

Description

This invention relates to a retrievable straddle packer for use in oil and gas wells. More specifically, the invention relates to an improved retrievable compression set straddle packer assembly to isolate a predetermined interval of perforations in an oil or gas well casing, to the selective break-down of the perforations to remove debris and produced materials therefrom or for the injection of stimulation fluids into the perforations to promote the free flow of formation fluids and gases into the well bore.

The perforated section of casing set across the producing zone in an oil or gas well can be many feet, sometimes several hundred feet, in length (one foot = 0.30 metres). To achieve the maximum stimulation effectiveness across the entire producing zone, as many perforations as possible must be open to accept stimulation fluids. Conventional practice has been to perforate the full length of the producing interval, then stimulate the entire zone in one operation. In long perforated intervals, some of the perforations will accept stimulation fluids more readily than others. These perforations then receive all the stimulation treatment leaving portions of the producing formation unstimulated.

To ensure that the maximum number of perforations within the perforated interval are open to accept stimulation fluids, short sections of the perforated interval may be isolated with a straddle packer. Hydrochloric acid or other stimulation fluids can then be injected into the perforations isolated by the two sets of packing elements to break down the perforations in this short interval. This will ensure that these perforations are open to produce reservoir fluids or to accept additional stimulation fluids. The shorter the perforated interval broken down at each packer setting, the more perforations within the entire producing interval will be known to be capable of accepting other stimulation fluids or to produce reservoir fluids or gases.

Typically, such injection operations have been performed using a retrievable packer having frusto-conical type cups thereof to isolate the perforations to be washed. However, such cup-type packers are susceptible to damage of the frusto-conical cups as they pass over the perforations in the casing, or through dry casing or through casing liners, and cannot be used with high differential fluid pressures acting across the frusto-conical cups to prevent the cups from being damaged.

Therefore, in certain instances, it is desirable to have a retrievable compression set straddle packer assembly having two sets of compression set packer elements thereon to isolate perforations in the casing in the well bore for washing.

Also, it is desirable to have such a retrievable compression set straddle packer assembly which can be used as a selective injection packer to isolate portions of the well bore for fluid injection operations, where the length of the packer

assembly between the compression set packer elements may be easily varied for use in a wide variety of well operations.

A retrievable compression set straddle packer assembly having two sets of compression set packer elements, but which are separated by a plurality of hydraulically set packer elements, is described in US-A-3398796. Each hydraulically set packer element is, in turn, separated from an adjacent one by a valve-containing module body.

We have now devised an improved retrievable compression set straddle packer assembly for use in oil and gas wells.

According to the present invention, there is provided a retrievable compression set straddle packer for use in wells, comprising: an hydraulic slip assembly; a tubular injection mandrel assembly secured to said hydraulic slip assembly and extending downward therefrom, said mandrel assembly having a plurality of injection ports extending through the wall thereof; upper packer element means disposed on said mandrel assembly adjacent to said hydraulic slip assembly; injection spacer means disposed on said mandrel assembly adjacent to and below said upper packer element means, said injection spacer means including upper and lower packer compression rings; lower packer element means disposed on said mandrel assembly adjacent to and below said injection spacer means; a slip body disposed on said mandrel assembly below said lower packer element means; a plurality of slips disposed on said mandrel assembly, the upper ends of said slips being longitudinally slidably mounted to said slip body and the lower ends of said slips being secured to a collar assembly therebelow surrounding said mandrel assembly; a drag block assembly disposed on said mandrel assembly below said split ring collar assembly and secured thereto; and a bypass assembly disposed on said mandrel assembly below said drag block means and secured thereto, said bypass assembly including bypass ports through the wall thereof adapted to communicate with said mandrel assembly, characterised in that said upper and lower packer compression rings are separated by a plurality of elongate longitudinal struts defining a plurality of elongate longitudinal apertures therebetween, said mandrel assembly has a plurality of bypass slots extending through the wall thereof below said injection ports, said slip body is splined to said mandrel assembly, the upper ends of said slips are splined to said slip body, said collar assembly is a split ring collar assembly to which the lower ends of the slips are radially slidably secured, said bypass ports are adapted to communicate with said bypass slots of said mandrel assembly when aligned therewith and J-slot means are provided comprising lug means secured to one of said mandrel assembly and said drag block means, and a cooperating J-slot secured to the other of said mandrel assembly and said drag block means.

In one preferred embodiment, the hydraulic slip

assembly comprises: an hydraulic hold down body having a plurality of apertures therein and a bore therethrough; a plurality of hydraulic slips located in a plurality of apertures in the hydraulic hold down body, each slip having an elongated slot extending through a portion thereof; a plurality of hold down straps overlying the plurality of hydraulic slips, each strap overlying the elongated slot in at least one hydraulic slip and being secured to the hold down body; and a plurality of hydraulic slip retractor springs, each spring having one end abutting a hold down strap and the other end abutting a portion of a hydraulic slip.

