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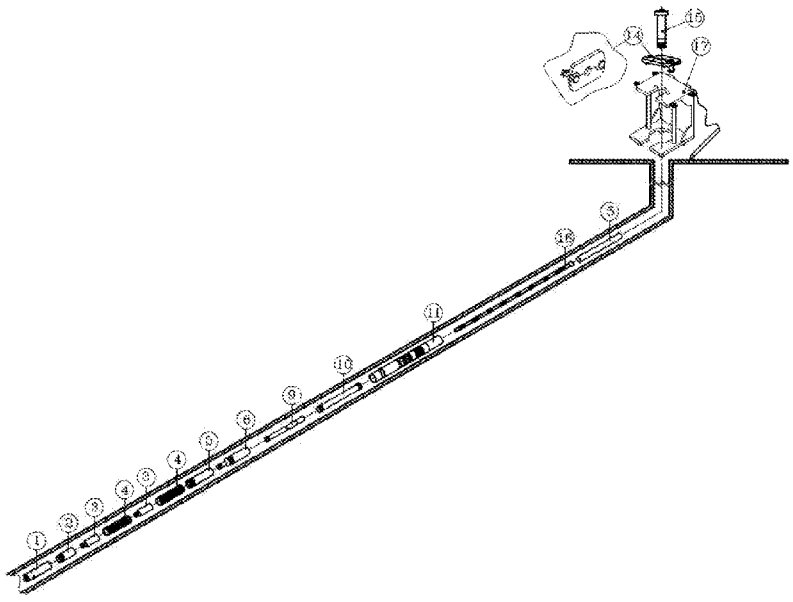
(54) **Title:** SAND CONTROL SYSTEM OF OIL RESERVOIRS

[Fig. 1]



(57) **Abstract:** Oil reservoir sand control system is used for controlling sand in sand-producing oil reservoirs. At the beginning a double poppet wash-down shoe is used. A polished stinger at the top of which wash pipes are fitted passes through this piece. Polished stinger and wash pipes assembly passes through the screens. The desired fluids are, then, moved and washed by being pumped through this assembly. They pass through the pipes, and from the lowest point inside, are directed behind the screens. Next comes the fitting and running of some screen pipes that play the role of filtering. The assembly is fixed to the blanks through which wash pipes run and then it goes to the desired depth. In the next step, the setting tool opens. As mentioned before, the swivel plays a vital role. The setting tool assembly, together with the wash pipes and polished stinger come out. In the last stage of sand control completion, the seal assembly runs through the well and the process ends when it is loaded into the packer.

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[Continued on next page]

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Description

Title of Invention : Sand Control System of Oil reservoirs

Technical Field

[0001] The invention is an assembly of components in the form of a device for sand control completion in sand-producing oil reservoirs. As a result, it can be grouped in the field of fixed constructions, earth drilling, mining and obtaining fluids from wells.

Background Art

[0002] Sand production occurs at the beginning of reservoir operation in low-strength sandstones, and in solid sandstones there will be the possibility for future sand production. The movement of sand particles to the well during oil and gas production is called sand production. This phenomenon occurs when the hole becomes perforated or when the formation is not strong enough to withstand flow pressure drop. When forces overcome rock resistance, the formation is destroyed. That is, if the pressure applied to sand particles exceeds their strength, the sand particles move and produce the so-called sand. In low-strength sandstones, sand production occurs at the beginning of reservoir operation, and in solid sandstones, there is a possibility of future sand production. Various factors may affect the strength of sand and its movement in the reservoir. Some of the factors that cause sand production are:

[0003] Impact of water on sand production

[0004] Capillary force

[0005] Carbonate dissolution

[0006] The effect of chemical substances and reactions

[0007] Baker, BOTIL and Schlumberger are among the largest companies in the manufacture and construction of sand control equipment in the world.

Summary of Invention

[0008] Oil reservoir sand control system is used for controlling sand in sand-producing oil reservoirs. At the beginning a double poppet wash-down shoe is used. In fact, this piece consists of two check valves (to achieve more control) to

prevent reservoir fluids from entering the completion string. Then, there should be a bar or a pipe to be used to provide space. Next, a pack off bushing is used. A polished stinger at the top of which wash pipes are fitted passes through this piece. Polished stinger and wash pipes assembly passes through the screens. The desired fluids are, then, moved and washed by being pumped through this assembly. They pass through the pipes, and from the lowest point inside, are directed behind the screens. Next comes the fitting and running of some screen pipes that play the role of filtering. The assembly is fixed to the blanks through which wash pipes run and then it goes to the desired depth. In the next step, the setting tool opens. As mentioned before, the swivel plays a vital role. The setting tool assembly, together with the wash pipes and polished stinger come out. In the last stage of sand control completion, the seal assembly runs through the well and the process ends when it is loaded into the packer.

Technical Problem

[0009] One of the biggest challenges in sandstone reservoirs is sand production phenomenon. In this phenomenon, sand particles separate from low-strength sandstones due to the great forces applied as a result of production from the reservoir layer imposing considerable costs on oil companies. Some of the problems that sand production has for production companies include:

[0010] Wearing a way of well and wellhead equipment such as pipes, pumps, valves and so on.

[0011] Blocking the equipment on the surface and inside the well.

[0012] Requiring more manpower to replace and repair equipment and clean wells.

[0013] Reduction of formation permeability resulting in decreased reservoir productivity.

[0014] Sand problem usually appears in shallow formations, although sometimes this problem occurs in formations deeper than 3,500 m.

[0015] The most important consequence of sand production is to reduce production and even to stop production. Generally, the consequences of sand production are as follows:

[0016] Reduction of oil production: Oil production is reduced due to the reduction of permeability of the porous portions of the reservoir where sand particles are trapped. Well column filled with sand also blocks the fluid flow path by the fine sand particles, thereby reducing oil production.

[0017] Wearing a way of wellhead equipment and pipelines: When sand particles start moving along with the fluid, they cause corrosion and wear in the production tubing as well as the equipment inside and outside the well such as pumps, pipes, valves and separators. The velocity of the sand-carrying fluid causes internal wear to the flow pipes and equipment so that due to the abrasive corrosion caused by sand production, most wellhead production valves and control valves at the manifold have internal leakage and should therefore be replaced after a short time of work.

[0018] Sand accumulation in the separator assembly: The transfer of oil along with the sand to the production units causes the accumulation of sand in them, which in some cases greatly reduces the separation capacity. Therefore, periodic repairs of separators for sand-cleaning, in the areas with sandstone wells, are often carried out at shorter time intervals than in other areas.

Solution to Problem

[0019] Using an assembly of equipment needed for sand control completion prevents the wall of the well from collapsing and entry of sand into the production tubing and stops or to a great extent delays the occurrence of the above problems.

Advantageous Effects of Invention

[0020] Economical savings

[0021] Easy operation, repair and maintenance

[0022] Preventing equipment such as pipes, pumps, valves and so on from wear

[0023] Preventing blockage of equipment on the surface and inside the well such as pipes.

[0024] No need for more manpower to replace and repair equipment and clean wells.

[0025] Increased permeability of the formation resulting in increased efficiency in the productivity of the reservoir.

[0026] Setting of the assembly at 91◦ (90◦ vertical and 91◦ horizontal), normally set up to 78◦.

[0027] Capability for correct performance up to a depth of 6000 m under the ground.

Brief Description of Drawings

[0028]

Fig.1

[0029] [fig.1] Sand Control Before Packer Set Up

Fig.2

[0030] [fig.2] Sand Control After Set Up

Fig.3

[0031] [fig.3] Cylinder Flow

Fig.4

[0032] [fig.4] Cylinder Flow

Fig.5

[0033] [fig.5] Seal Sub

Fig.6

[0034] [fig.6] Seal Sub

Fig.7

[0035] [fig.7] X-Over Sub

Fig.8

[0036] [fig.8] Wire wrapped Screen

Fig.9

[0037] [fig.9] Blank Pipe

Fig.10

[0038] [fig.10] Way Safety Crossover

Fig.11

[0039] [fig.11] Swivel

Fig.12

[0040] [fig.12] Polished Stinger

Fig.13

[0041] [fig.13] Pup Joint

Fig.14

[0042] [fig.14] Seal Bore Ext

Fig.15

[0043] [fig.15] Packer Sab

Fig.16

[0044] [fig.16] Setting Tools

Fig.17

[0045] [fig.17] Wash Pipe Table

Fig.18

[0046] [fig.18] Rams

Fig.19

[0047] [fig.19] Lift Sub

Fig.20

[0048] [fig.20] Seal Assembly

Fig.21

[0049] [fig.21] Screen Table

Description of Embodiments

[0050] Oil reservoir sand control system is used for controlling sand in sand-producing oil reservoirs. For this purpose, in sand control completion, at the beginning a double poppet wash-down shoe is used. This piece is used at the end of the completion string in the wells with sand- producing reservoirs. In fact, this piece consists of two check valves (to achieve more control) to prevent reservoir fluids from entering the completion string. After D.P.W.D.S, a bar or a pipe shall be fitted as spacer accommodating some part of a piece called Polished Stinger. Next, a pack off bushing is used (the parts are connected to

each other in the order mentioned and then enter the well.) Through this piece, polished stinger at the top of which Wash Pipes are fitted passes. Polished stinger and wash pipes assembly pass through the screens. Then, the desired fluids are moved and washed by being pumped through this assembly. They pass through the pipes, and from the lowest point inside (float shoe), are directed behind the screens. It is worth noting that in the reservoirs with no need for sand washing and removal, these pieces are not used and instead caps are used for blocking the ends of the screens. Next comes the fitting and running of some screen pipes that play the role of filtering. In order to move the screens in the well without any damage, screen tables, retaining clips as well as lift subs shall be used. First, the screen table is taken to the rig floor and fixed on a rotary table. Then, rams suitable with the sizes of screen pipes are placed on the screen table. After running screen pipes, some blanks shall be fixed. The screen table, lift sub and rams are then lowered. The blanks are secured using slips and safety clamps. The wash pipe table is placed on the rotary table and slips suitable for the of the wash pipe are fitted inside it. Then, the polished stinger and some wash pipes are placed inside the well using the wash pipe table. In the next stage, the swivel is connected to the setting tool and the assembly is located inside the seal bore extension which is connected to the packer. The mentioned assembly is connected to the blanks in which wash pipes run and reaches the desired depth. After reaching to the desired depth, the path, determined by throwing a metal ball, is tied to the top from beneath the packer, and the packer is set at the desired depth by applying hydraulic pressure. After that, the hydraulic pressure goes higher until the ball is set free and the pressure is released. In the next stage the setting tool opens. As mentioned before, the swivel plays a vital role in this regard, and the setting tool assembly along with the wash pipes and polished stinger come out. In the last stage of sand control completion, the seal assembly is run into the well and after being placed inside the packer the process ends. There are some pieces called safety crossover, 2-way and 3-way. These pieces are mounted on the rig's safety valve to control the rare cases of well overflow and prevent accidents. For instance, when you have some 4.5″ pipes in the well with some 2 3/8 ″ wash pipes passing through them when the well overflows; you have to use a 3-way safety crossover so that one end of the pin is attached to the wash pipes and the other end of the pin is attached to the 4.5″ pipe, and from the

other end which is a box, the overflow can be pumped to the well and the danger is somehow prevented.

