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Declarations under Rule 4.17:

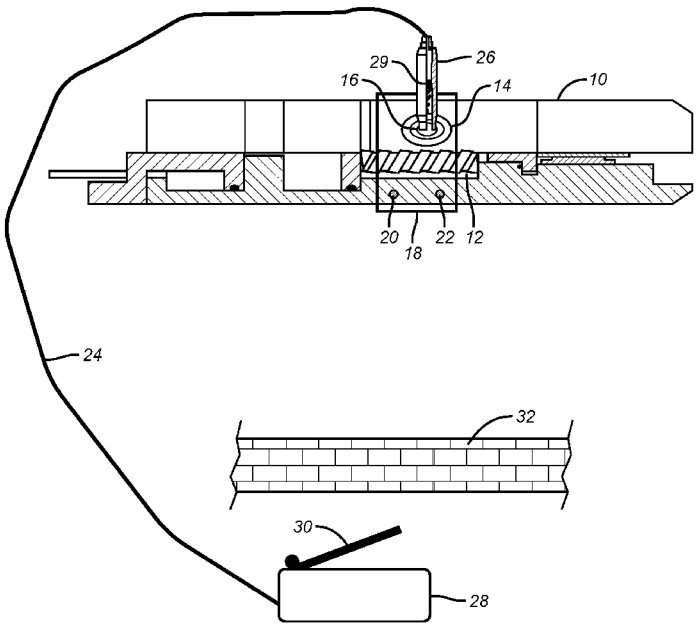
— *as to applicant's entitlement to apply for and be granted a patent (Rule 4.17(ii))*

— *as to the applicant's entitlement to claim the priority of the earlier application (Rule 4.17(iii))*

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— *with international search report (Art. 21(3))*

(54) **Title**: REMOTE DEPRESSURIZATION SYSTEM FOR HIGH PRESSURE COMPARTMENT IN A SUBTERRANEAN TOOL



(57) **Abstract**: A subterranean tool that has a pressurized chamber when brought out of the hole after being actuated is depressurized by a tool that facilitates location of a technician at a distance when the gas is allowed to escape. Preferably, the tool features a hydraulic system with a device to build pressure at the technician end and a suitably long hydraulic line to the subterranean tool to connect to the venting tool that is independently secured to the subterranean tool to be depressurized. Raising the hydraulic pressure in the system extends a piston in the venting tool against a rupture disc to cause the disc to fail and the pressurized gas to escape. The vent tool is secured against longitudinal or relative rotational movement with respect to the subterranean tool. Variations including pneumatic or electrically or magnetically driven pistons, among other variants are also contemplated.

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REMOTE DEPRESSURIZATION SYSTEM FOR HIGH PRESSURE COMPARTMENT IN A SUBTERRANEAN TOOL

FIELD OF THE INVENTION

[0001] The field of the invention is subterranean tools that are removed to the surface after use with a pressurized chamber that needs to be vented for tool disassembly prior to redressing the tool after use.

BACKGROUND OF THE INVENTION

[0002] Exploration and production of oil and gas has many potential dangers and personnel safety is a very important issue every single day. Some tools are configured with charged gas chambers as a potential energy source for subsequent operation at a subterranean location. When those tools come out of the hole the chamber can still have as much as 700 PSIG or more. The chamber needs to be depressurized so that the tool can be assembled and spent parts such as shear pins replaced as the tool is made ready for another use in a different or the same hole. US 5845669 illustrates a tool that can be secured to the pressurized compartment where there is a vent port covered by a rupture disc. A technician stands close by as the bolt is advanced with a tool into the rupture disc to break the disc. At this point the very high pressure escapes with the technician close at hand. This is not desirable. First is the high velocity of the escaping gas that could also take with it parts of the now ruptured rupture disc. Another hazard of rapidly escaping gas is the high decibel level of the ensuing noise from a high velocity gas release that follows breaking the rupture disc.