The injection mandrel assembly preferably comprises: a tubular injection mandrel having said injection ports through the wall thereof; a tubular J-slot mandrel having said lug means protruding radially therefrom and said bypass slots through the wall thereof; and a plug in the bore of said J-slot mandrel below said bypass slots.

Use of a J-slot mandrel in conjunction with a J-slot secured to a drag-block, for actuating a mechanical slip assembly and a packer assembly of a conventional retrievable packer, is described in US-A-3426846.

In order that the present invention may be more fully understood, reference is made to the accompanying drawings, wherein:

FIGURES 1A to 1D illustrate a preferred embodiment of the retrievable straddle packer assembly of the present invention, in enlarged partial cross-section.

FIGURE 2 is a development of the J-slot employed in the drag block sleeve of the embodiment of Figure 1.

FIGURE 3 is a schematic view of a retrievable straddle packer assembly of the present invention deployed in a cased well bore having perforations therethrough.

Referring now to FIGS. 1A-1D of the drawings, straddle packer assembly 10 of the present invention comprises an hydraulic slip assembly 12, an injection mandrel assembly 30, a packer assembly 170, a mechanical slip assembly 250, a drag block assembly 330, and a bypass assembly 380.

Hydraulic slip assembly 12 (to be described in greater detail below) has internal threads at the top of toolbore 16. At the lower end of hydraulic slip assembly 12 is a second threaded bore 122, above which O-ring 120 rests in annular cavity 118. O-ring 24 seals against lead surface 28 on the exterior of tubular injection mandrel 32 at the top of injection mandrel assembly 30, below which lead surface 28 external threads 34 engage second threaded bore 122 of hydraulic slip assembly 12.

A plurality of circumferential injection ports 48 extend from tool bore 16 through the wall of injection mandrel 32 opening onto seal surface 46, below which a plurality of splines 50 extend radially outwardly from the exterior of injection mandrel 32. Below splines 50, oblique annular

shoulder 52 terminates in annular flat 54, below which frusto-conical slip cam surface 56 tapers inwardly back to trailing surface 58 of injection mandrel 32.

External threads 60 at the bottom of injection mandrel 32 engage threads 62 at the top of J-slot mandrel 64, O-ring 66 effecting a seal therebetween. A plurality of J-slot lugs 68 extend radially outward from cylindrical exterior surface 70 of J-slot mandrel 64, below which a plurality of circumferentially disposed bypass slots 72 extend from mandrel assembly bore 16 through the wall of J-slot mandrel 64. Immediately below bypass slots 72, annular shoulder 74, defined by upper and lower oblique surfaces 76 and 77 respectively with longitudinally extending bore wall 78 therebetween, extends radially inwardly. At the bottom of J-slot mandrel 64, external threads 80 run to the end 82 thereof. Radial vent passages 83 extend through the wall of J-slot mandrel below annular shoulder 74.

Removable plug 84, characterized by upstanding fishing neck 86 protruding from the top of plug body 88, rests on shoulder 74 of J-slot mandrel 64. Plug 84 is supported on top of oblique surface 86 by radially outwardly extending shoulder 89, and a fluid-tight seal is effected between the cylindrical exterior 91 of plug body 88 and bore wall 78 of J-slot mandrel 64 by O-rings 93 in annular grooves 96.

Injection mandrel assembly 30 includes injection mandrel 32, J-slot mandrel 64, and plug 84.

Returning to the top of retrievable straddle packer assembly 10 (see FIG. 1A) hydraulic slip assembly 12 comprises a hydraulic hold down body 90, a plurality of hydraulic slips 92 retained within body 90, a plurality of hydraulic hold down straps 94 retaining the plurality of hydraulic slips 92 within body 90 and a plurality of hydraulic slip retractor springs 96 biasing the plurality of slips 92 in a retracted position within body 90.

The hydraulic hold down body 90 comprises an annular elongated cylindrical member 100 having, on the exterior thereof, a first cylindrical portion 102, first annular chamfered shoulder 104, second cylindrical portion 106, and radially flat lower face 108 and, on the interior thereof, first threaded bore 110, first annular shoulder 112, first cylindrical bore 114, oblique annular shoulder 115, second cylindrical bore 116, and third cylindrical bore 117, having annular cavity 118 therein containing O-ring 120, and second threaded bore 122 (see FIG. 1A).

The hydraulic hold down body 90 further includes a plurality of first bores 126 and second bores 128 having, in turn, a diameter smaller than first bores 126 extending through the body 90 from the second cylindrical portion 106 on the exterior of the body 90 to the second cylindrical bore 116 on the interior thereof, a plurality of threaded apertures 130 extending partially through body 90 extending inwardly from second cylindrical portion 106 of body 90, and a plurality of elongated recesses 132 in second cylindrical portion 106 of body 90, a portion of each elongated

gated recess 132 extending over each first bore 126 in the body 90.

