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(54) Title: TUBING RETRIEVABLE INJECTION VALVE ASSEMBLY

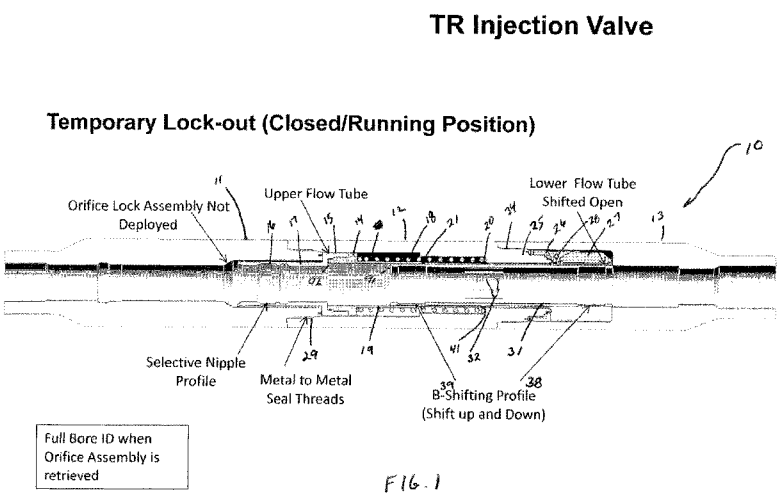


FIG. 1

(57) Abstract: A method and apparatus for controlling the flow of fluid in an injection well includes a main valve assembly having a valve and a retrievable orifice selective lock assembly (ROSLA). The ROSLA is operable when positioned within the valve body to open the valve when fluid is pumped into the well and closes the valve when fluid flow is terminated. The ROSLA includes a replaceable orifice nozzle so that orifices of different dimensions may be used in conjunction with the valve assembly.

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PCT PATENT APPLICATION

TITLE OF INVENTION:

TUBING RETRIEVABLE INJECTION VALVE ASSEMBLY

BACKGROUND OF INVENTION

1. Field of the Invention

[0001] This invention is directed to an injection valve typically used in conjunction with an injection well. Injection wells are drilled for example in close proximity to producing oil or gas wells that have peaked in terms of their output. Fluid for example water is pumped under pressure into the injection well which in turn acts to force the oil or gas into the producing wells thus increasing the yield.

2. Description of Related Art

[0002]

BRIEF SUMMARY OF THE INVENTION

[0003] The invention includes providing a tubing retrievable injection valve having a full bore internal diameter when running and retrieving the valve. A slick line retrievable choke is carried by a retrievable orifice selective lock assembly. The choke is retrievable without removing the injection valve. Consequently the diameter of the choke orifice may be changed on the surface. The injection valve also has a temporary lock out feature so that the valve may be placed in the well in a lock out mode.

BRIEF DESCRIPTION OF THE SEVERAL VIEWS OF THE DRAWING(S)

[0004] FIG. 1 is a cross sectional view of the valve in a lock out, running position.

[0005] FIG. 2 is a cross sectional view of the valve in a pre-injection position with the valve member closed.

[0006] FIG. 3 is a cross-sectional view of the retrievable orifice selective lock assembly.

[0007] FIG. 4 is a perspective view of the retrievable orifice selective lock assembly.

[0008] FIG. 5 is a cross sectional view of the valve showing the retrievable orifice selective lock assembly located within the valve body.

[0009] FIG. 6 is a cross sectional view of the valve in an open injection position.

DETAILED DESCRIPTION OF THE INVENTION

[0010] Referring to FIG. 1, an embodiment of the invention includes a pressure containing body comprising an upper valve body member 11 to a tubular, a middle valve body member 12 suitably attached to the upper valve body member 11 by threads at 29, for example, and a lower valve body member 13 which is connectable to a tubular at its downhole end. Valve body members 12 and 13 are secured to each other by threads for example at 34.

