These objectives according to the present invention are achieved by providing a safety valve for extraction wells of hydrocarbons as specified in claim 1.

Further characteristics of the invention are indicated in the dependent claims, which are an integral part of the present description.

In accordance with a first aspect of an embodiment, there is provided a safety valve for extraction wells, configured to be installed on an oil well head and for enclosing a portion of a tubular material inserted inside the well, said tubular material being internally hollow and configured to contain and transport fluids and other substances extracted from the well, the safety valve being provided with a central hole through which the tubular material passes and comprising:

- a blocking system, configured to firmly keep the tubular material to be cut fixed with respect to the safety valve;
- a cutting and closing group configured to cut and close the well under certain operative conditions; and
- a sealing mechanism, configured to actuate an hydraulic sealing of the well, after the cutting,

wherein the cutting and closing group consists of a hole saw housed in a respective chamber of said cutting and closing group, said hole saw being rotated by a motorized actuation means and being configured to move in a controlled mode along a substantially orthogonal direction with respect to the development

direction of the well,
the cutting and closing group is provided with a movable protection element which at least partially surrounds the hole saw and which is configured to move along the same movement direction as the hole saw for arriving into the well and going in contact against the sealing mechanism, so as to effect the hydraulic sealing of the central hole of the safety valve and consequently of the well.

In accordance with a second aspect of an embodiment, there is provided a method for the closing of a well which comprises the following steps:

- fixing a safety valve onto the well head, so that a portion of a tubular material inserted inside the well is enclosed inside a central hole of the safety valve and a cutting and closing group of said safety valve is positioned in correspondence with the tubular material;
- actuating the rotation of a hole saw belonging to said cutting and closing group and the controlled advancing of said hole saw along a direction substantially orthogonal to the development direction of the well, so as to effect the progressive cutting of said tubular material;
- controlled advancing of a movable protection element belonging to said cutting and closing group and that surrounds at least partially the hole saw, said movable protection element being configured to move along the same movement direction as said hole saw for arriving into the well, so as to effect the occlusion of the central hole of the safety valve; and

- activating a sealing mechanism of the safety valve, said sealing mechanism being seal-engaged against the movable protection element to effect the watertight closing of the central hole of the safety valve and therefore the well.

The safety valve according to the invention is provided with its own control unit and independent feeding. After the shearing operation, said safety valve is capable of closing the well, producing hydraulic sealing.

The actuation of the safety valve is of the reversible type for allowing the restoration of the well if this is possible. The actuation of the safety valve, which always occurs after the actuation of the BOPs and should their closing action and safeguarding of the well fail, can be operated either during a so-called "kick" phase (influx into the well of gas coming from geological formations), or possibly during a blow-out of the well. After installation, the safety valve can also be left on the well head during the production phase, when the BOP has been removed, remaining below the production cross, thus reducing environmental risks in the case of possible damage of the cross itself.

The safety valve according to the invention is capable of functioning by cutting tubular materials having larger dimensions than the pipe bodies and under critical operating conditions, for example with the tubular material in the BOP and under compression due to the pressure thrust of the well, or with the tubular material arranged randomly inside the safety valve.

The characteristics and advantages of a safety

CLAIMS

1. A safety valve for extraction wells, configured to be installed on an oil well head and for enclosing a portion of a tubular material inserted inside the well, said tubular material being internally hollow and configured to contain and transport fluids and other substances extracted from the well, the safety valve being provided with a central hole through which the tubular material passes and comprising:

- a blocking system, configured to firmly keep the tubular material to be cut fixed with respect to the safety valve;
- a cutting and closing group configured to cut and close the well under certain operative conditions; and
- a sealing mechanism, configured to actuate an hydraulic sealing of the well, after the cutting,

wherein the cutting and closing group consists of a hole saw housed in a respective chamber of said cutting and closing group, said hole saw being rotated by a motorized actuation means and being configured to move in a controlled mode along a substantially orthogonal direction with respect to the development direction of the well,

the cutting and closing group is provided with a movable protection element which at least partially surrounds the hole saw and which is configured to move along the same movement direction as the hole saw for arriving into the well and going in contact against the sealing mechanism, so as to effect the hydraulic sealing of the central hole of the safety valve and consequently of the well.