Retained within each first bore 126 in the hydraulic hold down body 90 is a cylindrical hydraulic slip 92. The hydraulic slip 92 comprises a cylindrical member 134 having an annular recess 136 in the exterior thereof having, in turn, annular elastomeric seal 138 therein, an elongated slot 140 extending through a portion thereof, a plurality of recesses 142 therein, and a plurality of teeth 144 thereon. The bottom 145 of each hydraulic slip 92 is in fluid communication with the second cylindrical bore 116 of hydraulic hold down body 30 via second bore 128 in the body 90.

Each hydraulic hold down strap 94 comprises an elongated, generally rectangular in cross-section member 146 having a width such that the member 146 readily is received within elongated recess 132 in hydraulic hold down body 90 and such that the elongated slot 140 in each slip 92 is wider than the width of member 146, having a plurality of bores 148 extending therethrough and having a plurality of circular recesses 152 therein. Each hydraulic hold down strap 94 is releasably secured to hydraulic hold down body 90 by a plurality of threaded fasteners 154, each fastener 154 having the threaded body 158 thereof extending through a bore 148 of strap 94 threadedly engaging threaded aperture 130 in body 90.

The hydraulic slip retractor springs 96 each comprise a coil wound type spring member 160 having one end 162 thereof retained within circular recess 152 of hydraulic hold down strap 94 and the other end 164 thereof received within recess 142 in hydraulic slip 92.

The hydraulic slip retractor springs 96 resiliently bias hydraulic slips 92 within first bores 126 within hydraulic hold down body 90.

Referring to FIGS. 1A and 1B, the packer assembly 170 comprises an upper shoe 172, a first upper packer element 174, spacer ring 176, a second upper packer element 178, injection spacer 180, a first lower packer element 182, spacer ring 184, a second lower packer element 186, and a lower shoe 188.

Upper shoe 172 comprises an annular member having a cylindrical exterior 190, a threaded bore 191 and a cylindrical bore 192 therebelow having annular recess 194 therein, within which rests elastomeric O-ring 196 therein. Upper shoe 172 also includes upper and lower radially flat faces 198 and 200, respectively. O-ring 196 sealingly engages the exterior 46 of injection mandrel 32, while threaded bore 191 engages external threads 34 of injection mandrel 30.

First upper packer element 174 comprises an annular elastomeric member having cylindrical bore 202 therethrough.

Spacer ring 176 comprises a washer-like annular member having an upper surface 204, a lower surface 206, and bore 208 therethrough.

Second upper packer element 178 comprises an annular elastomeric member having a cylindrical bore 210 therethrough.

Injection spacer 180 comprises upper and lower packer compression rings 212 and 214, respectively, separated by a plurality of injection struts 216 having a plurality of slots 218 therebetween. Ring 212 has a radially flat upper face 220, and ring 214 has a radially flat lower face 222. The interior of injection spacer 180 defines a shallow annular cavity 224 between struts 216 and the exterior 46 of injection mandrel 32. The exterior of injection spacer 180 is recessed adjacent struts 216, rings 212 and 214 extending radially therebeyond.

First lower packer element 182 comprises an annular elastomeric member having cylindrical bore 226 therethrough.

Spacer ring 184 comprises a washer-like annular member having upper and lower radially flat surfaces 228 and 230, and bore 232 therethrough.

Second lower packer element 186 comprises an annular elastomeric member having cylindrical bore 234 therethrough. Lower shoe 188 includes a radially flat upper face 236, a first cylindrical bore 238, a radially flat interior lower face 240 and a threaded interior bore 242. The exterior of lower shoe 188 includes a first cylindrical surface 244 leading to inwardly tapering annular surface 246.

Mechanical slip assembly 250 includes slip body 252, a plurality of slips 254, and a split ring collar assembly 256. The left-hand side of FIG. 1C in the vicinity of slip assembly 250 has been rotated slightly to the left for a clearer view of the exterior thereof.

Slip body 252 includes threaded exterior lead surface 260 which engages threaded bore 242 of lower shoe 188, annular shoulder 262 and cylindrical exterior surface 264 having a plurality of wedge shaped recesses 266 therein having slip wedge surfaces 267, each recess 266 extending from the lower end 268 of slip body 252 to an intermediate position 270 on the exterior 264 thereof. Recesses 266 include laterally extending channels 272 at either side thereof. The interior of slip body 252 comprises cylindrical bore 274, having lugs 275 extending radially inwardly therefrom, engaged with splines 50 of injection mandrel 32.

Each slip 254 comprises an elongated member of generally rectangular cross-sectional shape throughout its upper extent, which possesses an arcuate exterior surface 276 having a plurality of wedge shaped gripping members 280 protruding therefrom. The mid-portion of each slip 254 comprises a neck member 282 defined by recesses at either side thereof, terminating at the bottom of slip 254 with laterally extending projections 284, forming therewith a T-shaped lug 285. The upper interior of each slip 254 comprises oblique surface 286 which rides on slip wedge surface 267 of recess 266, while the lower interior of each slip 254 comprises an arcuate surface 288. Lateral webs 290 extend from either side of oblique surface 286 and are received in channels 272 in slip body 252.