Examples

[0051] Instructions for the application of the ball for which three actions shall be taken:

[0052] Provision of the schematic sketch for all items used in the assembly available to the installation team explaining the way and order of the installation of the items in the well. For instance; first, 200 tubing pieces; second, 70 screen pieces and third, the packer shall be transferred to the well. In this way, all orders shall be determined and the items which are to be transferred to the well and remain there shall be specified.

[0053] The second part of the instruction is the writing of the tally. The writer of the tally has to record the dimensions of all pieces like screens and tubing's to be used so that the correctness of the job could be ensured.

[0054] Written equipment installation procedure submitted as a document to the employer upon whose approval installation activities shall be commenced.

[0055] Normally, equipment installation takes 5 to 8 days.

Industrial Applicability

[0056] There are many different oil fields and reservoirs around the world, in which this subject has led to the adoption of a different approach in exploiting these reservoirs. Among these oil fields and reservoirs are those which produce sand due to geological aspects leading to losses and damages such as damages to wellhead equipment, equipment in the well and oil production reductions. However, considering the high volume of oil in these reservoirs, these problems necessitate a strategy for the improvement of operations and production processes.

Reference Signs List

[0057] 1- Double Valve/Float Shoe

[0058] 2- Pack Off Bushing/O-ring Seal Sub

[0059] 3- X-Over Sub

[0060] 4- Wire wrapped Screen

[0061] 5- Blank Pipe

[0062] 6- Way Safety Crossover

[0063] 7- Swivel

[0064] 8- Polished Stinger

[0065] 9- Pup Joint

[0066] 10- Seal Bore Ext

[0067] 11- Packer

[0068] 12- Setting Tools

[0069] 13- Wash Pipe Table

[0070] 14- Rams

[0071] 15- Lift Sub

[0072] 16- Seal Assembly

[0073] 17- Screen Table

[0074] 11- Cylinder Flow

[0075] 12- Shear Screw

[0076] 13- Pin

[0077] 14- Core

[0078] 15- Ring

[0079] 16- Stand Pin

[0080] 17- Core

[0081] 18- Grout

[0082] According Fig

[0083] 21- O-ring

[0084] 22- Spacer Ring

[0085] 23- Special Kit

[0086] 24- O-ring

[0087] 71- Top Sub

[0088] 711- Set Screw

[0089] 712- Set Screw

[0090] 72- Adaptor Clutch

[0091] 721- Backup

[0092] 722- O-ring

[0093] 723- O-ring

[0094] 73- Ring

[0095] 74- Cylinder

[0096] 741- Set Screw

[0097] 75- Mandrel

[0098] 76- Clutch

[0099] 761- Set Screw

[0100] 77- Bottom Sub

[0101] 771- O-ring

[0102] 91- Nipple

[0103] 92- Coupling

[0104] 111- Bottom Sub Assay

[0105] 1111- O-ring

[0106] 1112- Backup

[0107] 112- Piston Cover

[0108] 1121- O-ring

[0109] 1122- Backup

[0110] 1123- Set Screw

[0111] 113- Piston Assay

[0112] 1131- Set Screw

[0113] 114- Body Lock Ring

[0114] 115- Lower Slip

[0115] 116- Bottom Keyed Cone

[0116] 1161- Shear Screw

[0117] 117- Cone Ring

[0118] 118- Packer Ring

[0119] 119- Seal Ring Assay

[0120] 1110- Packer Element

[0121] 11101- O-ring

[0122] 11102- Ring

[0123] 11103- Seal Ring Assay

[0124] 11104- Packer ring

[0125] 11105- Cone Ring

[0126] 1112- Top Keyed Cone

[0127] 11121- Packer

[0128] 1113- Upper Slip

[0129] 1114- Body of Connect

[0130] 121- Main Body

[0131] 122- Catcher Sub Extension

[0132] 123- Catcher Sub

[0133] 124- Ball Catcher Sub

[0134] 125- Ball

[0135] 126- O-ring

[0136] 127- Backup Ring

[0137] 128- O-ring

[0138] 129- O-ring

[0139] 1210- Shear Screw

[0140] 1211- Set Screw

[0141] 131- Ring-1

[0142] 132- Ring-2

[0143] 133- Rung Bar

[0144] 134- Pin

[0145] 135- Hex Bolt

[0146] 136- Hex Nut

[0147] 137- Plain Washer

[0148] 141- Plate

[0149] 142- Pin

[0150] 143- Lock

[0151] 144- Hex Bolt

[0152] 145- Pin

[0153] 161- Main Body

[0154] 162- Packing Barry

[0155] 163- Re-Entry Guide Shoe

[0156] 164- O-ring

[0157] 165- V-ring

[0158] 166- V-packing

[0159] 167- V-packing

[0160] 168- Female Packing Adapter

[0161] 169- Half Male Adapter

[0162] 1610- Main Ring

[0163] 1611- Set Screw

[0164] 171- Side Plate

[0165] 172- Upper Plate

[0166] 173- Porter Pin

[0167] 174- Lower Plate

[0168] 175- Plate

[0169] 176- Hook

[0170] 177- Pin

[0171] 178- Section

[0172] 179- Hope Plate

[0173] 1710- Stopper Pin

[0174] 1711- Chain

Claims

[Claim 1] The sand control system of oil reservoirs is used to control the sand from production layers entering the production tubing and consequently wellhead equipment. The sand control system includes the following components: Wire wrapped screen, seal sub cylinder flow: packer, seal bore ext., polished stinger, swivel, 3-way safety crossover, blank pipe, screen table, seal assembly, lift sub, rams, wash pipe table, setting tools, sub, D.P.W.D.S

[Claim 2] According to claim 1, In this system a cylinder flow is used which includes: shear screw, pin, core, ring, stand pin, core and grout.

[Claim 3] According to claim 1, In this system a seal sub is used which includes: O-ring, spacer ring and a special kit.

[Claim 4] According to claim 3, In this system O-ring seal sub (pack off bushing) is used. The job of this piece is to stop the leakage in the space between the external diameter of polished stinger passing from it and its own internal diameter.

[Claim 5] According to claim 1, Pieces called safety cross-over with two or three threads for ensuring safety during running process are used.

[Claim 6] According to claim 1, The system has a swivel which includes components like top sub, set screw, adaptor clutch, backup, O-ring, ring, cylinder, mandrel, clutch and bottom sub.

[Claim 7] According to claim 6, A tool mounted under the setting tool after ball installation, to prevent the transfer of the torque to wash pipes at the time of opening the setting tool.

[Claim 8] According to claim 1, The system has polished stinger for accelerating washing process and reservoir sand transfer mounted at the beginning of wash pipes.

[Claim 9] According to claim 1, The system includes pup joint comprised of nipple and coupling.

[Claim 10] According to claim 9, In the system seal bore extension is used which is a piece with smooth and finished internal diameter with the same size as the ball to increase the length of pack off bushing mounted under the ball.

[Claim 11] According to claim 1, The system includes packer sub comprised of the components such as bottom sub assay, O-ring, backup, piston cover, set screw, piston assay, body lock ring, lower slip, bottom keyed cone ‹shear screw ‹cone ring ‹packer ring ‹seal ring assay ‹packer element, ring, top keyed cone, packer, upper slip and body of connect.

[Claim 12] According to claim 1, The system has setting tool with components such as main body, catcher sub extension, catcher sub, ball catcher sub, ball, O-ring, backup ring, shear screw and set screw which is one of the most important parts of this assembly used for the installation of the ball.

[Claim 13] According to claim 12, In the design of setting tools a replaceable sub has been used which when replaced, it is possible to run all existing sand screens with different threads without replacing the whole setting tool.

[Claim 14] According to claim 12, In the system it is possible to run the manufactured setting tools with all sizes and threads of drill pipe.

[Claim 15] According to claim 12, Considering the operation requirements, it is possible to replace the parts of the setting tool with O-rings at the rig location after each operation.

[Claim 16] According to claim 1, The system uses wash pipe table comprised of ring, rung bar, pin, hex bolt, hex nut and plain washer.

[Claim 17] According to claim 16, In this system wash pipe table is used for running wash pipes on the rig floor at running process.

[Claim 18] According to claim 1, In the system rams are used including components such as plate, lock, hex bolt and pin.

[Claim 19] According to claim 1, The system has parts called lift sub which are used in different sizes and appropriate with the screens for lifting up screen pipes on the rig floor without being damaged.

[Claim 20] According to claim 1, In the system seal assembly is used comprised of components such as main body, packing Barry, re-entry guide shoe, O-

ring, v-ring, v-packing, female packing adapter, half male adapter, main ring and set screw.

[Claim 21] According to claim 20, The system has a piece called the seal assembly, which is mounted on top of the ball. It controls the expansion and contraction of well pipes and sealing of the space above the packer and Annulus. In addition, when necessary the string above the ball comes out from this part.

[Claim 22] According to claim 1, The system includes screen table comprised of components such as side plate, upper plate, porter pin, lower pin, plate, hook, pin, section, hope plate, stopper pin and chain.

[Claim 23] According to claim 22, In manufacturing screen table adjustable rotary plates have been used that can run sand screens from 2-7/8" to 5-1/2" in size. These 2-piece adjustable plates are made of fully resistant alloy, taking into account the required strength and size, as well as the weight of production tubing's used.

[Claim 24] According to claim 22, In this system the size of the screen table manufactured is determined based on limited space of the offshore platforms and appropriate for the available rig floors.

[Claim 25] According to claim 16, In this system screen table & rams are table and parts for securing screen pipes while connecting them to each other on the rig floor.

[Claim 26] According to claim 1, The system comes with a basket designed to be appropriate for the transfer and placement of all the equipment needed from 2-8/7" to 5-1/2" in size, allowing for the loading, transportation and unloading of the equipment with the least amount of space required.