[0003] The present invention seeks to address these issues by allowing the venting operation to occur in a shop or in the field under conditions where the technician can stand clear of the tool when the rupture disc is broken. The device is an actuation system that is preferably hydraulic to advance a piston onto the disc from a remote location. The technician can stand away from the source of noise and high velocity gas, preferably behind a wall or some other shelter. The vent tool is secured to the subterranean tool against any movement before actuation. After the pressure is fully relieved, the tool is disconnected. These and other aspects of the present invention will be more readily apparent to those skilled in the art from a review of the detailed

description of the preferred embodiment and the associated drawing while recognizing that the full scope of the invention is to be determined by the appended claims.

SUMMARY OF THE INVENTION

[0004] A subterranean tool that has a pressurized chamber when brought out of the hole after being actuated is depressurized by a tool that facilitates location of a technician at a distance when the gas is allowed to escape. Preferably, the tool features a hydraulic system with a device to build pressure at the technician end and a suitably long hydraulic line to the subterranean tool to connect to the venting tool that is independently secured to the subterranean tool to be depressurized. Raising the hydraulic pressure in the system extends a piston in the venting tool against a rupture disc to cause the disc to fail and the pressurized gas to escape. The vent tool is secured against longitudinal or relative rotational movement with respect to the subterranean tool. Variations including pneumatic or electrically or magnetically driven pistons, among other variants are also contemplated.

BRIEF DESCRIPTION OF THE DRAWING

[0005] The Figure illustrates a hydraulic solution to remote venting a pressurized compartment in a subterranean tool by a technician after the tool is deployed and before the tool is redressed for a subsequent use.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

[0006] The subterranean tool **10** has a pressurized compartment **12** when retrieved out of a wellbore after use. The compartment **12** has an outlet **14** closed off with a rupture disc **16**. The pressure venting tool **18** is schematically represented by a rectangle. It has hardware and fixation pins **20** and **22** that go into exterior holes in the tool **10** for fixation of the venting tool **18** to the subterranean tool **10**. Those same exterior holes that are not shown are used in assembly of tool **10** to insert a wrench to assemble parts together with relative rotation.

[0007] A hydraulic line **24** connects a piston housing **26** to a pressure building device **28**. Preferably the line length is long enough to allow the technician to stand behind a nearby wall for protection from noise, high velocity gas stream or any fragment propelled by the high velocity gas stream. In most shops a length of about 10 meters should be more than adequate for

reaching a remote location for the technician. The piston housing **26** has an internal piston **29** with a sharp leading end designed to penetrate the rupture disc **16** to vent pressurized gas. The device **28** can be a well-known device akin to those used to jack up cars that with a repetitive motion of the handle **30** builds pressure in line **24**. As the operator is pumping the handle **30** he or she can stand behind a wall **32** to keep out of harm's way as the pressure is released. The wall also reduces the noise associated with the gas release, but a prudent technician would also be wearing ear plugs for noise protection.

[0008] There are variations that are contemplated by the present invention. The device **28** can be a pressurized pneumatic line such as from a system air compressor that is available in most mechanical shops. Alternatively the piston **29** can be driven by a stepper motor with device **28** being the control for actuation of the stepper motor or some other electrically actuated device such as a solenoid that releases a potential energy force such as a spring. Alternatively a motor can operate a threaded shaft that advances axially on rotational input from the motor that is enabled by a device such as **28**. The motor in the latter case can be electrically driven or fluid driven such as hydraulically, pneumatically, with a magnetic or other type of force field or with steam if available.

[0009] In essence the venting procedure separates the technician from the hazard at the time of the gas release. The tool can then be redressed after its pressurized compartment is vented to atmospheric pressure. While there are many ways to trigger the gas venting some of which involve breaking a rupture disc, the fluid retention device can also be a one way valve such as a spring loaded ball that is pushed off its seat with movement of the piston **29**. The technician can get far enough away from the venting location to avoid hearing damage and the high velocity gas stream which could directly or indirectly by propelling an object cause the technician serious personal injury.