Split ring collar assembly 256 comprises a plurality of arcuate shaped collar members 300

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secured to each other and forming an annular assembly by means of a plurality of threaded fasteners 302. Each collar member 300 includes an arcuate outer surface 304, first arcuate inner surface 306, second arcuate inner surface 308, third arcuate inner surface 310, and fourth arcuate inner surface 312. Each collar member 300 further includes a T-shaped recess 314 therein defined by lateral channels 316 and longitudinal channel 318 extending thereto from the upper end 320 of each member 300. Each recess 314 receives a T-shaped lug 285 of a slip 254 therein.

Drag block assembly 330 includes a plurality of drag blocks 332, drag block springs 334 and a drag block sleeve 336.

Drag blocks 332 each comprise a longitudinally extending member 340 having carbide buttons 342 disposed on the radially exterior surface thereof. At the upper and lower extents of member 340 lips 344 and 346 extend therefrom. Longitudinal slot 348 is cut into the interior of member 340, receiving the ends 350 and 352 of drag block spring 334.

Drag block sleeve 336 comprises a cylindrical body 356 having radially extending annular shoulder 358 above circumferential channel 360 at its upper end, which structure engages the lower end of split ring collar assembly 256. Tabs 362 are welded onto body 356 and extend over upper lips 344 of drag blocks 332. In the center of body 356 is a cavity 364 into which drag blocks 332 may be biased against drag block springs 334, the center 354 of each drag block spring 334 bearing against the top of J-slot housing 366, which contains J-slots 368 cut into the inside thereof, into which J-slot lugs 68 from J-slot mandrel 64 radially extend. A development of J-slots 368 is shown in FIG. 2 of the drawings. Lower lips 346 of drag blocks 332 are maintained in drag block sleeve by tabs 370 which are secured to body 356 by bolts 372.

The lower end 374 of drag block sleeve 336, in conjunction with bypass seal body 376, and the lower end of J-slot mandrel 64 comprises bypass assembly 380. Drag block sleeve 336 is undercut at its lower end to form an annular recess 382, defined by radial flat 384 and interior bore wall 386. Bypass ports 388 extend through the wall of sleeve 336, opening into recess 382. Below recess 382, threaded bore 390 extends to the lower end of sleeve 336. Bypass seal body 376 has threaded leading end 392 on its upper exterior, which engages threaded bore 390, leading surface 394 defining the lower extent of recess 382. The exterior of bypass seal body 376 comprises a first cylindrical surface 396, a frusto-conical inwardly extending surface 398, and a second cylindrical trailing surface 400. The interior of bypass seal body comprises a cylindrical bore 402 having two shallow annular recesses 404 and 406 therein, each such recess holding a plurality of O-ring seals 408 supported by teflon backup rings 410, which seals bear sealingly against the exterior 70 of J-slot mandrel 64.

Referring to drawing FIGS. 1-3, the operation of

the preferred embodiment 10 of the straddle packer assembly of the present invention is as follows.

The hydraulic hold down body 90 of the hydraulic slip assembly 12 is connected to the bottom of a tubing string 500 to be run into well bore 502 from rig 504.

When the straddle packer assembly 10 is run into well bore 502, the drag block assembly 330 of the packer assembly 10 slidingly, resiliently engages the well bore casing 506. To set the straddle packer assembly 10 in the well bore, the tubing string 500 is rotated to the right and right hand torque is maintained on the tubing string 500. This causes the lugs 68 on J-slot mandrel 64 to move from the short portion of the J-slots 368 to the long portion of the J-slots 368, lugs 68 having been moved from the bottom of the short portion of the J-slots 368 to the top thereof (see FIG. 2) by the relative movement of the drag block assembly 330 with respect to the J-slot mandrel 64 as the packer assembly 10 is run into the well bore by means of the drag blocks 332 of drag block assembly 330 engaging the well bore casing 506. Next, while holding right hand torque on the tubing string, the tubing string is lowered or "slacked off" until the slips 254 of mechanical slip assembly 250 begin to take weight off the tubing string. During this operation, the lugs 68 on J-slot mandrel 64 move downwardly in the long portion of the J-slots 368 in drag block sleeve 336, causing frusto-conical slip cam surface 56 of injection mandrel 32 to cam the slips 254 into engagement with well bore casing 506. At this time, the right hand torque may be released with continued movement of the tubing string 500 downwardly in well bore 502 until the desired amount of weight is set on the packer assembly 10.

As the packer assembly 10 picks up weight from the tubing string 500 the downward movement of the hydraulic hold down body 90, injection mandrel 32 and J-slot mandrel 64 with respect to the stationary slips 254 and slip body 252 cause the upper and lower packer elements 174, 178 and 182, 186 respectively, to be compressed into engagement with the well bore casing 506 while bypass slots 72 on the J-slot mandrel 64 move downwardly past the upper set of O-rings 408 in bypass seal body 376, closing bypass assembly 380.

