

CUTTING DEVICE, SAFETY VALVE, METHOD AND USES FOR SEVERING A PIPE-STRING-RELATED OBJECT IN A SAFETY VALVE FOR A WELL

Field of the invention

The invention concerns a cutting device for a safety valve, a safety valve for a well, a
5 method for severing a pipe-string-related object in a safety valve and also three uses
for severing a pipe-string-related object located in a through bore in a safety valve for
a well.

Such a safety valve may be comprised of a blowout preventer ("BOP"), for example a
blowout preventer for drilling a well. The safety valve may also be comprised of a
10 Christmas tree for a completed well, for example a production well, injection well, geo-
thermal well or a water well. In this context, the well may be comprised of an under-
water well, for example a subsea well, or a surface well.

Background of the invention

The background of the invention relates to the so-called Macondo-blowout, which was
15 initiated in April, 2010. The blowout originated from a BP-operated oil well located in
ca. 1500 meter deep water in the Gulf of Mexico. Following a preceding explosion on a
floating drilling rig ("Deepwater Horizon") connected to the oil well, attempts were
made to sever an associated oil pipe extending through a blowout preventer placed on
the seabed above the oil well. High pressure from flowing oil in the oil pipe caused the
20 pipe to bend and displace to a non-centric position within the through bore (pipe inte-
rior) of the blowout preventer. Among other things, this blowout preventer was pro-
vided with a so-called blind shear ram designed for severing a steel pipe and also for
subsequent sealing of the bore through the blowout preventer. The shear ram, how-
ever, was not designed for severing a non-centric pipe in the blowout preventer. This
25 resulted in incomplete severing and sealing of the bore of the blowout preventer,
whereby oil at high pressure leaked out for a long time thereafter.

Prior art and disadvantages thereof

There are a number of publications, including patent publications, relating to various aspects of well safety valves and cutting devices associated therewith.

The closest prior art appears to be represented by the following patent publications:

- 5 - US 5,407,172 A; and
- DE 4,114,355 A1.

US 5,407,172 A concerns a piston-type blowout preventer comprising a location device for pistons associated with corresponding closing rams in the blowout preventer. The location device is provided with electromagnetic induction instrumentation for reporting information about the positions of the pistons within the blowout preventer.

DE 4,114,355 A1 concerns a method and a cutting device for killing burning blowouts in land-based petroleum wells. The method involves digging a shaft down into the underground and onward to the petroleum-producing pipes of the well, thereby gaining free access to the well pipes. A blowout preventer having piston rams is then placed around the well pipes so as to clamp these together until the pipes seal against each other. In order to prevent the well pipes from cracking during the compression, the pipes may possibly be heated inductively in the compression region of the pipes. It is very essential that the pipes are not severed in context of said compression, insofar as such severing will allow the blowout to be conducted into said shaft and up to the surface. Then a cutting device, which comprises a drill, is attached in a sealing manner to the outside of the outermost well pipe, and below said compression region, whereupon the drill is activated and drills into the well pipes. Finally, a well kill fluid is pumped down into the well to stop the blowout. The method is carried out via remote control.

The following patent publications are also mentioned as examples of cutting devices for such well safety valves:

- 25 - US 1,875,673 A;
- US 1,949,672 A;
- US 3,561,526 A;
- US 3,590,920 A;
30 - US 3,736,982 A;
- US 3,766,979 A;
- US 4,313,496 A;
- US 4,540,046 A;
- US 4,646,825 A;
35 - US 4,923,008 A;

- US 4,987,956 A; and
- US 5,400,857 A (corresponds to NO 310840 B1).

Common to all of these publications is that they concern cutting devices based on mechanical cutting principles, the cutting devices of which are generally structured for cutting of well pipes.

Pipe strings used in wells may also comprise various objects being far more massively structured than that of ordinary well pipes incorporated in such pipe strings. For example, said pipe-string-related objects may comprise various tools and equipment connected to such pipe strings. Moreover, pipe strings comprising pipes having a particularly large material thickness, for example so-called drill collars used in bottomhole assemblies (BHA) for drill strings, may be used. Upon using known cutting devices for well safety valves, it may prove far more cumbersome and even impossible, in an emergency, to sever such tools, equipment and thickened well pipes than that of severing ordinary well pipes.