[0010] The above description is illustrative of the preferred embodiment and many modifications may be made by those skilled in the art without departing from the invention whose scope is to be determined from the literal and equivalent scope of the claims below:

We claim:

1. A servicing method for a subterranean tool after use downhole and prior to disassembly, comprising:

mounting a venting device to the subterranean tool;

positioning an actuator for said venting device at a remote location from the subterranean tool;

opening a vent passage from a pressurized compartment of the subterranean tool with said actuator triggering said venting device;

venting gas from the subterranean tool before disassembly.

2. The method of claim **1**, comprising:

accomplishing said opening with the breaking of a rupture disc.

3. The method of claim **1**, comprising:

accomplishing said opening with overcoming a one way valve.

4. The method of claim **1**, comprising:

moving a piston to accomplish said opening.

5. The method of claim **5**, comprising:

driving said piston hydraulically or with steam.

6. The method of claim **5**, comprising:

driving said piston pneumatically.

7. The method of claim **5**, comprising:

driving said piston electrically or with a field.

8. The method of claim **7**, comprising:

using an electric motor to drive said piston.

9. The method of claim **1**, comprising:

securely mounting said venting device to the subterranean tool against relative movement.

10. The method of claim **9**, comprising:

preventing said venting device from sliding along the subterranean tool or rotating with respect to the subterranean tool.

11. The method of claim **1**, comprising:

positioning said actuator behind a wall to protect a technician from noise, gas velocity or venting gas propelled objects.

12. The method of claim **10**, comprising:

inserting at least one member on said venting device into at least one exterior recess on the subterranean tool to accomplish said preventing.

13. The method of claim **2**, comprising:

moving a piston to accomplish said opening.

14. The method of claim **13**, comprising:

driving said piston hydraulically or with steam.