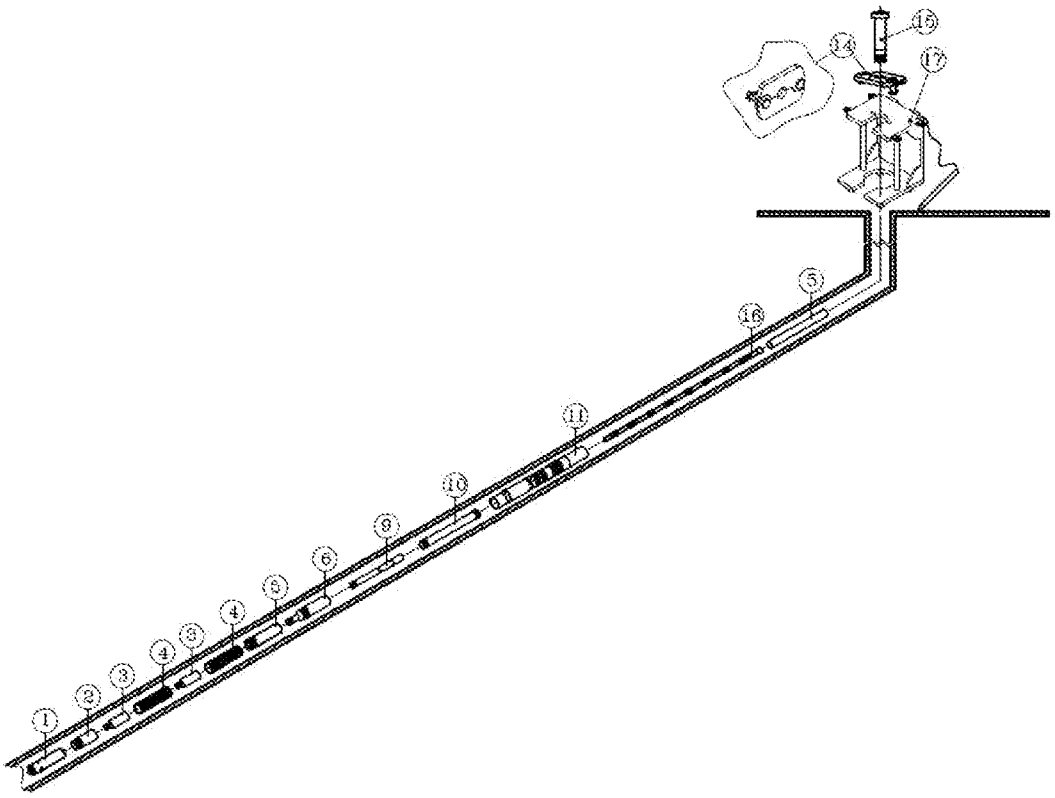
[Claim 27] According to claim 1, According to the operating instructions, the system will be able to release the setting tools from the wash pipe and carry out subsequent actions in case due to operational problems running sand control completion string is not possible at depths above the designed depth.

[Claim 28] According to claim 1, The system has a piece called D.P.W.D.S, which is used at the end of the completion string in wells with sand-producing reservoirs. In fact, this piece consists of two check valves (to achieve more control) to prevent reservoir fluids from entering the completion string

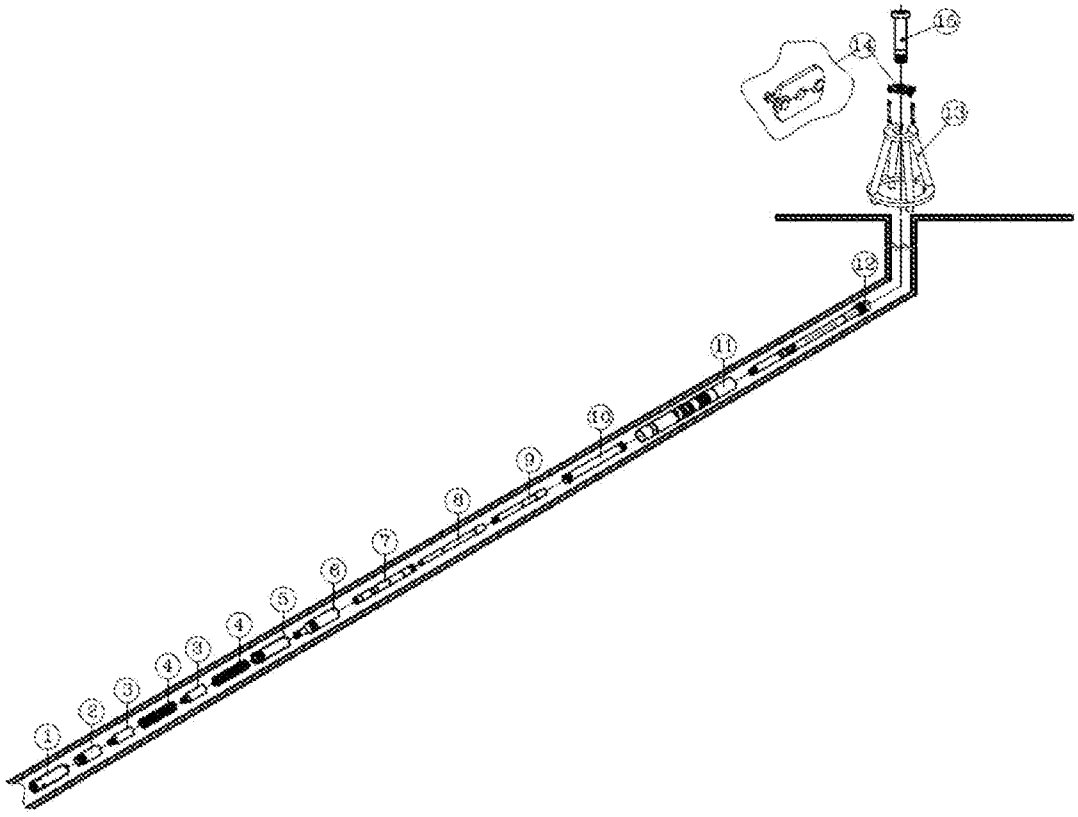
[Claim 29] According to claim 1, In this system there is a piece called blank pipe for creating a space into which a piece called polished stinger is inserted.

[Claim 30] According to claim 1, The parts comprising this assembly are normally made from metals (appropriate for the conditions of the well). However, for the parts with sealing duties, non-metal (polymeric) sealers have been used.

[Fig. 1]



[Fig.2]



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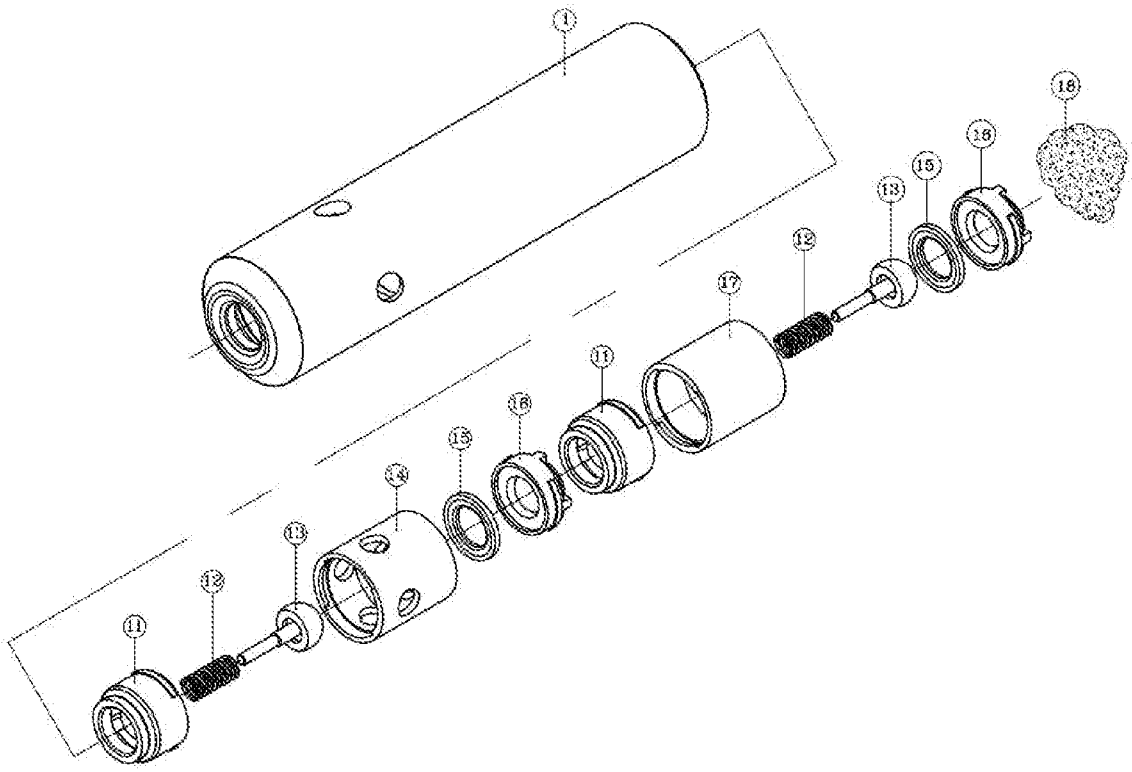
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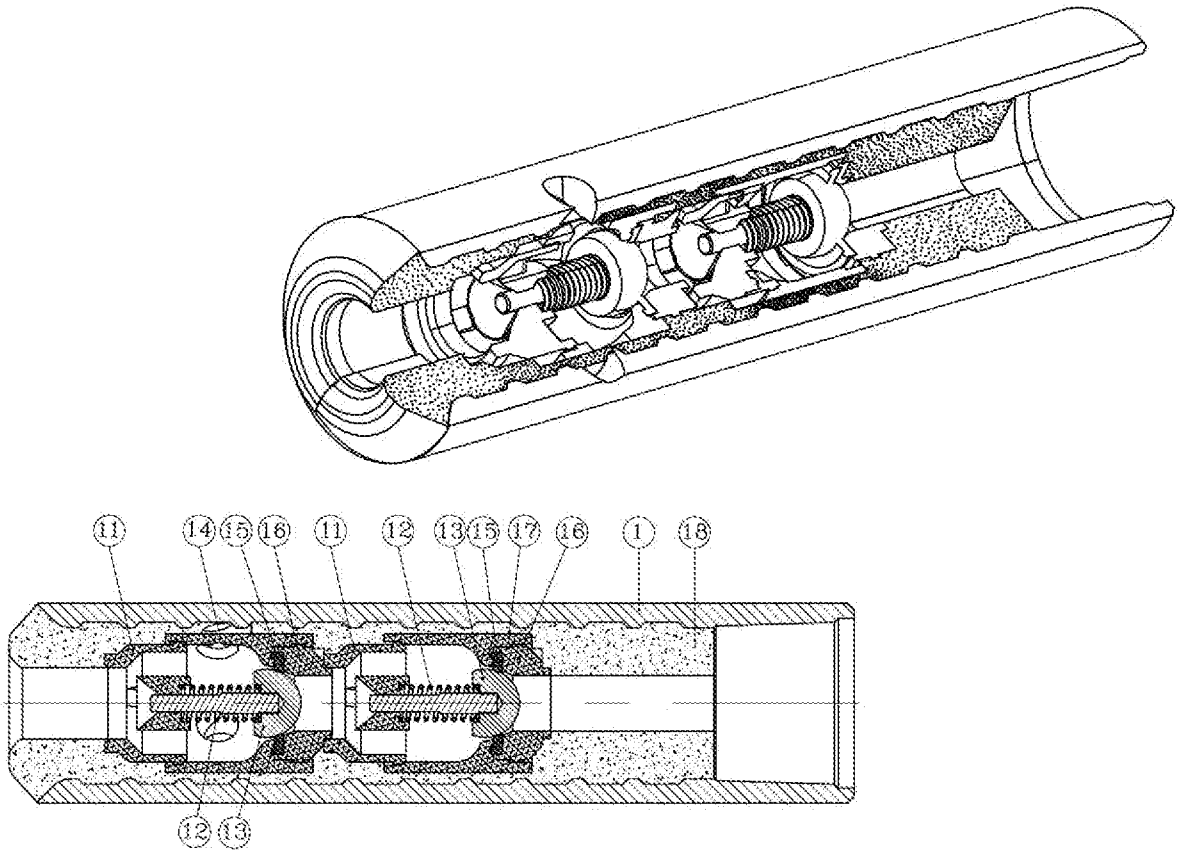
[Fig.4]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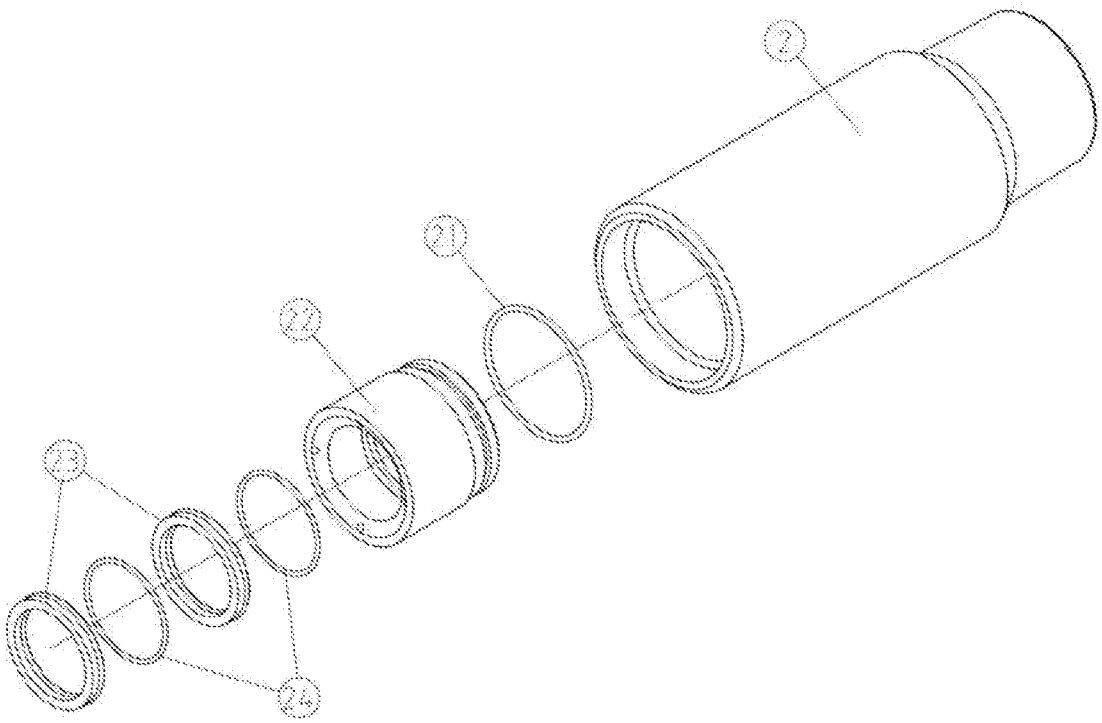
[Fig.5]