After the retrievable straddle packer assembly 10 is set in the well bore 102, the portion of the well bore located between upper packer elements 174 and 178 and the lower packer elements 182 and 186 is isolated. If it is desired to treat perforations 510 adjacent this isolated portion 508 of the well bore 502, the portion of the well bore located between upper packer elements 174 and 178 and the lower packer elements 182 and 186 is isolated. If it is desired to treat perforations 510 adjacent this isolated portion 508 of the well bore 502, treating fluid may be pumped down the tubing string 502 through hydraulic hold down body 90 of the upper hydraulic slip assembly 12, and

Injection mandrel 32 through injection ports 48 in injection mandrel 32 and slots 218 in injection spacer 180, into isolated well bore 508 and into perforations 510.

When treating fluid is pumped through upper hydraulic slip assembly 12, the hydraulic slips 92 are forced into engagement with the well bore by the pressure of the treating fluid acting on the bottom 145 of each slip 92. When the slips 92 engage the well bore casing 506, this in conjunction with slips 254 engaging the well bore casing 506 helps prevent movement of the straddle packer assembly 10 in the well bore in either direction. Upon the cessation of the pressure of the treating fluid acting upon the bottom 145 of the hydraulic slips 92, the slips disengage the well bore by hydraulic slip retractor springs 96 biasing the slips 92 into a retracted position within the body 90.

When finished treating the isolated portion 508 of the well bore 502, to retrieve the packer assembly 10, weight is picked up from the packer assembly 10 by tubing string 500 thereby allowing the various components of packer assembly 10 to return to their positions shown in drawing FIGS. 1A-1D with hydraulic slips 92, upper and lower packer element 174, 178 and 182, 186 respectively and mechanical slips 254 disengaging the well bore casing 506 to allow the movement of the packer assembly 10 in the well bore 502 to isolate another area for treatment or to retrieve packer assembly 10.

When the packer assembly 10 is moved upwardly, bypass slots 72 in J-slot mandrel 64 move upwardly into communication with recess 382, allowing fluid communication between the exterior and interior of the bypass assembly 380 of the packer assembly 10 through ports 388, recess 382, slots 72, tool bore 16 and injection ports 48 to equalize pressure on either side of the lower packer elements 182 and 186 to prevent damage thereto when retrieving the packer assembly. If the fluid pressure is not equalized across lower packer elements 182 and 186 prior to moving the packer assembly 10, any higher fluid pressure above the packer elements 182 and 186 than therebelow will tend to cause them to remain engaged with the well bore casing 506 thereby causing them damage upon any movement of the packer assembly 10.

If it is desired to move packer assembly 10 downward in well bore 502 from the position shown in FIG. 3, tubing string 500 is picked up, rotated to the left, and set back down to lock J-slot lugs 58 in the short portion of J-slots 368, to prevent slips 254 from engaging well bore casing 406. Normally, in order to avoid rotation of the tubing string 500, the lowermost interval 508 having perforations 510 will be treated first, and packer assembly 10 moved progressively upward in the well bore 502. Such an operation only requires picking up and setting down tubing string 500.

Generally, injection ring 180 may be sized so as to provide a six-inch (15.2cm) spacing between

upper packer element 178 and lower packer element 182, whereby two perforations 510 in casing 506 may be treated or broken down at a time, such perforations generally being made at three-inch (7.6cm) intervals. However, if it is desired to treat a single perforation or several at a single level in the well bore 502 (see FIG. 3), injection spacer 180 may be replaced with a shorter three-inch (7.6cm) spacer ring 180' (see FIG. 1B) and lower shoe 188 may be replaced with a longer, upward-extending lower shoe 188' (see FIG. 1B) three inches (7.6cm) greater in length, thereby shifting lower packer elements 182 and 186 upwardly on injection mandrel 32. In similar fashion, if a longer interval of perforated casing is to be treated, a longer injection spacer may be substituted with a longer injection mandrel having appropriately spaced injection ports.

Claims

1. A retrievable compression set straddle packer for use in wells, comprising: an hydraulic slip assembly (12); a tubular injection mandrel assembly (30) secured to said hydraulic slip assembly and extending downward therefrom, said mandrel assembly having a plurality of injection ports (48) extending through the wall thereof; upper packer element means (174, 178) disposed on said mandrel assembly adjacent to said hydraulic slip assembly; injection spacer means (180) disposed on said mandrel assembly adjacent to and below said upper packer element means, said injection spacer means including upper (212) and lower (214) packer compression rings; lower packer element means (182, 186) disposed on said mandrel assembly adjacent to and below said injection spacer means; a slip body (252) disposed on said mandrel assembly below said lower packer element means; a plurality of slips (254) disposed on said mandrel assembly, the upper ends of said slips being longitudinally slidably mounted to said slip body and the lower ends of said slips being secured to a collar assembly (256) therebelow surrounding said mandrel assembly; a drag block assembly (330) disposed on said mandrel assembly below said split ring collar assembly and secured thereto; and a bypass assembly (380) disposed on said mandrel assembly below said drag block means and secured thereto, said bypass assembly including bypass ports (388) through the wall thereof adapted to communicate with said mandrel assembly, characterised in that said upper (212) and lower (214) packer compression rings are separated by a plurality of elongate longitudinal struts (216) defining a plurality of elongate longitudinal apertures (218) therebetween, said mandrel assembly has a plurality of bypass slots (72) extending through the wall thereof below said injection ports, said slip body (252) is splined to said mandrel assembly, the upper ends of said slips are splined to said slip body, said collar assembly is a split ring collar assembly to which the lower ends of the slips are

