(12) **PATENT**

(19) NO (11) **341495** (13) **B1**

NORWAY

(51) Int Cl.
E21B 43/00 (2006.01)
E21B 43/01 (2006.01)
F17D 1/00 (2006.01)
F16L 55/07 (2006.01)
E21B 33/03 (2006.01)

Norwegian Industrial Property Office

(21)	Application nr.	20161220	(86)	International Filing Date and Application Number
(22)	Date of Filing	2016.07.22	(85)	Date of Entry into National Phase
(24)	Date of Effect	2016.07.22	(30)	Priority
(41)	Publicly Available	2017.11.27		
(45)	Granted	2017.11.27		

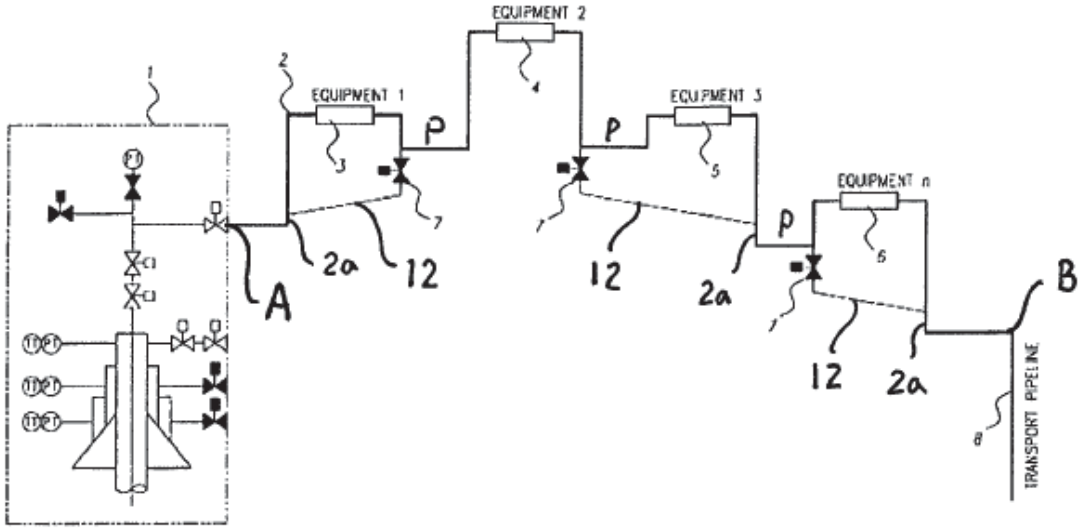
(73) Proprietor Kværner AS, Postboks 74, 1325 LYSAKER, Norge
(72) Inventor Odd Inge Stuedal, Haakon Odd Christiansens Veg 38, 7048 TRONDHEIM, Norge
Arne Budal, Laura Hangerås' veg 8, 7026 TRONDHEIM, Norge
(74) Agent or Attorney Protector Intellectual Property Consultants AS, Oscarsgate 20, 0352 OSLO, Norge

(54) Title **An arrangement of an unmanned and remotely operated production facility**

(56) References Cited: WO 2016/028158 A1

(57) Abstract

An arrangement of an unmanned and remotely operated production facility comprising a wellhead platform including a wellhead assembly (1) having an X-mas tree, a flowline (2) transporting hydrocarbon fluids produced from a well via said wellhead assembly to two or more consecutive process equipment(s) (3-6), and further on to a destination via a transport line (8). Any process equipment and/or pipeline section located at a higher level than said outlet point A from said wellhead assembly (1), is arranged to either drain back to the x-mas tree, or drain downstream to said transport pipeline by assistance of respective valves arranged along said flowline (2).



An arrangement of an unmanned and remotely operated production facility

The present invention relates to an arrangement of an unmanned and remotely operated production facility comprising a wellhead platform including a wellhead assembly having an X-mas tree, a flowline starting from an outlet point from the X-mas tree and transporting hydrocarbon fluids produced from a well via the wellhead assembly to one or more consecutive process equipment(s), and further on to a destination via a transport pipeline starting at a point located at a level lower than the outlet point.

The invention is also related to evacuation of liquids in a process system and more specifically evacuation of liquids from segments in a process system to other sections of the same process system and final pressure relief of the system.

The present concept which describes the system, the arrangement and a method for evacuating liquids in parts of a process system is typically applicable for use in situations where a shutdown of the process system is necessary, or that shut down of parts or components in the process system is necessary due to intrusive activities as maintenance and replacement of components.