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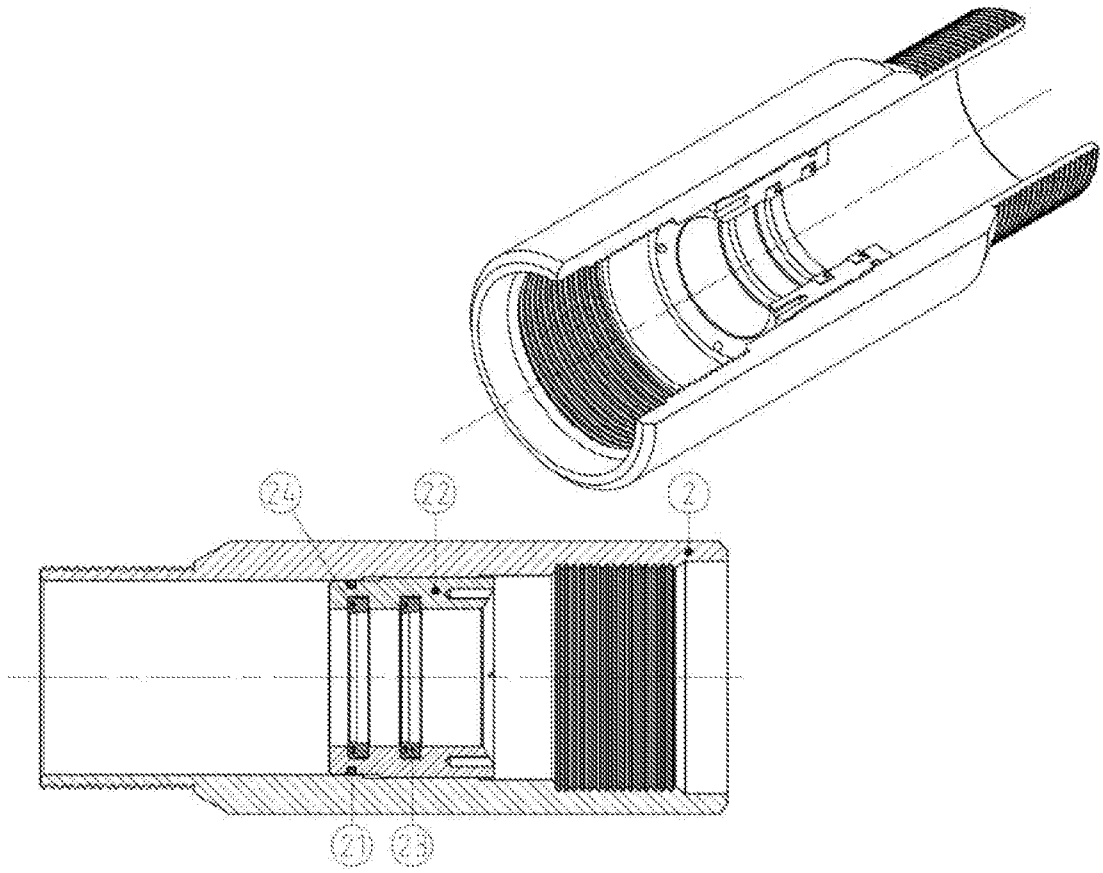
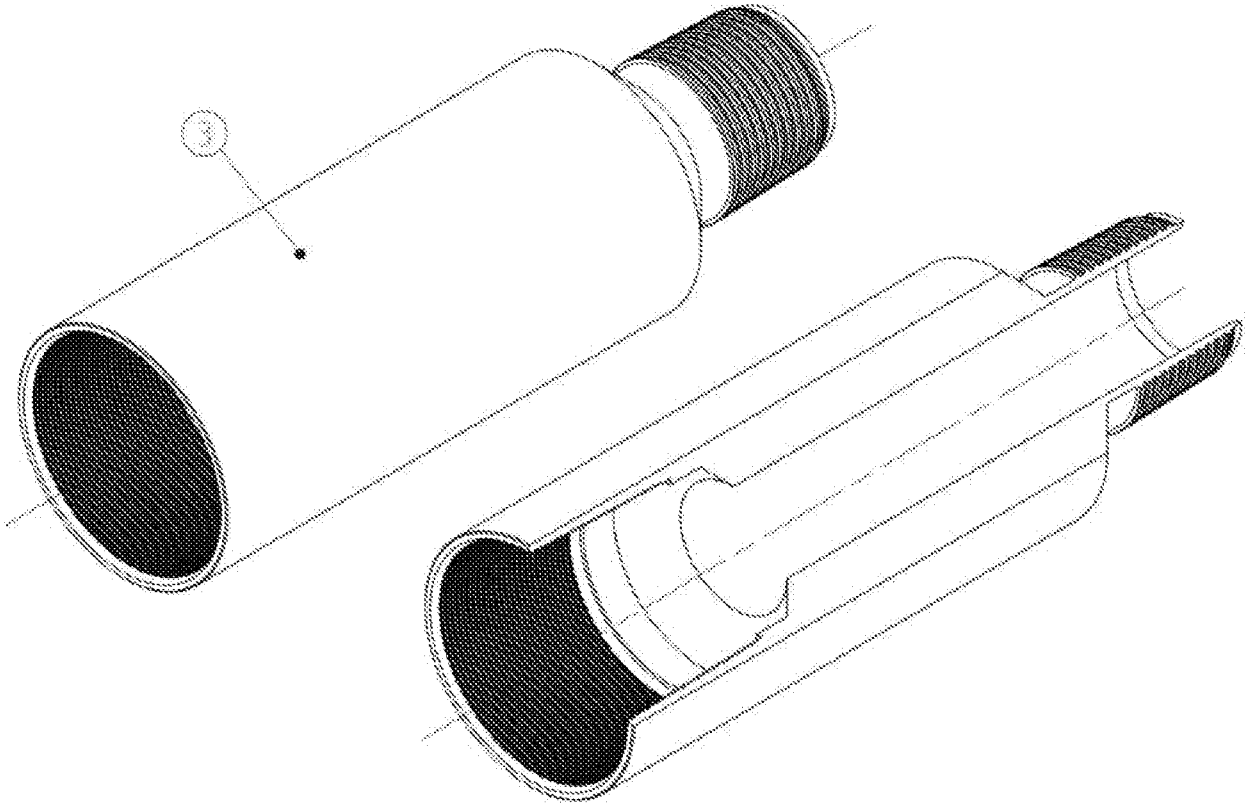
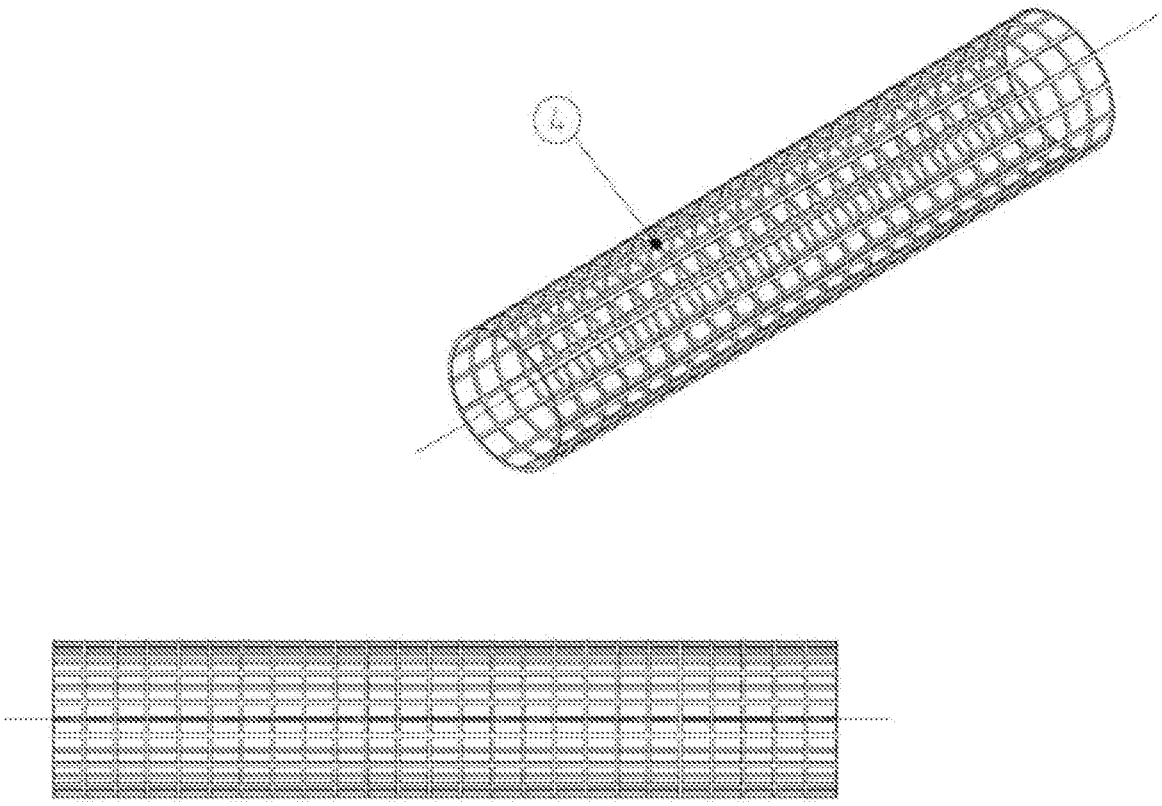