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radially slidably secured, said bypass ports (388) are adapted to communicate with said bypass (72) slots of said mandrel assembly when aligned therewith and J-slot means are provided comprising lug means (68) secured to one of said mandrel assembly and said drag block means, and a cooperating J-slot (368) secured to the other of said mandrel assembly and said drag block means.

2. A packer according to claim 1, wherein the hydraulic slip assembly comprises: an hydraulic hold down body (90) having a plurality of apertures (126) therein and a bore therethrough; a plurality of hydraulic slips (92) located in the plurality of apertures in the hydraulic hold down body, each slip having an elongated slot (140) extending through a portion thereof; a plurality of hold down straps (94) overlying the plurality of hydraulic slips, each strap overlying the elongated slot in at least one hydraulic slip and being secured to the hold down body; and a plurality of hydraulic slip retractor springs (96), each spring having one end abutting a hold down strap and the other end abutting a portion of a hydraulic slip.

3. A packer according to claim 1 or 2, wherein said injection mandrel assembly comprises: a tubular injection mandrel (32) having said injection ports through the wall thereof; a tubular J-slot mandrel (64) having said lug means protruding radially therefrom and said bypass slots through the wall thereof; and a plug (86) in the bore of said J-slot mandrel below said bypass slots.

4. A packer according to claim 1, 2 or 3, wherein the upper packer element means comprises: an upper shoe (172); a first upper packer element (174) located below the upper shoe; a spacer ring (176) located below the first packer element; a second upper packer element (178) located below the spacer; and wherein the lower packer element means comprises a first lower packer element (182) located below the injection spacer; a spacer ring (184) located below the first lower packer element; a second lower packer element (186) located below the spacer ring; and a lower shoe (188) located below the second lower packer element.

5. A packer according to any of claims 1 to 4, wherein the drag block assembly comprises: a drag block sleeve (336) having a plurality of recesses (382) therein and a bore therethrough; a plurality of drag blocks (332), each block located in a recess in the drag block sleeve; and a plurality of drag block springs (334), each spring having a portion thereof engaging a portion of each drag block and a portion of the drag block sleeve.

Patentansprüche

1. Rückholbarer, unter Druck setzbarer Spreizpacker zur Verwendung in Bohrlöchern, enthaltend eine hydraulische Gleitanordnung (12), eine rohrförmige Injektionsdornanordnung (30), die an der hydraulischen Gleitanordnung

befestigt ist und von dieser nach unten verläuft, sowie eine Vielzahl von Einspritzöffnungen (48) enthält, die sich durch ihre Wandung erstrecken, obere Packerelementmittel (174, 178) an der Injektionsdornanordnung angrenzend an die hydraulische Gleitanordnung, Einspritzabstandsmittel (180) an der Einspritzdornanordnung, die unten an die oberen Packerelementmittel angrenzen und obere und untere Packerdruckringe (212 bzw. 214) enthalten, untere Packerelementmittel (182, 186) an der Injektionsdornanordnung, die unten an die Einspritzabstandsmittel angrenzen, ein Schlupfkörper (252) an der Injektionsdornanordnung unter den unteren Packerelementmitteln, eine Vielzahl von Schlupfelementen (254) an der Einspritzdornanordnung, deren obere Enden in Längsrichtung gleitbeweglich an dem Schlupfkörper angebracht und deren untere Enden an einer Ringanordnung (256) befestigt sind, die darunter die Einspritzdornanordnung umgibt, eine Bremsblockanordnung (330) an der Einspritzdornanordnung, die unten an der Ringanordnung befestigt ist, und eine By-passanordnung (380) an der Einspritzdornanordnung, die unten an der Bremsblockanordnung befestigt ist und in ihrer Wandung By-passöffnungen (388) enthält, die mit der Einspritzdornanordnung in Verbindung stehen, dadurch gekennzeichnet, daß die oberen und unteren Packerdruckringe (212 bzw. 214) durch eine Vielzahl von langgestreckten Längsstreben (216) getrennt sind, die zwischen sich eine Vielzahl von länglichen Längsöffnungen (218) bestimmen, daß die Einspritzdornanordnung eine Vielzahl von Bypass-Schlitzen (12) aufweist, die sich unterhalb der Einspritzöffnungen durch die Wandung der Einspritzdornanordnung erstrecken, daß der Schlupfkörper (252) durch eine Keilführung mit der Einspritzdornanordnung und die oberen Enden der Schlupfelemente durch eine Keilführung mit dem Schlupfkörper verbunden sind, daß die Ringanordnung eine Spaltringanordnung ist, an der die unteren Enden der Schlupfelemente radial gleitbeweglich befestigt sind, daß die Bypassöffnungen (388) mit den Bypass-Schlitzen (72) der Einspritzdornanordnung kommunizieren, wenn sie dazu ausgerichtet sind, und daß J-Schlitzmittel vorgesehen sind, die an der Einspritzdornanordnung oder der Bremsblockanordnung befestigte Vorsprungmittel (68) und damit zusammenwirkende J-Schlitze (368) in der Bremsblockanordnung bzw. der Einspritzdornanordnung aufweisen.