[0011] The injection valve 10 further includes an upper flow tube having a first section 17 and a second section 14 which are secured together. Section 17 has an interior nipple profile at 16 for receiving a tool. Section 14 has an elongated sleeve portion 19 that extends to valve seat 26 when the valve is in the position shown in FIG. 1. A lower flow tube 31 is positioned within the elongated sleeve portion 19 of the upper flow tube. Lower flow tube 31 has a plurality of slots 32 and a plurality of ridges formed on its outer periphery where the slots 32 are located so as to form a flexible profile for engagement with recesses 21 and 20 on the inner surface of elongated sleeve portion 19. Lower flow tube 31 also has shifting profiles 39 and 38 at each end thereof.

[0012] Middle body member 12 has a reduced diameter portion 25 that carries an annular valve seat 26. A flopper valve 27 is pivotably connected at 28 to portion 25 and is resiliently biased to a closed position on valve seat 26 as is known in the art.

[0013] A coil spring 18 is positioned about elongated sleeve portion 19 and is captured between shoulder 14 of the upper flow tube and an internal shoulder 41 provided within middle valve body member 12.

[0014] In the temporary lock out running position shown in FIG. 1, lower flow tube 31 is positioned within the valve body so as to extend beyond valve seat 26 thereby maintaining flapper valve 27 in an open position.

[0015] When the valve is positioned within the well at the desired location, a suitable running tool is lowered into the well and engages the upper shifting profile 39 of lower flow tube 31 and the flow tube is moved upwardly or to the left as shown in FIG. 2, to the position shown in FIG. 2. The uphole end portion 91 of the lower flow tube 31 will abut a shoulder portion 92 of the upper flow tube 15 as shown in FIG. 2. In this position, the resiliently biased flapper valve will be in the closed position.

[0016] The retrievable orifice selective lock assembly (ROSLA) will now be discussed with reference to FIGs. 3 and 4. The ROSLA 50 includes a shiftable sleeve formed by generally cylindrical member 51, 52, and 53 having an interior flow passage 61. A plurality of selective lock dogs 58 are located around a portion of its periphery as shown in FIG. 4. Leaf springs 59 are positioned under lock dogs 58. ROSLA 50 includes an annular packing assembly 55. A replaceable and retrievable orifice nozzle 53 is releaseably attached to the body portion of the ROSLA and includes an orifice 54. Orifice nozzle 53 may be replaced on the surface with another nozzle having a different size orifice 54.

[0017] FIG. 5 illustrates the position of the ROSLA within the injection valve prior to the injection stage. ROSLA may be lowered into the valve body by a suitable tool to a position where the selective lock dogs 58 engage the selective nipple profile 16 in upper flow tube 17. At this point the ROSLA will be physically connected to the upper flow tube; however flapper valve 27 is still in the closed position.

[0018] The next step in the process is to pump a fluid such as water under pressure into the valve body. As the fluid flows through the ROSLA, a pressure drop will occur across orifice 54 which will cause the ROSLA and upper flow tube assembly 15, 14 to move downhole or to the right as shown in FIG. 6.

[0019] This movement will compress spring 18. The downhole portions of both the upper flow tube and lower flow tube will be forced into contact with flapper valve 27 and as they are moved further by the pressure differential, they will open the flapper valve to the position as shown in FIG. 6.

[0020] As long as the fluid is being pumped the injection valve will remain open. However when the pumping stops, compressed spring 18 will move the ROSLA and the upper and lower flow tubes back to the position shown in FIG. 5 in which the flapper valve is in the closed position.

[0021] Although the present invention has been described with respect to specific details, it is not intended that such details should be regarded as limitations on the scope of the invention, except to the extent that they are included in the accompanying claims.