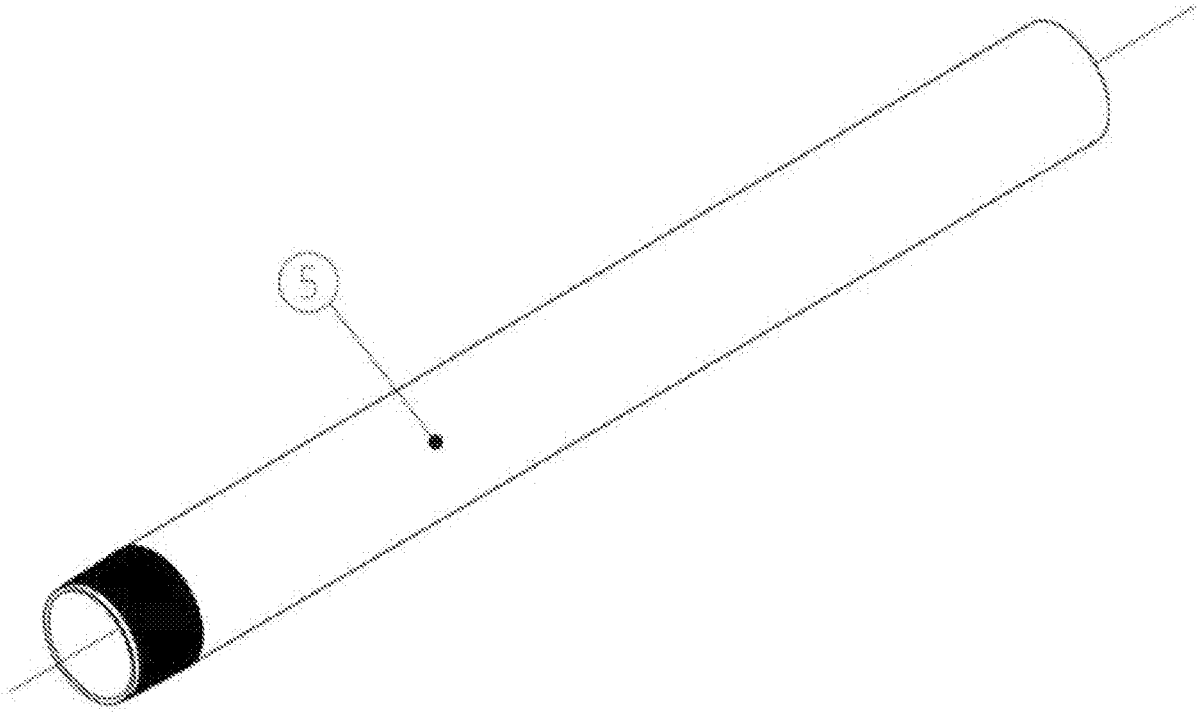
[Fig.7]



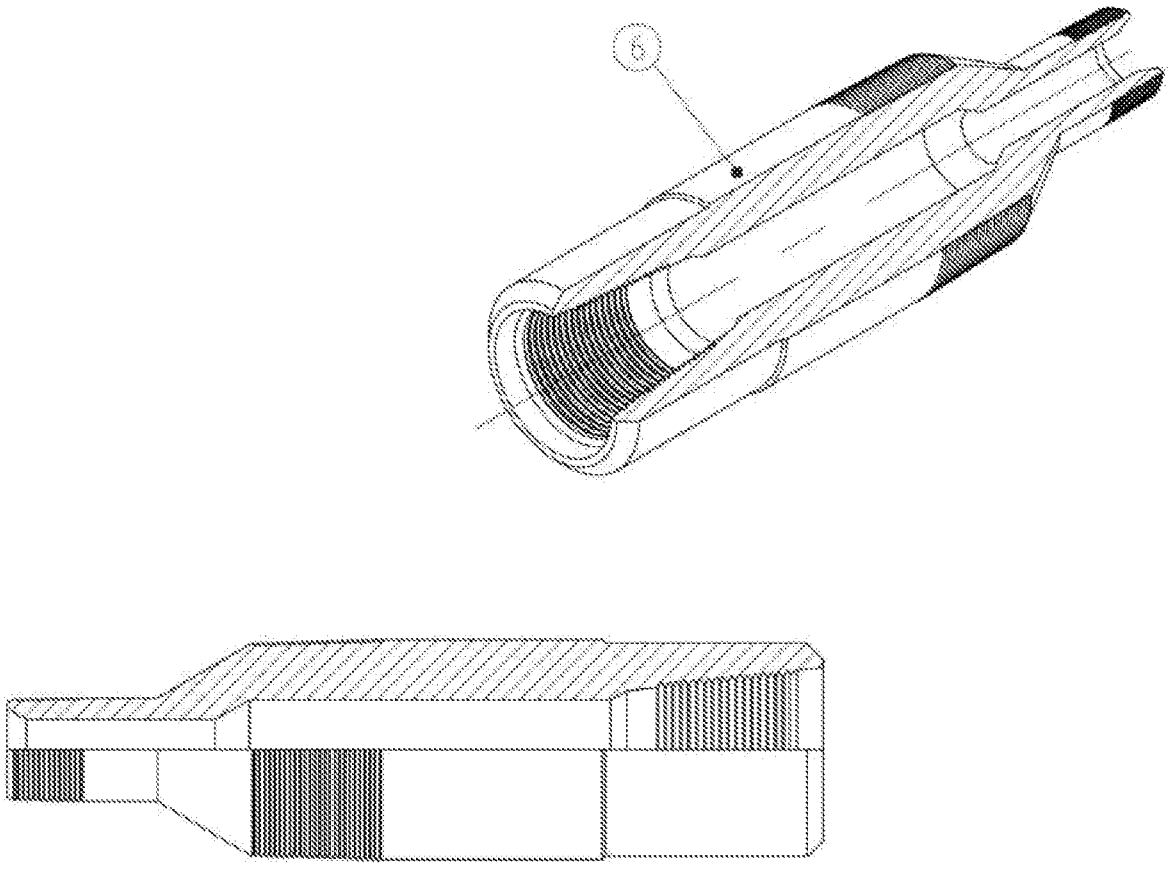
[Fig.8]



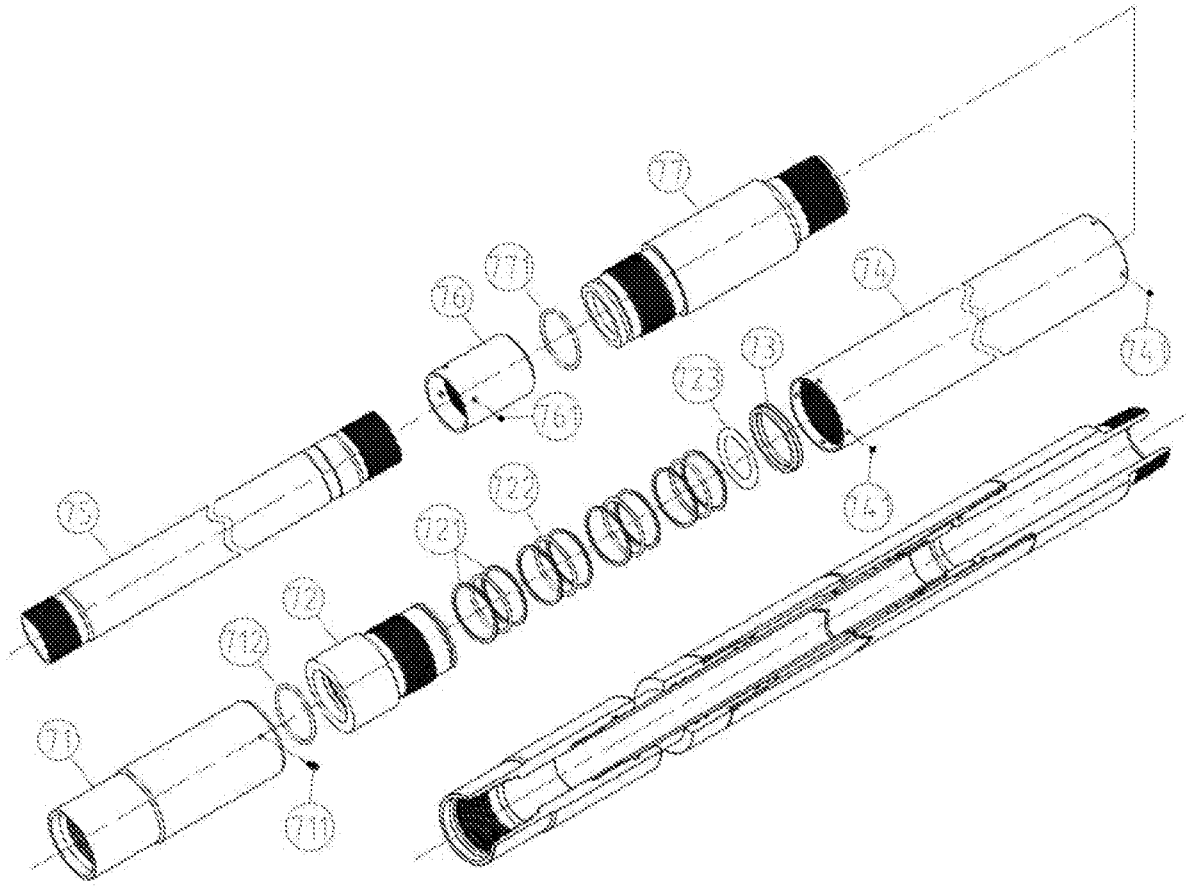
[Fig.9]