For manned facilities, a dedicated closed drain system is well known technology for drainage of liquids from segments. This type of systems is in daily use in several locations. For such facilities, systems are manually drained prior to any intervention or during extended duration shutdowns. Liquids are typically routed to a closed drain system, which collects and disposes of any liquids remaining in the segment.

From patent application, PCT/NO2015/050135 a concept for drainage of liquids from a wellhead assembly is described. The concept describes a continuously sloping pipe arrangement from wing valve to riser for drainage of liquids under the action of gravity. Such a design introduces restrictions to both the physical

design and the use of certain process components, which have flow direction preferences.

Another example of prior art is found in the publication US6397948, which publication discloses vent lines for depressurizing manifolds and flowlines of a subsea production system installed directly on the seabed.

According to the present invention an arrangement of an unmanned and remotely operated production facility of the introductory said kind is provided, which arrangement is distinguished in that any process equipment and/or pipeline section located at a higher level than the outlet point from the wellhead assembly, is arranged to either drain back to the x-mas tree, or drain downstream to the transport pipeline by assistance of respective valves arranged along the flowline.

Preferably, the process equipment may include components like meters, valves, sensors, manifolds, vessels, mechanical equipment or process assemblies.

Any process equipment low-level pockets is connected to a lower segment by use of respective actuatable short circuit valve and associated piping conducting fluids to a lower level.

In still another embodiment, the associated piping and circuit valve are short-circuited either to an upstream or to a downstream segment.

Moreover, the production facility may include an optional manifold receiving fluid from one or more additional wells and route to transport pipeline for transport to destination. Such destination can be a processing facility.

Thus, the invention relates to a production system which design facilitates remote/unmanned operation for extraction of hydrocarbon fluids from reservoirs. The present invention eliminates requirement for a dedicated drainage system and continuously sloping piping. As such, the design allows for an arbitrary

number of high points in the production piping, and a high degree of flexibility with regards to physical layout. This flexibility can be used to make the system more compact and/or to cater for upwards flowing installation requirements of inline components.

When shutting down a remote operated facilities e.g. for the purpose of intrusive maintenance or operational difficulties, it could be required to dispose of liquid hydrocarbon inventory by draining segments of, or the entire topside. On a manned facility, such draining will normally take place by an operator connecting hoses, or utilizing a permanent drain line to a drain system, which collects and disposes of the liquid. Such manual intervention is not suitable for remote operated facilities. Self-draining piping could be used, but could impose suboptimal restrictions to the layout design. The present invention provides a system design assembly comprising:

- A conventional wellhead assembly (x-mas tree)
- A fluid transport pipe (flowline)
- Inline components such as valves, meters, detectors, transmitters, equipment and assemblies.
- Optional manifold to collect fluid from several wells and route to transport pipeline connection
- Connection to transfer pipeline to processing facility

Between the conventional wellhead assembly and the transport pipeline there may be any number of local high points, which may or may not introduce pockets in the system. Any pocket low point is connected to a lower segment by use of actuated short circuit valve and piping.

With this arrangement, any liquid inventory trapped in low point can be remotely drained from the pockets in which it collects, without the use of a dedicated drainage system, and without imposing layout restrictions. Segments with local high points, but without a pocket, will self-drain to either side of the high point. Liquids can be drained back to the well, or to the transfer pipeline.

As a result of this invention, the facility may be designed without a separate drainage system for reduced cost and operational complexity. It may also be designed with use of compact layouts and inline components where upwards flow is considered advantageous or mandatory.

The short circuit valve(s) may be activated manually by host platform operator, or automatically upon system trip/shutdown. For automatic draining, the system may be implemented by use of sequential valve operations to allow for liquid to drain into the transport pipeline prior to closing the final valve between the facility and the transfer pipeline. The duration of the delay(s) is specific for each facility and calculated based on factors such as liquid fraction, liquid holdup, pipe orientation, pipe dimension and length.

Other and further objects, features and advantages will appear from the following description of preferred embodiments of the invention, which is given for the purpose of description, and given in context with the appended drawings where:

Fig. 1 shows in schematic view a wellhead platform with a wellhead assembly having an x-mas tree and pocketed piping and short-circuiting lines,

Fig. 2 shows in schematic view a wellhead platform similar to fig. 1, but omit the pocketed piping and short circuiting lines,

Reference is made to fig. 1 showing a schematic of a wellhead platform with a wellhead assembly 1 including an x-mas tree, a flowline 2 in which produced fluids from the well are flowing to any process components such as meters, valves, sensors, manifolds, vessels, mechanical equipment or process assemblies 3 to 6. The process components may or may not be located in high points with pocketed piping as shown in the figure. Pockets are short-circuited to downstream segment by use of automated valve(s) 7. Extracted fluids are produced to the transport pipeline 8.