CLAIM(S)

I claim:

1. A method of injecting fluid into a well comprising:

providing a valve assembly having a temporary lock out mode, an upper and lower flow tube, a valve, and a retrievable orifice selective lock assembly,

placing the valve assembly in a temporary lock out mode,

positioning the valve assembly on a tubing and running the tubing into the well,

shifting the lower flow tube to a retraced position,

running a retrievable orifice selective lock assembly into the valve assembly,

injecting fluid into the valve assembly thereby opening the valve, and

closing the valve by termination the flow of fluid into the valve assembly,

2. A valve assembly for controlling the flow of fluid within an injection well comprising:

a valve body,

axially movable upper and lower flow tubes within the body

a valve located at a downhole end of the valve body, and

a retrievable orifice selective lock assembly positionable within the valve body and operable to open the valve when fluid flow is initiated through the valve body and operable to close the valve when fluid flow in terminated.

3. An injection valve for use in a subterranean well comprising: a pressure containing body attachable to a production tubing, a shiftable sleeve having a retrievable orifice, and a closure means, where said shiftable sleeve operates in response to fluid being injected into the well from the surface.

4. The injection valve of claim 3 further comprising, said retrievable orifice may be retrieved from the wellbore while leaving said closure means in the well in a closed position.

5. The injection valve of claim 3 further comprising, said shiftable sleeve is adapted to be alternately shifted to a first position to lock the injection valve in the open position.

6. The injection valve of claim 3 further comprising, said shiftable sleeve is adapted to return the injection valve in the normal operating or closed position.

TR Injection Valve

Temporary Lock-out (Closed/Running Position)