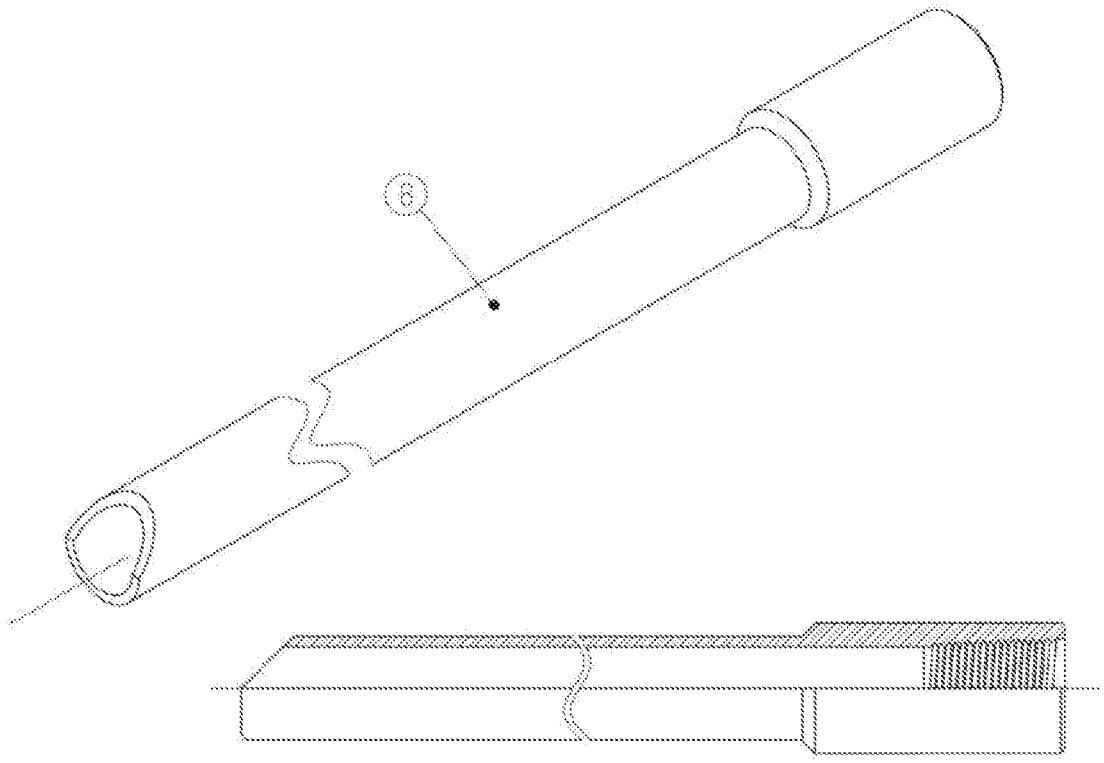
[Fig.10]



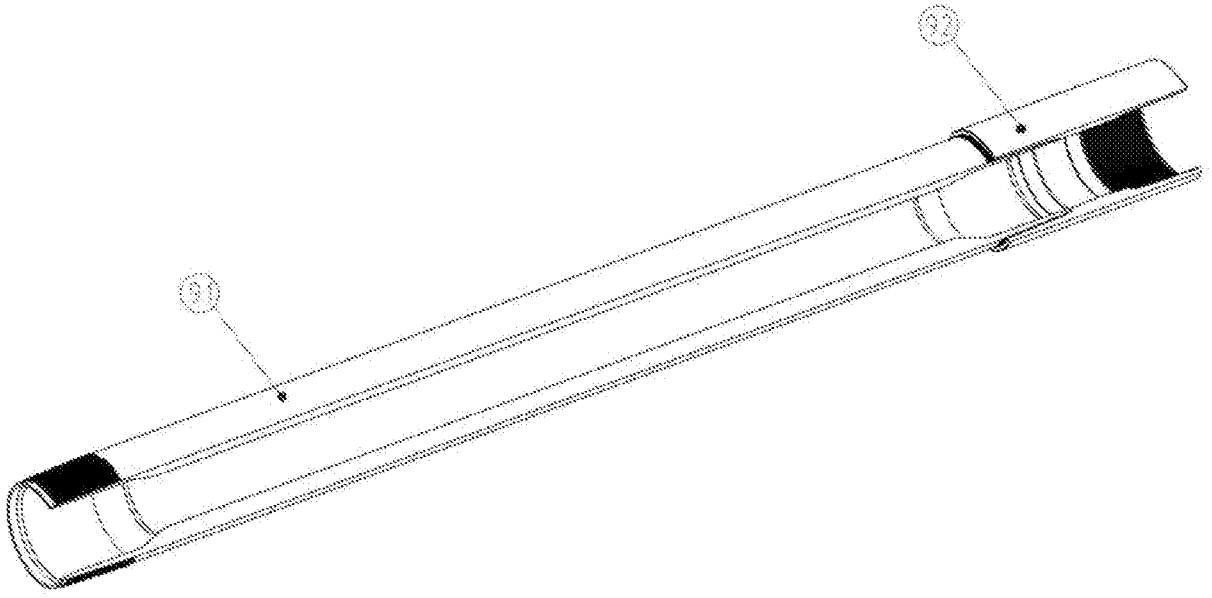
[Fig.11]



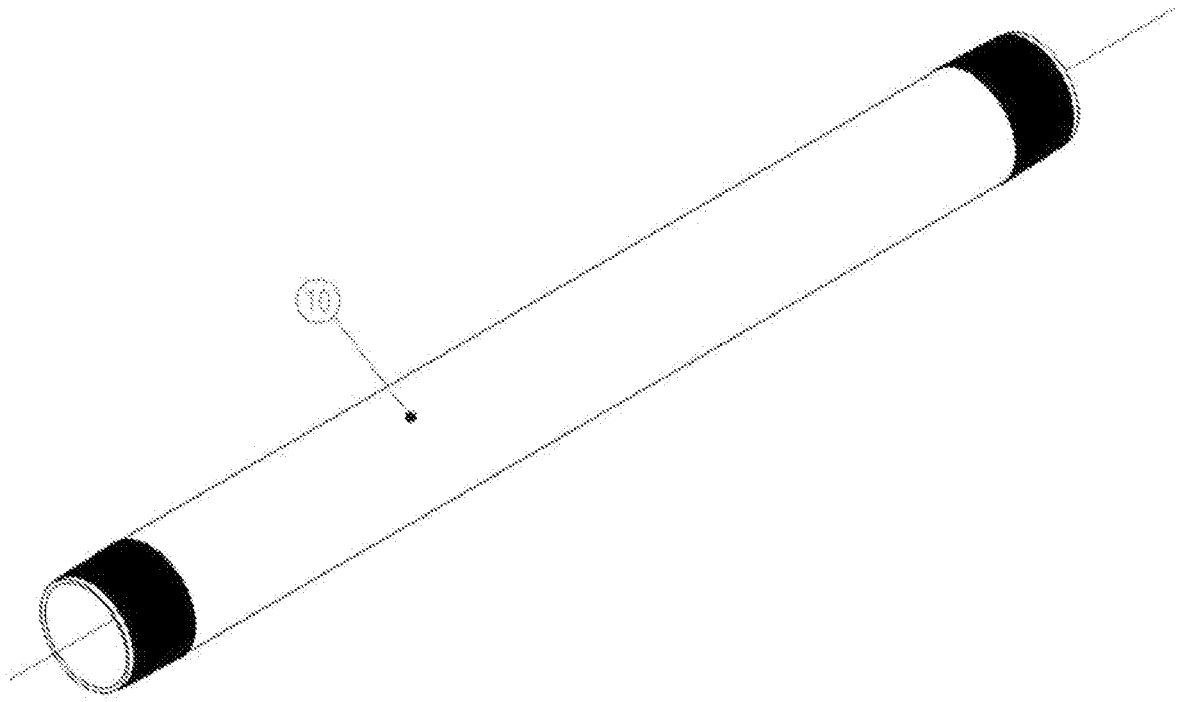
[Fig.12]



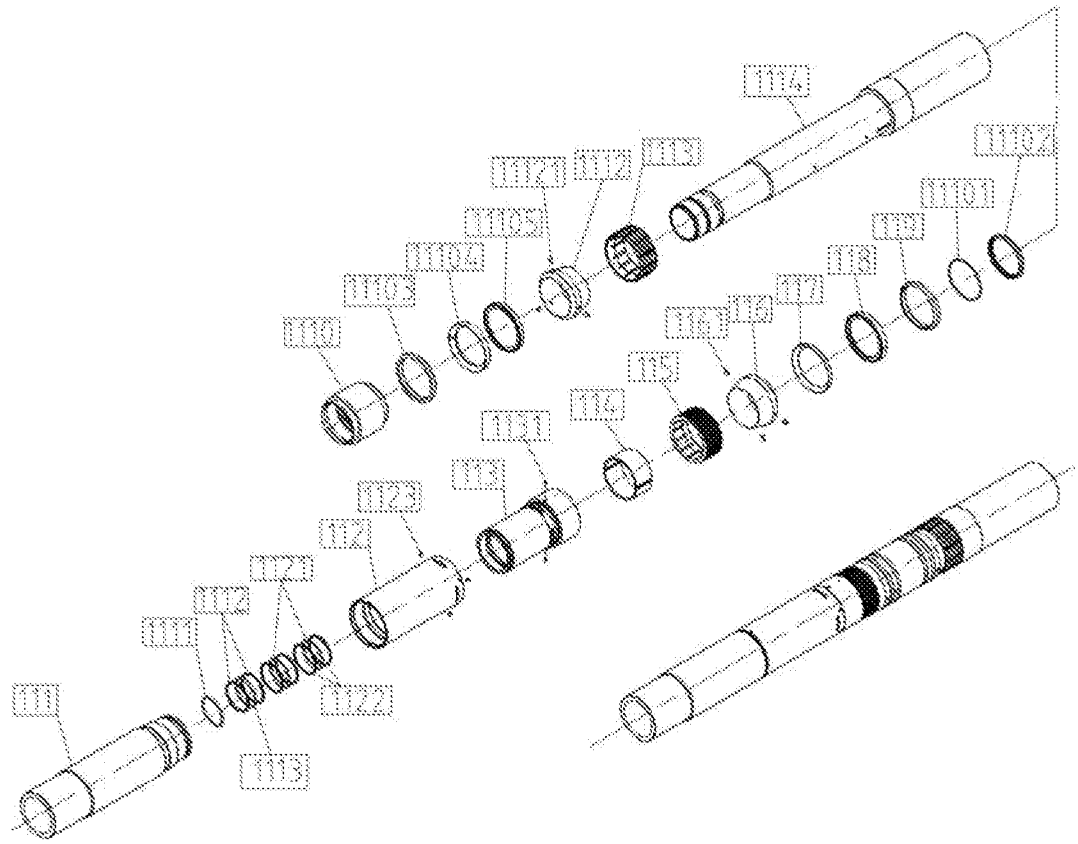
[Fig.13]