2. Packer nach Anspruch 1, dadurch gekennzeichnet, daß die hydraulische Gleitanordnung einen hydraulischen Rückhaltekörper (90) mit einer Vielzahl von Durchbrüchen (126) und einer durchgehenden Bohrung aufweist, eine Vielzahl von hydraulischen Gleitelementen (92) in der Vielzahl von Durchbrüchen in dem hydraulischen Rückhaltekörper und mit einem Längsschlitz (140) durch einen Teil jedes hydraulischen Gleitelementes, eine Vielzahl von an dem Rückhaltekörper befestigten Rückhaltebändern (94) über der Vielzahl von hydraulischen Gleitelementen jeweils über dem Längsschlitz von wenigstens



einem hydraulischen Gleitelement, und eine Vielzahl von Rückzugsfedern (96) für die hydraulischen Gleitelemente, deren eines Ende an einem Rückhalteband und deren anderes Ende an einem Teil eines hydraulischen Gleitelementes anliegt.

3. Packer nach Anspruch 1 oder 2, dadurch gekennzeichnet, daß die Einspritzdornanordnung einen rohrförmigen Einspritzdorn (32) mit den seine Wandung durchsetzenden Einspritzöffnungen aufweist, einen rohrförmigen J-Schlitzkörper (64) mit den davon radial vorstehenden Vorsprungsmitteln und den seine Wandung durchsetzenden Bypass-Schlitzten, und ein Stopfen (88) unterhalb der Bypass-Schlitzte in einer Bohrung des J-Schlitzkörpers.

4. Packer nach Anspruch 1, 2 oder 3, dadurch gekennzeichnet, daß die oberen Packerelementmittel einen oberen Schuh (172) aufweisen, sowie ein erstes oberes Packerelement (174) unter dem oberen Schuh, einen Abstandsring (176) unter dem ersten Packerelement, und ein zweites oberes Packerelement (178) unter dem Abstandsring, und daß die unteren Packerelementmittel ein erstes unteres Packerelement (182) unter den Einspritzabstandsmitteln aufweisen, sowie einen Abstandsring (184) unter dem ersten unteren Packerelement, ein zweites unteres Packerelement (186) unter dem Abstandsring, und einen unteren Schuh (188) unter dem zweiten unteren Packerelement.

5. Packer nach einem der Ansprüche 1 bis 4, dadurch gekennzeichnet, daß die Bremsblockanordnung eine Bremsblockhülse (336) mit einer Vielzahl von Ausnehmungen (382) und einer durchgehenden Bohrung aufweist, sowie eine Vielzahl von Bremsblöcken (332) jeweils in einer Ausnehmung der Bremsblockhülse, und eine Vielzahl von Bremsblockfedern (334), von denen jeweils ein Teil einem Teil eines Bremsblockes und einem Teil der Bremsblockhülse anliegt.

Revendications

1. Packer amovible d'intervalle à calage par compression, destiné à être utilisé dans des puits, comprenant un ensemble à patins hydrauliques (12), un ensemble de mandrin creux d'injection (30), tubulaire, fixé sur cet ensemble à patins hydrauliques et s'étendant vers le bas à partir de celui-ci, cet ensemble de mandrin creux comportant plusieurs orifices d'injection (48) traversant sa paroi, un dispositif formant élément supérieur de packer (174, 178), disposé sur l'ensemble de mandrin creux dans une position adjacente à l'ensemble à patins hydrauliques, un dispositif formant entretoise d'injection (180), disposé sur l'ensemble de mandrin creux dans une position adjacente à ce dispositif formant élément supérieur de packer et au-dessous de celui-ci, ce dispositif formant entretoise d'injection comprenant des anneaux supérieur (212) et inférieur (214) de compression de packer, un dispositif formant élément inférieur de packer (182, 186), disposé sur l'ensemble de mandrin creux dans une position adjacente à ce dispositif formant