Objects of the invention

The principal object of the invention is to remedy or reduce at least one disadvantage of the prior art, or at least to provide a useful alternative to the prior art.

Another object of the invention is to be able to sever, in a well safety valve, pipe-string-related objects being more massively structured than that of ordinary well pipes.

A further object of the invention is to be able to sever, in a well safety valve, pipe-string-related objects being non-centrally positioned within the through bore of the safety valve.

General description of the manner in which the objects are achieved

The objects are achieved by virtue of features disclosed in the following description and in the subsequent claims.

According to a first aspect of the invention, a cutting device is provided for severing a pipe-string-related object in a safety valve for a well, wherein the cutting device is structured for incorporation in the safety valve, and wherein the cutting device comprises a housing having a through bore structured for passing said object there-through. The distinctive characteristic of the cutting device is that it comprises at least one induction coil device disposed in said housing, and around at least a portion of the bore of the housing;

- wherein said induction coil device is directed inwards in the direction of the bore;
- wherein the induction coil device is structured for optional, cutting-promoting heating, hence thermal structural weakening, of the object when located vis-à-vis the induction coil device;

- 5 - wherein the induction coil device is structured in a manner allowing it to be connected to at least one electric power source for supply of electric power for said heating; and
- wherein the housing comprises a heat-insulating portion disposed between the induction coil device and the housing.

10 In context of a hydrocarbon well, heating by means of such an induction coil device may involve danger of explosion and/or danger of fire. This, however, may only occur if air/oxygen is supplied to the cutting device in the course of heating. Such a situation will not exist under water or in the event that the particular well is not producing hydrocarbons.

15 If said course of heating is carried out above water, and in context of a hydrocarbon well, danger of explosion and/or danger of fire may be avoided by enclosing, or enveloping, the present cutting device in a non-flammable means which ensures that air/oxygen is not supplied in the course of heating. For example, such a non-flammable means may be comprised of an air-tight receptacle enclosing the cutting
20 device and being filled with e.g. water or a non-flammable gas, for example nitrogen, carbon dioxide and/or an inert gas. When required, it is even conceivable to envelope the cutting device in such a gas being supplied from a suitable gas supply arrangement associated with the cutting device.

As mentioned, said pipe-string-related object in the safety valve may comprise a relatively massively structured object, for example various tools and equipment connected
25 to a pipe string extending through a through bore in said housing. As such, the object may comprise a well tool, for example a measuring instrument, a well valve, an actuator, a pumping device or similar. Oftentimes, but not always, such objects have a tubular design.

30 The object may also be comprised of a typical tubular object. As such, the object may comprise an ordinary well pipe *per se*, for example a casing, a production tubing, an injection pipe, a drill pipe, a drill collar or similar.

For optional heating of said object, the at least one induction coil device may also be structured for connection to an electric power supply network on an associated instal-

lation, for example on a platform or a vessel, possibly on a remote host facility on-shore or offshore. As an alternative or addition, the induction coil device may be structured for connection to one or more batteries, for example a battery pack, for supply of electric power to the induction coil device.

5 Further, the induction coil device may comprise one or more induction coil devices disposed, for example incorporated in a cavity, in said housing, and around a longitudinal portion and/or circumferential portion of the bore of the housing. For example, two opposite induction coil devices incorporated each in a respective opposite cavity in the housing may thus be used. In this context, a heat-insulating portion, for example
10 an asbestos-containing and/or ceramic-containing portion, may be disposed between the induction coil devices and the surrounding material (goods) of the housing. By so doing, the induction coil devices may possibly heat and melt said object until being severed, but without the surrounding material of the housing being weakened or melting at the same time.

