a flat, two-dimensional surface 32 on the opposite side of the vane 11. This flat surface feature reduces fluid drag and simplifies the manufacturing process because the mold is easier to open with the flat surfaces.

As shown in FIG. 4, the vane 11 and a vane 11 overlap along a centerline 34 by roughly the width of a vane. Thus, each vane subtends roughly 180° around the rod guide. The vane 11 also includes a flat, two-dimensional surface 36 extending radially outwardly from an elongate, cylindrical body 38. The vane 11 includes a flat, two-dimensional surface 40 on the opposite side of the vane 11 (see FIG. 6). With this orientation, each vane defines a minimum thickness at a mid-point along the vane and maximum thickness at each end of the vane.

The principles, preferred embodiment, and mode of operation of the present invention have been described in the foregoing specification. This invention is not to be construed as limited to the particular forms disclosed, since these are regarded as illustrative rather than restrictive. Moreover, variations and changes may be made by those skilled in the art without departing from the spirit of the invention.

1. A rod guide comprising:
   an elongate cylindrical body;
   a first vane defining opposing, parallel, flat, two-dimensional first and second side walls, the first vane wrapping substantially half-way around the body; and
   a second vane extending radially outwardly from the body,
   the second vane defining opposing, parallel, flat, two-dimensional third and fourth side walls, the first vane wrapping substantially half-way around the body.

2. The rod guide of claim 1, wherein the first and second vanes are offset from one another by substantially 180°.

3. The rod guide of claim 1, wherein the body defines a first end and a second end, and further comprising:
   a first conical end cap extending from the first end of the body; and
   a second conical end cap extending from the second end of the body.

4. The rod guide of claim 1, wherein the first vane defines a first end, a second end, and a middle, and wherein the first vane defines a maximum width and the first end and the second end and a minimum width at the middle.

5. The rod guide of claim 4, further comprising:
   a first conical end cap extending from the first end of the body;
   a second conical end cap extending from the second end of the body;
   a first angled edge between the first end of the first vane and the first conical end cap; and
   a second angled edge between the second end of the first vane and the second conical end cap.

6. The rod guide of claim 5, wherein the first angled edge defines a first straight, non-wrapping vane segment and further wherein the second angled edge defines a second straight, non-wrapping vane segment.

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