Figure 2 shows a schematic of a wellhead platform with a wellhead assembly 1 including an x-mas tree, a flowline 2 in which produced fluids from the well are flowing to any process components such as meters, valves, sensors, manifolds, vessels, mechanical equipment or process assemblies 3 to 6. The process components may or may not be located in high points with continuously sloping piping to either side to facilitate accumulation of liquid in well 1 and transport pipeline 8 respectively. The local high point may be any of the installed components.

Patent claims

1.

An arrangement of an unmanned and remotely operated production facility comprising a wellhead platform including a wellhead assembly (1) having an X-mas tree, a flowline (2) starting from an outlet point A from said X-mas tree and transporting hydrocarbon fluids produced from a well via said wellhead assembly (1) to one or more consecutive process equipment(s) (3-6), and further on to a destination via a transport pipeline (8) starting at a point B located at a level lower than point A, **characterized in that**
any process equipment and/or pipeline section located at a higher level than said outlet point A from said wellhead assembly (1), is arranged to either drain back to the x-mas tree, or drain downstream to said transport pipeline by assistance of respective valves arranged along said flowline (2).

2.

The arrangement of an unmanned and remotely operated production facility according to claim 1, **characterized in that** said process equipment may include components like meters, valves, sensors, manifolds, vessels, mechanical equipment or process assemblies (3 – 6).

3.

The arrangement of an unmanned and remotely operated production facility according to any of the claims 1-2, **characterized in that** any process equipment (3 – 6) low-level pockets (P) is connected to a lower pipeline segment (2a) by use of respective actuatable short circuit valve (7) and associated piping (12) conducting fluids to a lower level.

4.

The arrangement of an unmanned and remotely operated production facility according to claim 3, **characterized in that** said associated piping (12) and short circuit valve (7) are short-circuited to a pipeline segment (2a) arranged either upstream or downstream.

5.

The arrangement of an unmanned and remotely operated production facility according to any of the claims 1-4, **characterized in that** said production facility includes an optional manifold receiving fluid from one or more additional wells and route to transport pipeline for transport to destination.

6.

The arrangement of an unmanned and remotely operated production facility according to any of the claims 1-5, **characterized in that** said destination is a processing facility.

Patentkrav

1. Anordning ved et ubemannet og fjernstyrt produksjonsanlegg, omfattende en brønnplattform som har en brønnhodesammenstilling (1) med et ventiltre, et brønnstrømrør (2) som starter fra et utløpspunkt A fra ventiltreet og som transporterer hydrokarbonfluider produsert fra en brønn via brønnhodesammenstillingen (1) til et eller flere konsekutive prosessutstyr (3-6), og videre til en destinasjon via en transportrørledning (8) som starter ved et punkt B som befinner seg ved et nivå lavere enn punkt A, **karakterisert ved at** ethvert prosessutstyr og/elle rørledningsseksjon som befinner seg ved et høyere nivå enn nevnte utløpspunkt A fra brønnhodesammenstillingen (1), er innrettet til å enten drenere tilbake til ventiltreet, eller drenere nedstrøms til transportrørledningen med assistanse fra respektive ventiler anordnet langsetter brønnstrømrøret (2).

2. Anordning ved et ubemannet og fjernstyrt produksjonsanlegg som angitt i krav 1, **karakterisert ved at** prosessutstyret kan innbefatte komponenter så som målere, ventiler, sensorer, manifolder, tanker, mekanisk utstyr eller prosessanordninger.

3. Anordning ved et ubemannet og fjernstyrt produksjonsanlegg som angitt i ett av kravene 1-2, **karakterisert ved at** enhver lavtliggende lomme (P) ved prosessutstyret (3-6) er forbundet til et nedre rørledningssegment (2a) ved bruk av respektiv aktiviserbar kortslutningsventil (7) og tilhørende rørsystem (12) som leder fluider til et lavere nivå.

4. Anordning ved et ubemannet og fjernstyrt produksjonsanlegg som angitt i krav 3, **karakterisert ved at** det tilhørende rørsystem (12) og kortslutningsventil (7) er kortsluttet til et rørledningssegment (2a) anordnet enten oppstrøms eller nedstrøms.

5. Anordning ved et ubemannet og fjernstyrt produksjonsanlegg som angitt i ett av kravene 1-4, **karakterisert ved at** produksjonsanlegget innbefatter en valgfri manifold som mottar fluid fra en eller flere ytterligere brønner og ledes til transportrørledningen for transport til destinasjon.