15 According to a first embodiment, the cutting device may also comprise at least one pipe ram disposed in said housing, and below the induction coil device;
- wherein said pipe ram is structured for optional activation and enclosing of the object when located vis-à-vis the pipe ram; and
- wherein the pipe ram is structured in a manner allowing it to be connected to at
20 least one power source for supply of activation power for said activation and enclosing.

By so doing, the pipe ram may be activated and caused to enclose a lower part of the object upon having severed, by means of the induction coil device, an overlying portion thereof from a lower part of the object.

According to an alternative, second embodiment, the cutting device may also comprise
25 at least one shear ram disposed in said housing and in vicinity of the induction coil device for cooperation therewith;
- wherein said shear ram is structured for optional activation and mechanical cutting of the object when located vis-à-vis the shear ram: and
- wherein the shear ram is structured in a manner allowing it to be connected to at
30 least one power source for supply of activation power for said activation and mechanical cutting.

By disposing at least one shear ram in vicinity of the induction coil device and also activating said shear ram upon having heated the object sufficiently, by means of the induction coil device, to weaken the object structurally, the shear ram and the induc-

tion coil device will cooperate and, hence, will contribute to a faster severing of the object than that of pure inductive severing of the object. For this reason, this second embodiment of the cutting device is also well suited for severing relatively massive objects in the bore of the housing.

- 5 In context of this second embodiment, the at least one shear ram may be disposed below and/or above the induction coil device.

According to this second embodiment, the cutting device may also comprise at least one pipe ram disposed in said housing, and below the shear ram;

- wherein said pipe ram is structured for optional activation and enclosing of the ob-
10 ject when located vis-à-vis the pipe ram; and
- wherein the pipe ram is structured in a manner allowing it to be connected to at least one power source for supply of activation power for said activation and enclosing.

- By so doing, the pipe ram may be activated and caused to enclose a lower part of the object upon having severed, by means of the induction coil device and possibly also
15 said shear ram, an overlying portion thereof from a lower part of the object.

- Further, said induction coil device may be structured so as to be radially movable relative to said bore. By so doing, the distance between the induction coil device and the object may be adjusted and, hence, may be adapted to the particular object in the bore. In this context, the induction coil device may be connected to a suitable moving
20 device, for example a suitable actuator, a hydraulic piston-and-cylinder arrangement or similar, which is connected to or incorporated in the housing. Such an adjustment possibility renders possible to position the induction coil device at an optimum distance from the object, thereby rendering possible to carry out the most efficient and fast heating of the object when required.

- 25 Yet further, the at least one induction coil device may also be structured so as to be replaceable, thereby allowing the induction coil device to be readily removed from the housing for repair or replacement. As such, the induction coil device may be releasably connected to the housing and possibly may be released and withdrawn from the housing, for example from the outside of the housing.

- 30 The cutting device may also be formed as at least one module structured for incorporation in said safety valve. By so doing, one module may be readily replaced with a corresponding module, if desirable or required.

According to a second aspect of the invention, a safety valve for a well is provided, wherein the safety valve is structured for severing a pipe-string-related object in the safety valve, and wherein the safety valve comprises a housing having a through bore structured for passing said object therethrough. The distinctive characteristic of the safety valve is that it comprises at least one induction coil device disposed in said housing, and around at least a portion of the bore of the housing;

- wherein said induction coil device is directed inwards in the direction of the bore;
- wherein the induction coil device is structured for optional, cutting-promoting heating, hence thermal structural weakening, of the object when located vis-à-vis the induction coil device;
- wherein the induction coil device is connected to at least one electric power source for supply of electric power for said heating; and
- wherein the housing comprises a heat-insulating portion disposed between the induction coil device and the housing.

In context of a hydrocarbon well, heating by means of such an induction coil device may, as mentioned, involve danger of explosion and/or danger of fire. This, however, may only occur if air/oxygen is supplied to the cutting device in the course of heating. Such a situation will not exist under water or in the event that the particular well is not producing hydrocarbons.