entretoise d'injection et au-dessous de celui-ci, un bloc à patins (252), disposé sur l'ensemble de mandrin creux au-dessous du dispositif formant élément inférieur de packer, plusieurs patins (254) disposés sur l'ensemble de mandrin creux, les extrémités supérieures de ces patins étant montées sur le corps à patins de manière à pouvoir glisser longitudinalement et leurs extrémités inférieures étant fixées sur un ensemble formant collier (256) entourant, au-dessous de ces extrémités inférieures, l'ensemble de mandrin creux, un ensemble formant bloc trainé (330), disposé sur l'ensemble de mandrin creux au-dessous de l'ensemble formant collier en plusieurs pièces et fixé sur celui-ci, et un ensemble de dérivation (380) qui est disposé sur l'ensemble de mandrin creux au-dessous de cet ensemble formant bloc trainé et qui est fixé sur celui-ci, cet ensemble de dérivation comportant des orifices de dérivation (388) traversant sa paroi et destinés à communiquer avec l'ensemble de mandrin creux, caractérisé en ce que les anneaux supérieur (212) et inférieur (214) de compression de packer sont séparés par plusieurs barres longitudinales allongées (216), travaillant à la compression, qui délimitent entre elles plusieurs ouvertures longitudinales allongées (218), en ce que l'ensemble de mandrin creux comporte plusieurs fentes de dérivation (72) traversant sa paroi au-dessous des orifices d'injection, en ce que le bloc à patins (252) coopère par des cannelures avec l'ensemble de mandrin creux, en ce que les extrémités supérieures des patins coopèrent par des cannelures avec le bloc à patins, en ce que l'ensemble formant collier est un collier en plusieurs pièces sur lequel les extrémités inférieures des patins sont fixées de façon à pouvoir glisser radialement, en ce que les orifices de dérivation (388) sont destinés de façon à communiquer avec les fentes de dérivation (72) de l'ensemble de mandrin creux lorsqu'ils sont alignés avec celles-ci et en ce qu'il est prévu un dispositif du type à fente en J qui comprend une patte (68), solidaire de l'un des deux éléments constitués par l'ensemble de mandrin creux et le dispositif formant bloc trainé, et une fente associée (368), en J, solidaire de l'autre des deux éléments constitués par l'ensemble de mandrin creux et le dispositif formant bloc trainé.

2. Packer suivant la revendication 1, dans lequel l'ensemble à patins hydrauliques comprend un bloc d'ancrage hydraulique (90), dans lequel sont ménagées plusieurs ouvertures (126) et qui est traversé par un alésage, plusieurs patins hydrauliques (92) disposés dans ces multiples ouvertures du bloc d'ancrage hydraulique, chaque patin comportant un évidement allongé (140) traversant une partie de ce patin, plusieurs bandes d'ancrage (94) recouvrant les multiples patins hydrauliques, chaque bande recouvrant l'évidement allongé ménagé dans au moins un patin hydraulique et étant fixée sur le bloc d'ancrage, et plusieurs ressorts de rappel de patin hydraulique (96), l'une des extrémités de chaque ressort étant en butée sur une bande d'ancrage et



son autre extrémité en butée sur une partie d'un patin hydraulique:

3. Packer suivant la revendication 1 ou 2, dans lequel l'ensemble de mandrin creux d'injection comprend un mandrin creux tubulaire d'injection (32), comportant des orifices d'injection à travers sa paroi, un mandrin creux tubulaire de fente en J (64), à partir duquel la patte fait saillie radialement et dont la paroi est traversée par les fentes de dérivation, et un bouchon (86) disposé dans l'alésage du mandrin creux de fente en J au-dessous de ces fentes de dérivation.

4. Packer suivant la revendication 1, 2 ou 3, dans lequel le dispositif formant élément supérieur de packer comprend une semelle supérieure (172), un premier élément de packer supérieur (174) disposé au-dessous de cette semelle supérieure, un anneau-entretoise (176) disposé au-dessous de ce premier élément de packer et un second élément de packer supérieur (178) disposé au-dessous de cette entretoise, et dans lequel le dispositif formant élément inférieur de packer

comprend un premier élément de packer inférieur (182) disposé au-dessous de la pièce d'espacement pour injection, un anneau-entretoise (184) disposé au-dessous de ce premier élément de packer inférieur, un second élément de packer inférieur (186) disposé au-dessous de cet anneau-entretoise et une semelle inférieure (188) disposée au-dessous de ce second élément de packer inférieur.

5. Packer suivant l'une quelconque des revendications 1 à 4, dans lequel l'ensemble formant bloc trainé comprend un manchon pour blocs trainés (336) dans lequel sont ménagés plusieurs évidements (382) et qui est traversé par un alésage, plusieurs blocs trainés (332), chaque bloc étant disposé dans un évidement de ce manchon pour blocs trainés, et plusieurs ressorts de bloc trainé (334), chaque ressort comportant une partie se trouvant au contact d'une partie de chaque bloc trainé et une partie au contact d'une partie du manchon pour bloc trainé.

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