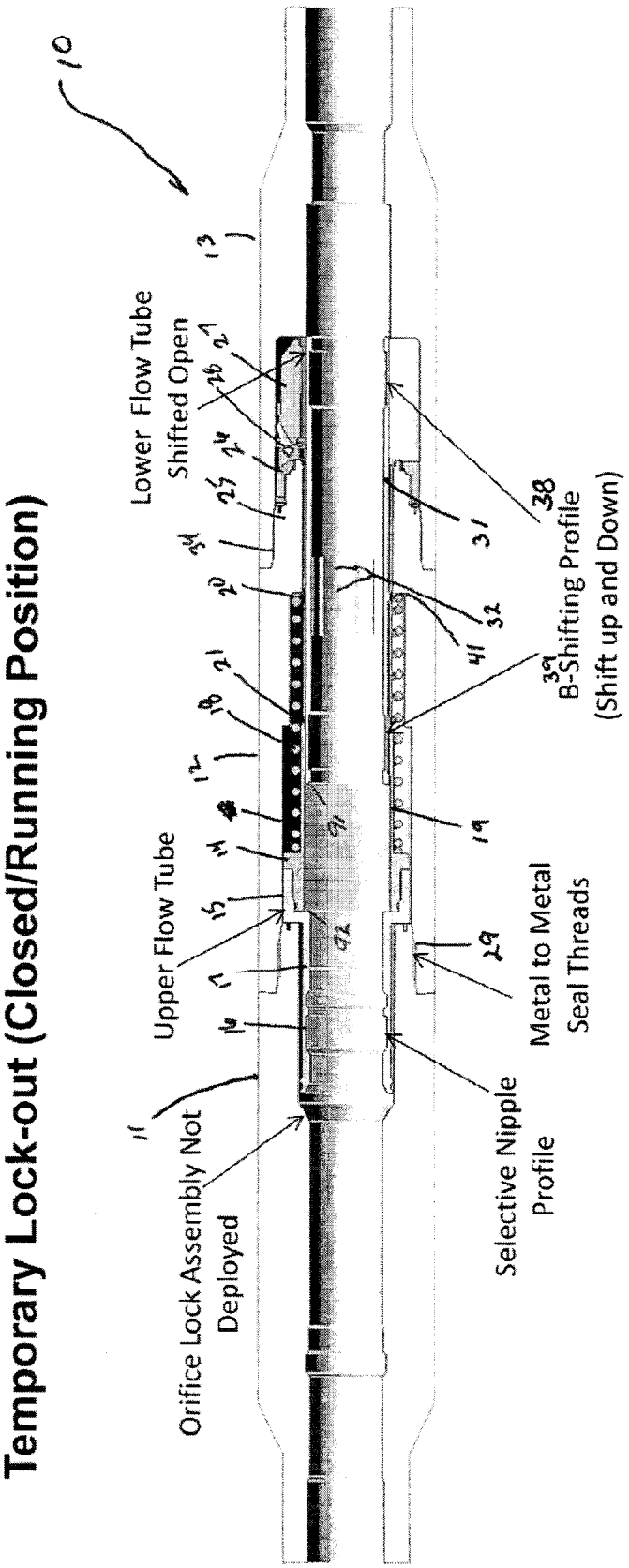


FIG. 1

TR Injection Valve

Pre-Injection Position (Valve Closed/ Lock-out Sleeve Retracted)