If said course of heating is carried out above water, and in context of a hydrocarbon well, danger of explosion and/or danger of fire may be avoided by enclosing, or enveloping, the present cutting device in a non-flammable means which ensures that air/oxygen is not supplied in the course of heating. For example, such a non-flammable means may be comprised of an air-tight receptacle enclosing at least the particular portion of the safety valve and being filled with e.g. water or a non-flammable gas, for example nitrogen, carbon dioxide and/or an inert gas. When required, it is even conceivable to envelope the safety valve, or the particular portion thereof, in such a gas being supplied from a suitable gas supply arrangement associated with the safety valve.

Furthermore, all comments regarding relevant features of the cutting device according to the first aspect of the invention also apply to the safety valve according to this second aspect of the invention.

According to a first embodiment of the safety valve, it may also comprise at least one pipe ram disposed in said housing, and below the induction coil device;

- wherein said pipe ram is structured for optional activation and enclosing of the ob-

ject when located vis-à-vis the pipe ram; and

- wherein the pipe ram is connected to at least one power source for supply of activation power for said activation and enclosing.

By so doing, the pipe ram may be activated and caused to enclose a lower part of the object upon having severed, by means of the induction coil device, an overlying portion thereof from a lower part of the object.

According to an alternative, second embodiment of the safety valve, it may also comprise at least one shear ram disposed in said housing and in vicinity of the induction coil device for cooperation therewith;

- wherein said shear ram is structured for optional activation and mechanical cutting of the object when located vis-à-vis the shear ram: and

- wherein the shear ram is connected to at least one power source for supply of activation power for said activation and mechanical cutting.

By disposing at least one shear ram in vicinity of the induction coil device and also activating said shear ram upon having heated the object sufficiently, by means of the induction coil device, to weaken the object structurally, the shear ram and the induction coil device will cooperate and, hence, will contribute to a faster severing of the object than that of pure inductive severing of the object. For this reason, this second embodiment of the cutting device is also well suited for severing relatively massive objects in the bore of the housing.

In context of this second embodiment of the safety valve, the at least one shear ram may be disposed below and/or above the induction coil device.

According to this second embodiment of the safety valve, it may also comprise at least one pipe ram disposed in said housing, and below the shear ram;

- wherein said pipe ram is structured for optional activation and enclosing of the object when located vis-à-vis the pipe ram; and

- wherein the pipe ram is connected to a power source for supply of activation power for said activation and enclosing.

By so doing, the pipe ram may be activated and caused to enclose a lower part of the object upon having severed, by means of the induction coil device and possibly also said shear ram, an overlying portion thereof from a lower part of the object.

Moreover, said power source for the shear ram and/or the pipe ram may comprise at least one hydraulic power source, for example a hydraulic power pack.

Further, the induction coil device may be structured so as to be radially movable relative to said bore. By so doing, the distance between the induction coil device and the object may be adjusted and, hence, may be adapted to the particular object in the bore. In this context, the induction coil device may be connected to a suitable moving
5 device, for example a suitable actuator, a hydraulic piston-and-cylinder arrangement or similar, which is connected to or incorporated in the housing. Such an adjustment possibility renders possible to position the induction coil device at an optimum distance from the object, thereby rendering possible to carry out the most efficient and fast heating of the object when required.

10 Yet further, the at least one induction coil device may also be structured so as to be replaceable, thereby allowing the induction coil device to be readily removed from the housing for repair or replacement. As such, the induction coil device may be releasably connected to the housing and possibly may be released and withdrawn from the housing, for example from the outside of the housing.

15 Furthermore, at least said induction coil device may be incorporated as a module in the safety valve. By so doing, one module may be readily replaced with a corresponding module, if desirable or required.

The safety valve may also comprise at least one shut-off valve for said bore, wherein the shut-off valve is disposed above the induction coil device. By so doing, the bore of
20 the safety valve may be shut off upon severing and withdrawing an upper part of the object. For example, said shut-off valve may comprise a ball valve.

Further, the object may be comprised of a tubular object, for example a well pipe or a well tool.