15. The method of claim **14**, comprising:

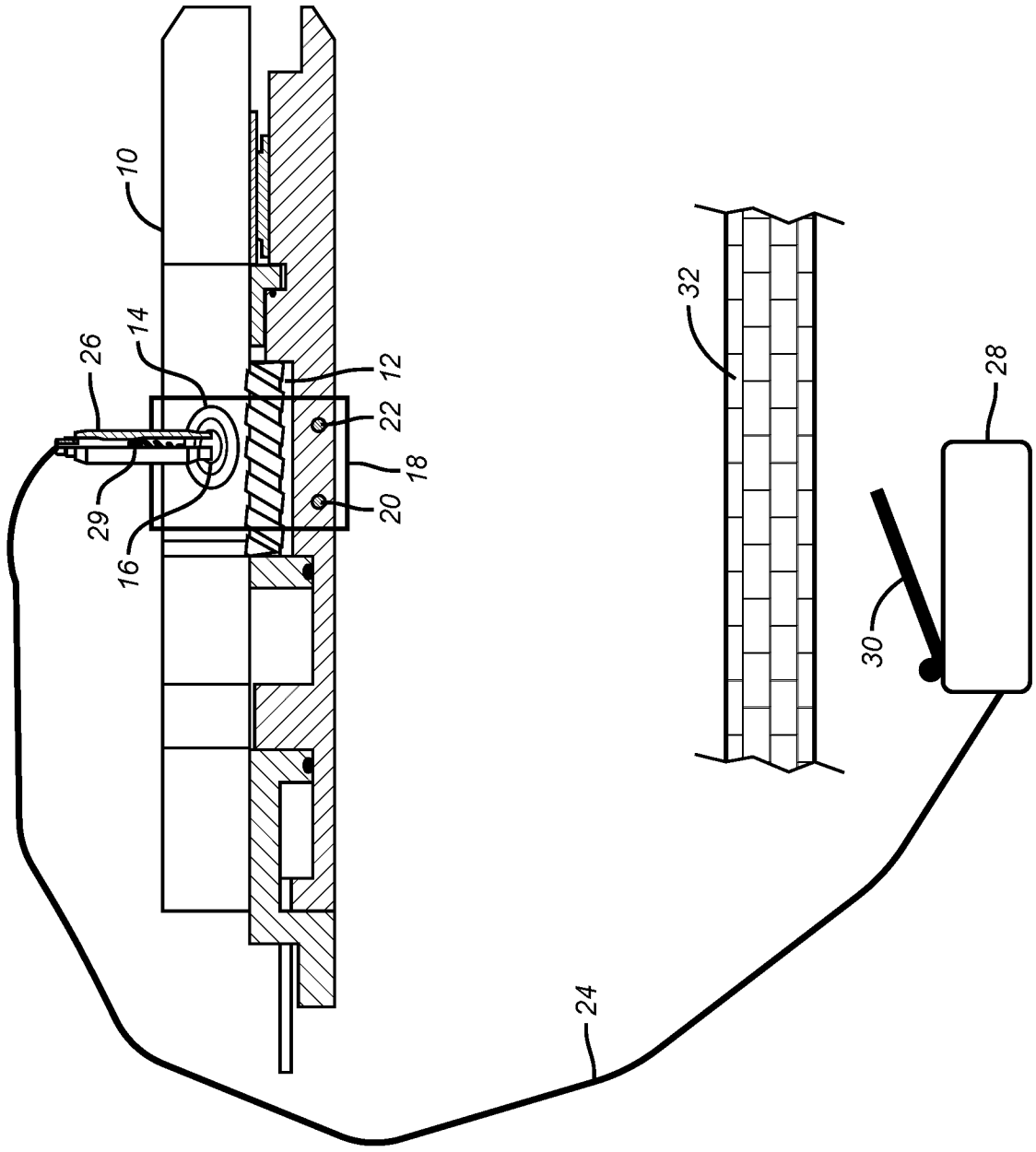
securely mounting said venting device to the subterranean tool against relative movement.

16. The method of claim **15**, comprising:

preventing said venting device from sliding along the subterranean tool or rotating with respect to the subterranean tool.

17. The method of claim **16**, comprising:

positioning said actuator behind a wall to protect a technician from noise, gas velocity or venting gas propelled objects.


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INTERNATIONAL SEARCH REPORT

International application No.
PCT/US2016/026757

A. CLASSIFICATION OF SUBJECT MATTER

F16K 17/14(2006.01)i, F16K 17/40(2006.01)i, E21B 34/00(2006.01)i

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)
F16K 17/14; F16K 17/38; F16K 17/40; E21B 34/00

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched
Korean utility models and applications for utility models
Japanese utility models and applications for utility models

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)
eKOMPASS(KIPO internal) & keywords: subterranean tool, venting device, actuator, vent passage, one way valve, rupture disc, and piston

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	US 5845669 A (ROSS, RICHARD J.) 08 December 1998 See column 2, line 67 - column 4, line 30, claim 1, and figures 3-6.	1-17
Y	US 2005-0103379 A1 (SUNDHOLM, GORAN) 19 May 2005 See paragraphs [0010]-[0012] and figures 1-2.	1-17
A	US 5495865 A (WASS et al.) 05 March 1996 See column 6, line 56 - column 7, line 43 and figure 5.	1-17
A	US 2005-0205129 A1 (KARALIS et al.) 22 September 2005 See paragraphs [0075]-[0077] and figures 9, 11-12.	1-17
A	US 3989057 A (MUDDIMAN, GEORGE ROBERT) 02 November 1976 See column 9, line 13 - column 10, line 10 and figure 3.	1-17

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

☒ See patent family annex.

* Special categories of cited documents:
"A" document defining the general state of the art which is not considered to be of particular relevance
"E" earlier application or patent but published on or after the international filing date
"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
"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
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INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No.
PCT/US2016/026757

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