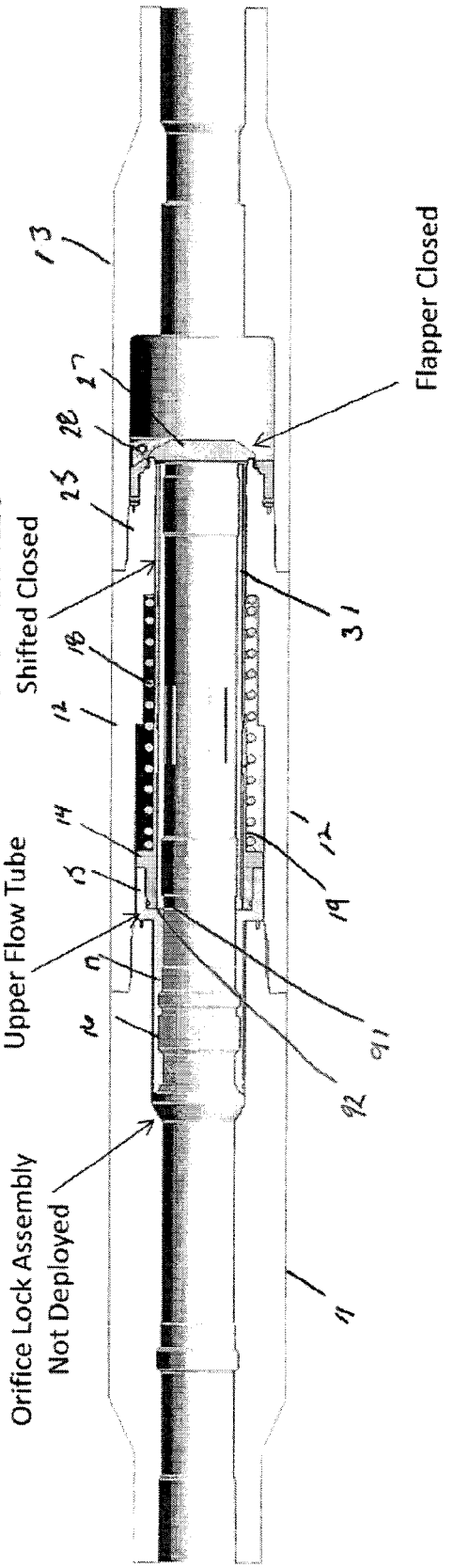


FIG. 2

TR Injection Valve

Retrievable Orifice Selective Lock Assembly

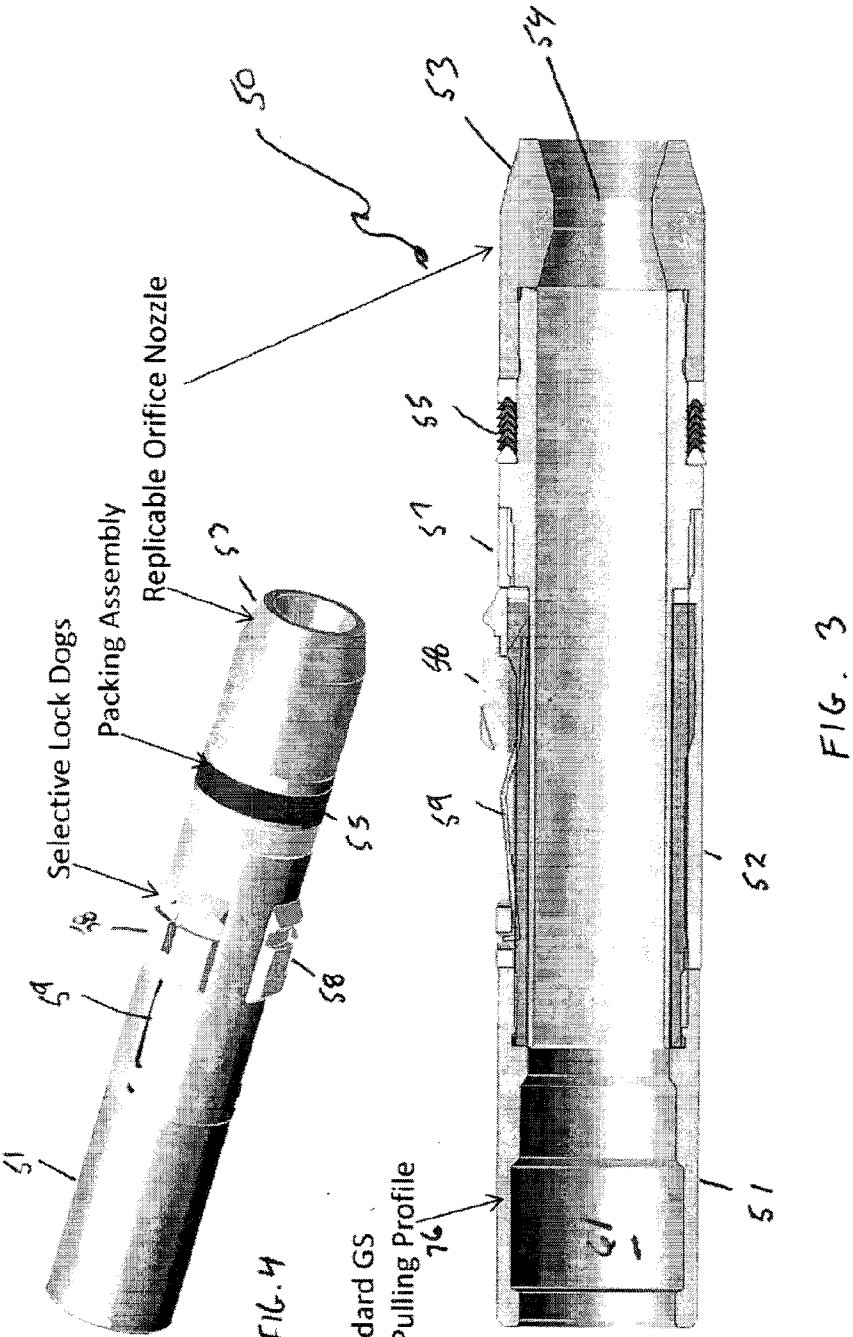