2. The safety valve according to claim 1, wherein the blocking system consists of at least one upper blocking clamp, arranged above the cutting and closing group, and at least one lower blocking clamp, arranged below the cutting and closing group.

3. The safety valve according to claim 2, wherein each blocking clamp consists of a blocking element capable of engaging the tubular material by interference, said blocking element being movable along a direction perpendicular to the axial direction of the well and being pushed by a hydraulically driven piston.

4. The safety valve according to claim 3, wherein each blocking clamp comprises a mechanism to block the piston in the position reached also in the case of a loss in the hydraulic pressure.

5. The safety valve according to claim 3 or 4, wherein each blocking clamp comprises a position sensor which exactly controls the stroke of the blocking element so as to center the portion of tubular material enclosed inside the safety valve.

6. The safety valve according to any claims 3 to 5, wherein each blocking clamp comprises an elastic bellows protecting the seals of the stem of the piston and the blocking element from the well fluids.

7. The safety valve according to claim 1, wherein the cutting and closing group comprises a hydraulic piston housed inside a respective cylinder, said hydraulic piston being actuated for imparting a controlled linear movement to both the hole saw and the movable protection element.

8. The safety valve according to claim 7, wherein the motorized actuation means comprises a transmission shaft inserted inside the stem of the hydraulic piston, said transmission shaft rotating the hole saw.

9. The safety valve according to claim 7 or 8, wherein the motorized actuation means consists of a hydraulic motor integral with the hydraulic piston and fed by a series of flexible sleeves which follow said hydraulic motor during the translation movement of said hydraulic piston, a linear sensor continuously providing the position of said hydraulic piston inside the respective cylinder.

10. The safety valve according to any claims 1 to 9, wherein the sealing mechanism comprises a sliding closing collar configured to envelope the tubular material, said sliding closing collar being provided with a sealing portion suitable for forced contact with the movable protection element and being actuated by the hydraulic pressure of a fluid contained in at least one thrust chamber obtained inside the sealing

mechanism.

11. The safety valve according to claim 10, wherein the sealing mechanism comprises one or more blocking pins suitable for blocking the sliding collar in one or more predefined positions, said one or more blocking pins being pushed into corresponding grooves of the sliding closing collar by means of one or more corresponding springs retractable by means of the thrust of a pressurized fluid contained in a respective chamber obtained inside the sealing mechanism.

12. The safety valve according to any previous claims, wherein it comprises a protection element consisting of a sleeve mounted around the central hole of the safety valve and provided with sealing rings for keeping the central hole of the safety valve separate from the chamber where the hole saw is housed.

13. The safety valve according to claim 12, wherein it comprises a pressure-compensating device configured to fill the chamber where the hole saw is housed with an inert fluid kept at the same pressure as the well.

14. The safety valve according to any previous claims, wherein it comprises a remote power and control system installed at a predefined distance from the well, said remote power and control system being operatively connected to the safety valve by means of electric and hydraulic connections comprising a remotely operated underwater vehicle.

15. A method for the closing of a well which comprises the following steps:

- fixing a safety valve onto the well head, so that a portion of a tubular material inserted inside the well is enclosed inside a central hole of the safety valve and a cutting and closing group of said safety valve is positioned in correspondence with the tubular material;
- actuating the rotation of a hole saw belonging to said cutting and closing group and the controlled advancing of said hole saw along a direction substantially orthogonal to the development direction of the well, so as to effect the progressive cutting of said tubular material;
- controlled advancing of a movable protection element belonging to said cutting and closing group and that surrounds at least partially the hole saw, said movable protection element being configured to move along the same movement direction as said hole saw for arriving into the well, so as to effect the occlusion of the central hole of the safety valve; and
- activating a sealing mechanism of the safety valve, said sealing mechanism being seal-engaged against the movable protection element to effect the watertight closing of the central hole of the safety valve and therefore the well.

16. The method according to claim 15, wherein it is reversible, thus allowing the re-opening of the well.