Yet further, the safety valve may be comprised of a blowout preventer ("BOP"), or of a
25 Christmas tree.

According to a third aspect of the invention, a method is provided for severing a pipe-string-related object in a safety valve for a well, wherein the safety valve comprises a housing having a through bore structured for passing the object therethrough. The distinctive characteristic of the method is that it comprises the following steps:

- 30 (A) disposing at least one induction coil device in said housing, and around at least a portion of the bore of the housing, the housing also comprising a heat-insulating portion located between the induction coil device and the housing;
- (B) structuring the induction coil device for optional, cutting-promoting heating, hence thermal structural weakening, of the object;

(C) connecting the induction coil device to at least one electric power source for supply of electric power for said heating; and

(D) for severing the object when located in the safety valve vis-à-vis the induction coil device, activating the induction coil device and heating the object until at least one of the following two conditions exist:

- the object melts and is separated into an upper part and a lower part; and
- the object is sufficiently weakened thermally and structurally to allow at least one shear ram in the safety valve to sever the object and separate it into an upper part and a lower part.

Further, the present method may also comprise the following steps:

(E) withdrawing the upper part of the object from the safety valve; and

(F) then shutting off the safety valve by means of at least one shut-off valve disposed above the induction coil device in the safety valve.

All comments from the above-mentioned cutting device and safety valve according to the first and second aspects of the invention also apply to the present method.

Further, and according to a fourth aspect of the invention, a use of a cutting device according to the first aspect of the invention is provided for severing a pipe-string-related object in a safety valve for a well.

Yet further, and according to a fifth aspect of the invention, a use of a safety valve according to the second aspect of the invention is provided for severing a pipe-string-related object in the safety valve.

Finally, and according to a sixth aspect of the invention, a use of a method according to the third aspect of the invention is provided for severing a pipe-string-related object in a safety valve for a well.

Short mentioning of figures of the exemplary embodiment

Hereinafter, a non-limiting exemplary embodiment of a safety valve for a well will be shown, wherein the safety valve is formed according to the second aspect of the invention. This well safety valve comprises a cutting device according to the first aspect of the invention. This exemplary embodiment describes a preferred embodiment depicted in the accompanying drawings, where:

Figure A1 shows a very schematic front elevation and vertical section through a safety valve according to the invention, wherein the figure shows a well pipe disposed in a through bore in the safety valve, wherein the figure

also shows (with a dashed line) a section window of a cutting device, which is shown in larger scale in Figures A2-A4, and wherein the cutting device is provided with an induction coil device (not shown) and a shear ram with opposite cutting knives (not shown);

5 Figure A2 shows the induction coil device of the cutting device upon having been activated and in the process of heating the well pipe;

Figure A3 shows the following step of the severing operation, wherein the shear ram of the cutting device also has been activated and has severed the well pipe by means of its two opposite cutting knives;

10 Figure A4 shows the last step of the severing operation, wherein the induction coil device and the shear ram of the cutting device have been deactivated, and each of said cutting knives has been withdrawn into a respective cylinder housing in the housing (material goods) of the safety valve;

15 Figure B1 shows the safety valve according to Figure A1, but wherein Figure B1 instead shows (with a dashed line) a horizontal section line B2 through the cutting device;

Figure B2 shows, in larger scale, the cutting device as viewed along the above-mentioned horizontal section line B2, wherein the cutting device is shown in a deactivated state before severing of said well pipe; and

20 Figure B3 shows, also in larger scale, the cutting device as viewed along the above-mentioned horizontal section line B2, but wherein the cutting device now is shown upon having been activated, and upon having conducted the opposite cutting knives of the shear ram toward each other so as to sever the well pipe.

25 As mentioned, the figures are very schematic and only show details and equipment being essential to the understanding of the invention. Further, the figures are much distorted with respect to the relative dimensions of details and components shown in the figures. The figures are also very simplified with respect to the shape and richness of detail of such details and components. Hereinafter, equal, equivalent or corresponding details in the figures will be denoted substantially with the same reference numerals.