FIG. 4

FIG. 3

TR Injection Valve

Pre-Injection Installation of Orifice Assembly

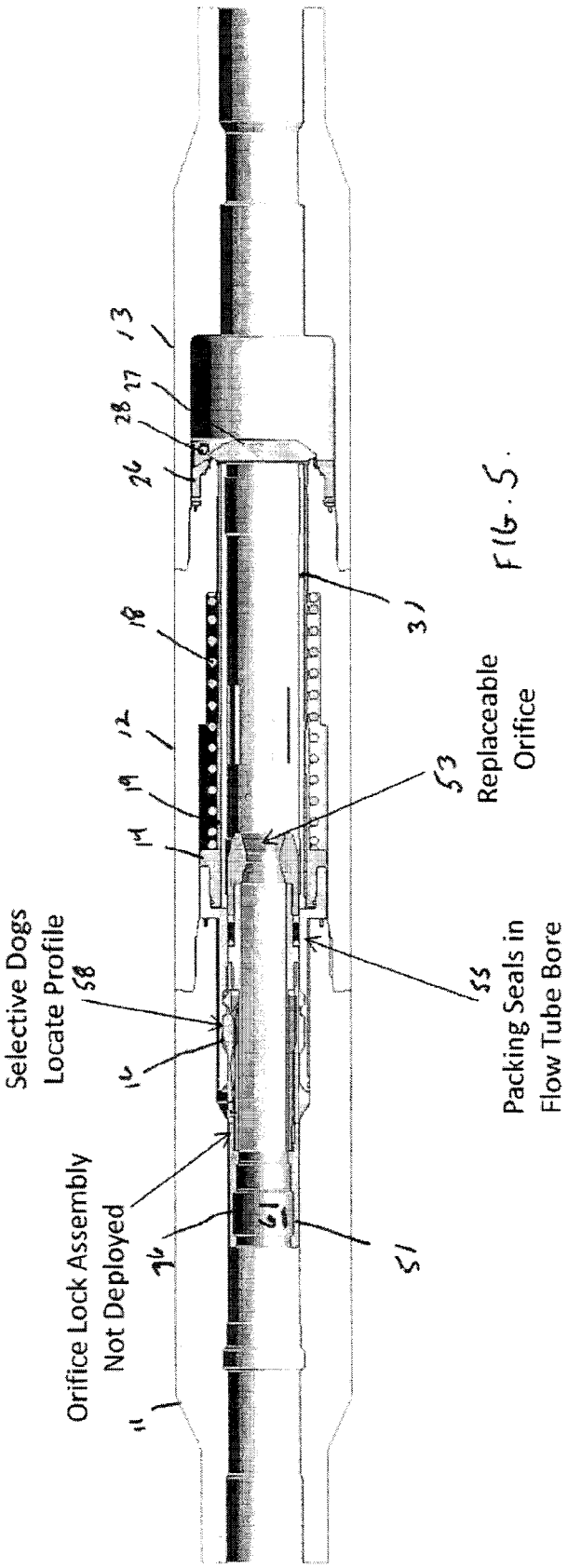


FIG. 5.