[Fig.14]



[Fig.15]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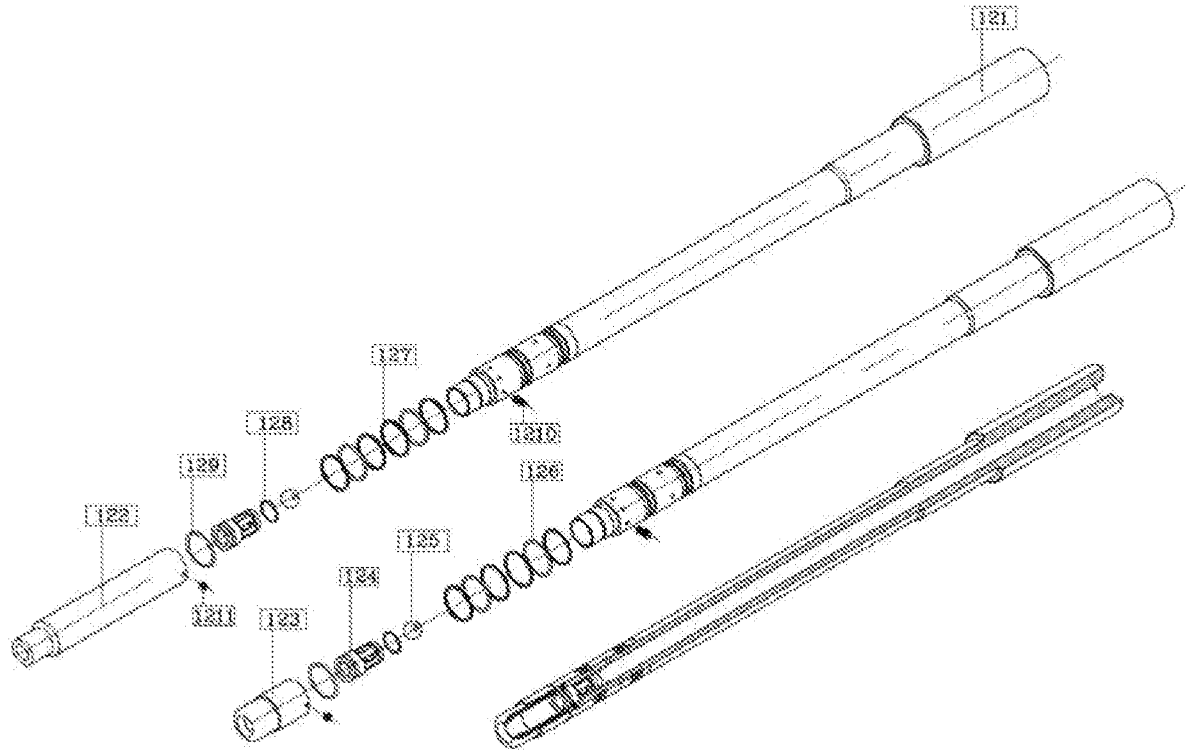
[Fig.16]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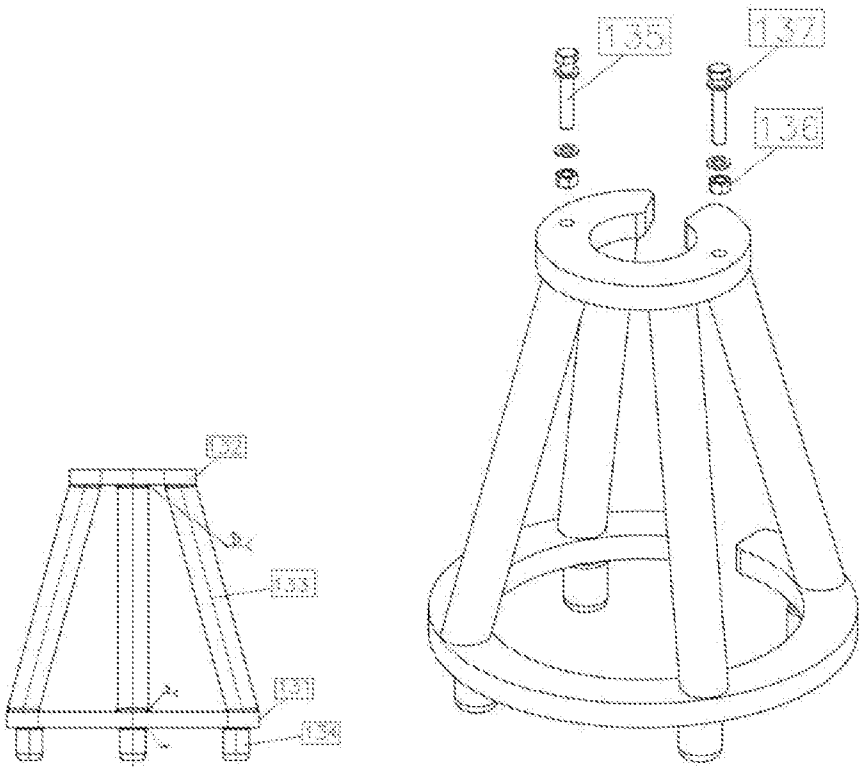
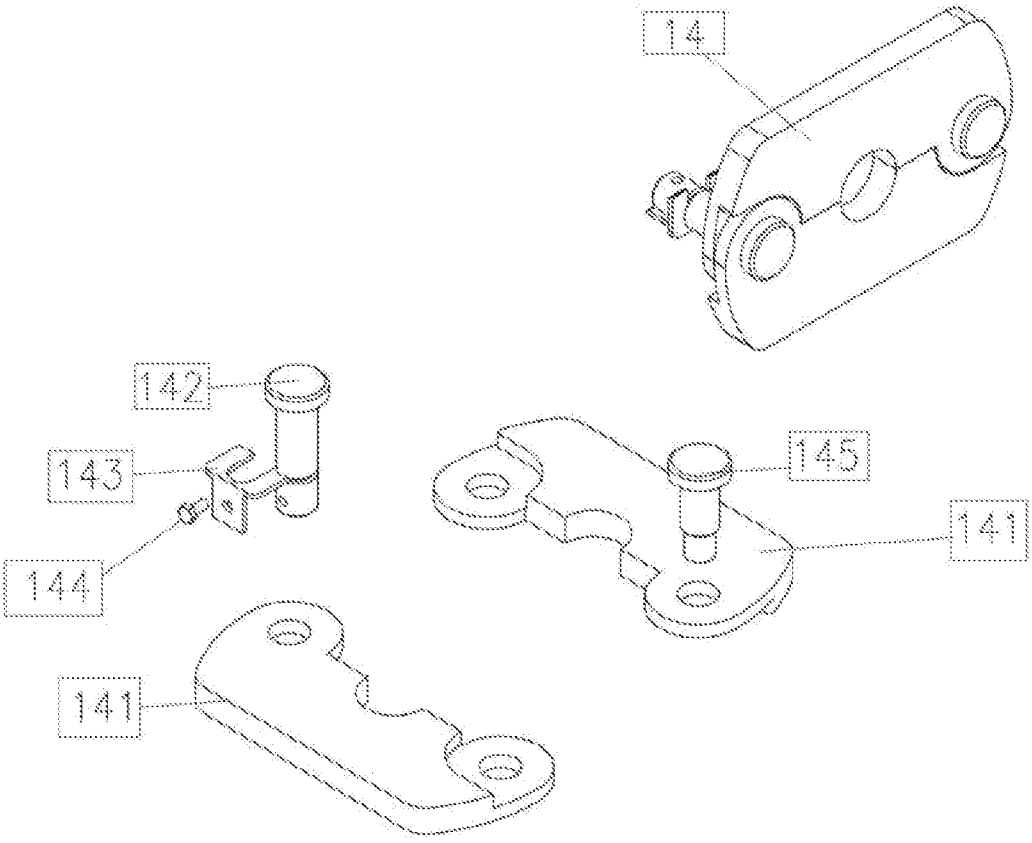
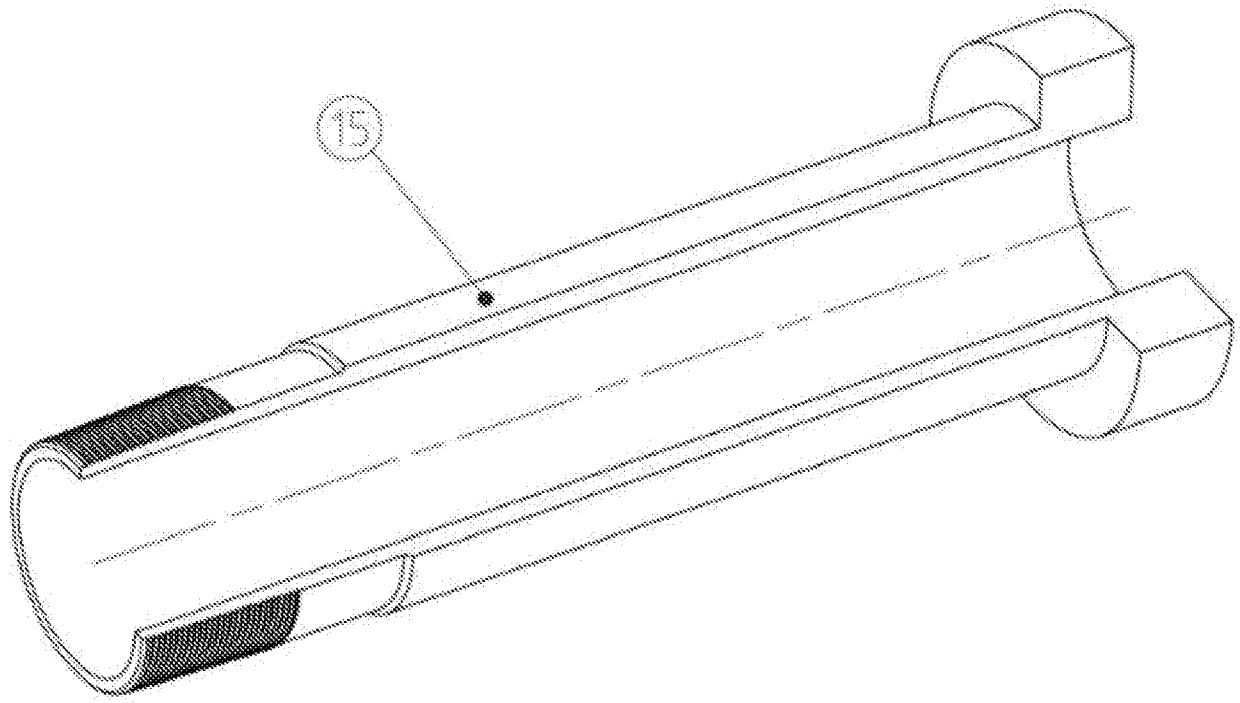
[Fig.17]