6. Anordning ved et ubemannet og fjernstyrt produksjonsanlegg som angitt i ett av kravene 1-5, **karakterisert ved at** destinasjonen er et prosessanlegg.

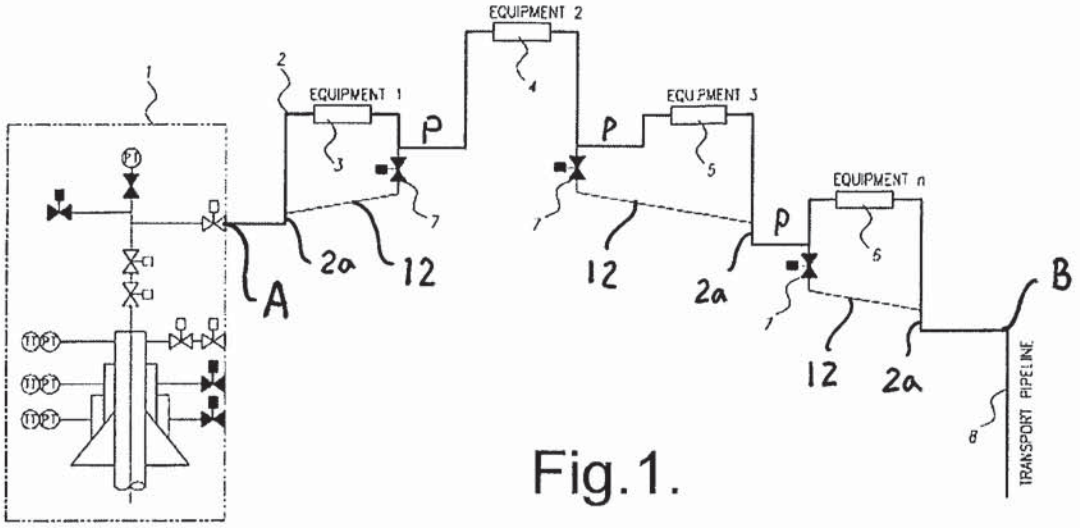

EQUIPMENT 2
EQUIPMENT 1
EQUIPMENT 3
EQUIPMENT n
P
P
P
A
2a
12
12
2a
12
2a
B
TRANSPORT PIPELINE

Fig.1.

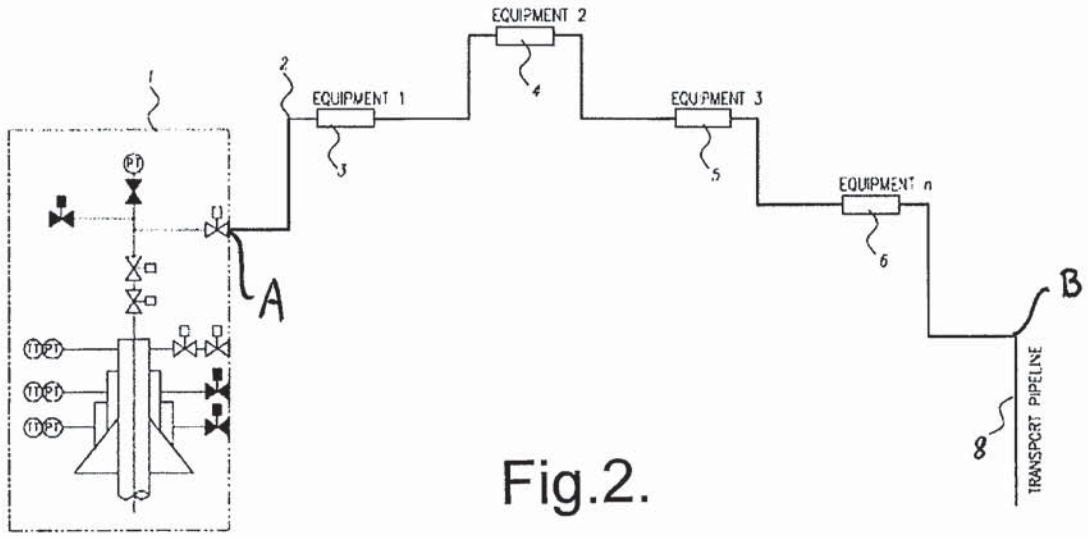

EQUIPMENT 2
EQUIPMENT 1
EQUIPMENT 3
EQUIPMENT n
A
B
TRANSPORT PIPELINE

Fig.2.