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Special description of the exemplary embodiment

Figure A1 shows a vertical section through a safety valve according to the invention. In this embodiment, the safety valve is comprised of a blowout preventer 2, i.e. a so-called "BOP", for a subsea well 4. The blowout preventer 2 is mounted on top of a wellhead 6 placed on a seabed 8. Further, the blowout preventer 2 is connected to, and is controlled from, an installation (not shown) on the surface (not shown). The blowout preventer 2 receives control signals, hydraulic power and electric power from said installation.

The blowout preventer 2 comprises a massive housing 10 having a through bore 12 connected to the well 4. Yet further, Figure A1 shows a well pipe 14, for example a drill string or a production tubing, conducted through the bore 12 in the housing 10 of the blowout preventer 2. In addition, the blowout preventer 2 comprises a cutting device 16 according to the invention. In this embodiment, the cutting device 16 is incorporated as a module 18 in the blowout preventer 2, the module 18 being shown only as a dashed section window in Figure A1. This exemplary embodiment is meant to illustrate the manner in which the well pipe 14 may be severed both quickly and efficiently by means of the cutting device 16 in the blowout preventer 2.

Accordingly, the cutting device 16 comprises an induction coil device 20 disposed in a peripheral groove 22 in an annular area 24 of the housing 10, wherein the area 24 is located around the bore 12. This annular area 24 of the housing 10 also comprises a heat-insulating portion (not shown) formed from a heat-resistant material, for example asbestos or ceramics. Further, the groove 22 and the induction coil device 20 are directed inwards in the direction of the bore 12. For supply and control of electric power when required, the induction coil device 20 is connected to electric wires 26 conducted through the wall of the housing 10, the wires of which are connected, via a suitable cable (not shown), to said installation. As an alternative or addition, the electric power supply may comprise a battery pack (not shown) disposed on, or in vicinity of, the blowout preventer 2. Yet further, the induction coil device 20 is structured for optional, cutting-promoting heating, hence thermal structural weakening, of (in this case) the well pipe 10 when located vis-à-vis the induction coil device 20.

In this embodiment, the cutting device 16 also comprises a shear ram 28 disposed immediately below the induction coil device 20. The shear ram 28 comprises two opposite cutting knives 30a and 30b disposed each in a radially movable manner in a respective opposite cylinder housing 32a and 32b in the massive housing 10 (material goods) of the blowout preventer 2. As shown in Figures A2-A4, the shear ram 28 is

disposed in immediate vicinity of the induction coil device 20, thereby allowing it to cooperate with the induction coil device 20 during severing of the well pipe 14. Each cutting knife 30a, 30b is connected to a hydraulic piston-and-cylinder arrangement (not shown) disposed in each cylinder housing 32a, 32b. For control and supply of hydraulic power when required, and via suitable hydraulic lines (not shown), each piston-and-cylinder arrangement is connected to said installation. As an alternative or addition, the hydraulic power supply may comprise at least one hydraulic power supply unit/-pack (not shown) disposed on, or in vicinity of, the blowout preventer 2. Yet further, the shear ram 28 is structured for optional activation and mechanical cutting of the well pipe 10 when located vis-à-vis the shear ram 28 which, accordingly, is placed in immediate vicinity of the induction coil device 20. In inactive position, each of the opposite cutting knives 30a, 30b of the shear ram 28 are disposed within a respective recess 34 in the wall of the housing 10 surrounding the bore 12 in the blowout preventer 2, as shown in Figures A1, A2, A4 and B2. In active position, however, the cutting knives 30a, 30b are pushed out from their recesses 34 and are disposed with their knife blades and knife edges toward each other at the centre of the bore 12, as shown in Figures A3 and B3. In this embodiment, the rectilinear knife blades of the cutting knives 30a, 30b have a width exceeding the outer diameter of the well pipe 14 (cf. Figure B3), whereby the cutting knives 30a, 30b may sever the complete well pipe 14 when required. Each cutting knife 30a, 30b also has a relatively pointy and V-shaped knife edge aligned, in the horizontal plane, with the opposite knife edge, as shown in Figure A3. Moreover, other knife blade configurations and/or knife edge configurations may be used. In this respect, there are many examples to be found from known cutting devices for well safety valves; cf. the above-mentioned patent publications. Further, opposite cutting knives having knife blades formed in a complementary manner with respect to each other may be used, for example. Opposite cutting knives having knife blades formed in a non-complementary manner with respect to each other may also be used, for example V-shaped knife blades directed toward each other. Further, and as an addition or alternative, opposite cutting knives displaced parallel to each other may be used, hence cutting/clipping off the particular pipe-string-related object, for example the well pipe 14.