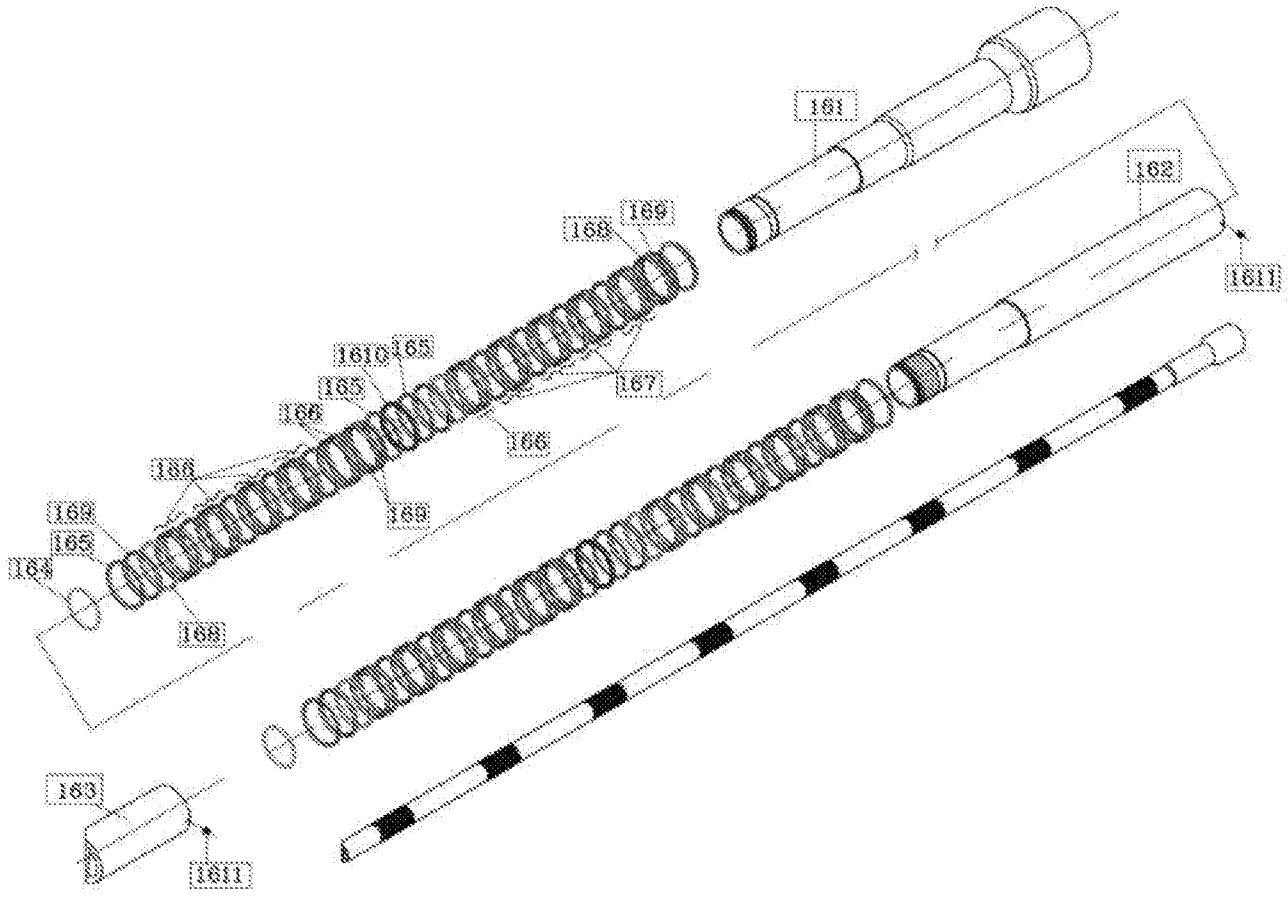
[Fig.18]



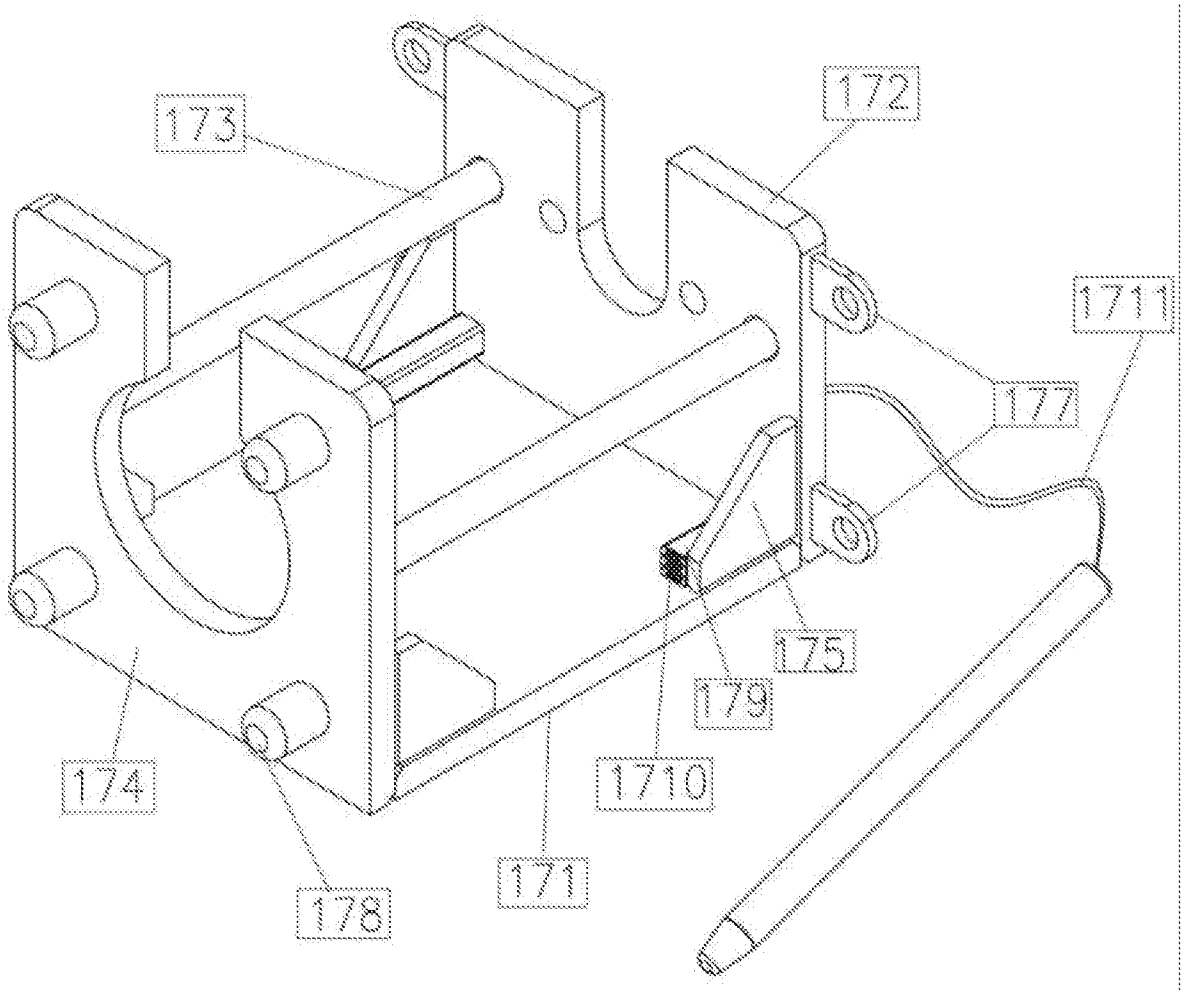
[Fig.19]



[Fig.20]



[Fig.21]



INTERNATIONAL SEARCH REPORT

International application No.
PCT/IB2020/050247

A. CLASSIFICATION OF SUBJECT MATTER
E21B43/02,E21B43/24 Version=2020.01

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

E21B

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

TotalPatent One, IPO Internal Database
Keywords: sand control, wire screen, packer, seal, cylinder, washer

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US7866383 B2 (HALLKIBURTON ENERGY SERVICES INC.) 11 JANUARY 2011 (11.01.2011) Abstract; Description, Paragraph 0048; Description, Paragraph 0052; Description, Paragraph 0076; Desciption, Paragraph 0082; Claim 1	1-30
A	CN107013190 A (CHINA PETROLEUM AND CHEM CORPORATION, Et,al) 4 AUGUST 2017 (04.08.2017) Abstract; Description, Paragraph 0033; Description, Paragraph 0035; Claim 1 ((as per English Translation in Espacenet)	1-30
A	CN107816336 A (CHINA PETROLEUM AND CHEM CORPORATION, Et,al) 20 March 2018 (20.03.2018) Abstract; Description, Paragraph 0019; Description, Paragraph 0023 (as per English Translation in Espacenet)	1-30

☒ Further documents are listed in the continuation of Box C. ☒ See patent family annex.

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Date of the actual completion of the international search	Date of mailing of the international search report
12-06-2020	12-06-2020

Name and mailing address of the ISA/	Authorized officer
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INTERNATIONAL SEARCH REPORT

International application No.
PCT/IB2020/050247

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.

INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.
PCT/IB2020/050247

Citation	Pub.Date	Family	Pub.Date
US 7866383 B2	11-01-2011	AU 2009285796 A1	04-03-2010
		CN 102137984 A	27-07-2011
		EP 2324191 A1	25-05-2011
		WO 2010025152 A1	04-03-2010