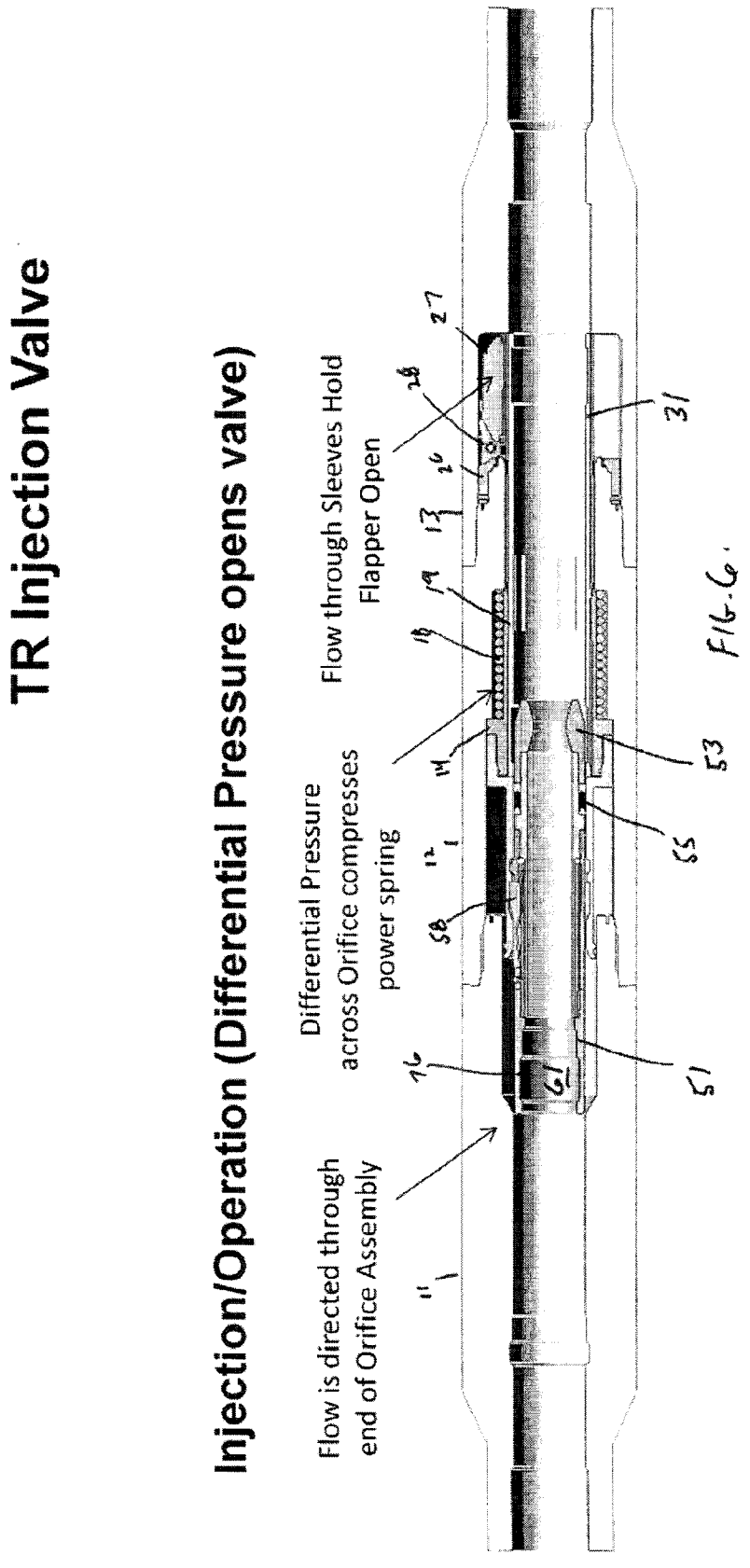

TR Injection Valve
Injection/Operation (Differential Pressure opens valve)
Flow is directed through end of Orifice Assembly
Differential Pressure across Orifice compresses power spring
Flow through Sleeves Hold Flapper Open
27
28
31
53
55
51
58

FIG. 6.

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US2013/038438

A. CLASSIFICATION OF SUBJECT MATTER
IPC(8) - E21B 34/10 (2013.01)
USPC - 166/322
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)
IPC(8) - E21B 34/06, 34/08, 34/10, 34/12, 34/14 (2013.01)
USPC - 166/80.1, 319, 321, 322, 332.8, 375

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched
CPC - E21B 34/08, 34/10, 34/105, 34/107, 2034/005 (2013.01)

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

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	US 2006/0162932 A1 (MCCALVIN) 27 July 2006 (27.07.2006) entire document	1-6
Y	US 4,362,214 A (PRINGLE et al) 07 December 1982 (07.12.1982) entire document	1-6

☐ Further documents are listed in the continuation of Box C. ☐

* Special categories of cited documents:
"A" document defining the general state of the art which is not considered to be of particular relevance
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"O" document referring to an oral disclosure, use, exhibition or other means
"P" document published prior to the international filing date but later than the priority date claimed
"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
02 August 2013	16 AUG 2013
Name and mailing address of the ISA/US Mail Stop PCT, Attn: ISA/US, Commissioner for Patents P.O. Box 1450, Alexandria, Virginia 22313-1450 Facsimile No. 571-273-3201	Authorized officer: Blaine R. Copenheaver PCT Helpdesk: 571-272-4300 PCT OSP: 571-272-7774