In this embodiment, the blowout preventer 2 also comprises several pipe rams 36 disposed in the massive housing 10, and below the shear ram 28. These pipe rams 36 are structured for optional activation and enclosing of the well pipe 14 when located vis-à-vis the pipe rams 36. Also these pipe rams 36 are connected, via suitable hydraulic lines (not shown), to said installation and a possible hydraulic power supply

unit/-pack (not shown) on/at the blowout preventer 2 for control and supply of hydraulic power when required.

The blowout preventer 2 also comprises at least one shut-off valve (not shown), for example a ball valve, for the bore 12 in the massive housing 10. Said shut-off valve is disposed above the cutting device 16, thereby allowing the bore 12 to be shut off upon severing and withdrawing an upper part 38 of the well pipe 14, whereas a lower part 40 of the well pipe 14 will be located below the cutting device 16.

Hereinafter, severing the well pipe 14 by means of the present cutting device 16 will be described in further detail.

When severing the well pipe 14 by means of this cutting device 16 is required, at first the induction coil device 20 is activated and heats the well pipe 14 until it is significantly weakened structurally via the heating. This heating step is shown in Figure A2. Upon sufficient heating and structural weakening of the well pipe 14, a hydraulic piston (not shown) in each of the opposite cylinder housings 32a, 32b is then activated and drives the opposite cutting knives 30a, 30b against each other and through the heated, structurally weakened well pipe 14 until the cutting knives 30a, 30b abut each other and sever the well pipe 14 into said upper part 38 and lower part 40. This cutting step is shown in Figures A3 and B3. Then the cutting knives 30a, 30b may be withdrawn toward their respective cylinder housings 32a, 32b, as shown in Figure A4, and the upper part 38 of the well pipe 14 is pulled out of the bore 12 and the blowout preventer 2. Finally, said shut-off valve (not shown) in the blowout preventer 2 may be closed, thereby closing the blowout preventer 2 completely. During the mechanical severing of the well pipe 14, the induction coil device 20 may become damaged completely or partially. This is shown in Figure B3. In this embodiment, however, the induction coil device 20 is structured so as to be replaceable (not shown), thereby allowing the induction coil device 20 to be readily removed from the housing 10 for repair or replacement.

P a t e n t c l a i m s

1. A cutting device (16) for severing a pipe-string-related object (14) in a safety valve (2) for a well (4), wherein the cutting device (16) is structured for incorporation in the safety valve (2), and wherein the cutting device (16) comprises a housing (10) having a through bore (12) structured for passing said object (14) therethrough, c h a r a c t e r i z e d i n that the cutting device (16) comprises at least one induction coil device (20) disposed in said housing (10), and around at least a portion of the bore (12) of the housing (10);
- wherein said induction coil device (20) is directed inwards in the direction of the bore (12);
- wherein the induction coil device (20) is structured for optional, cutting-promoting heating, hence thermal structural weakening, of the object (14) when located vis-à-vis the induction coil device (20);
- wherein the induction coil device (20) is structured in a manner allowing it to be connected to at least one electric power source for supply of electric power for said heating; and
- wherein the housing (10) comprises a heat-insulating portion disposed between the induction coil device (20) and the housing (10).
2. The cutting device (16) according to claim 1, c h a r a c t e r i z e d i n that the cutting device (16) also comprises at least one pipe ram (36) disposed in said housing (10), and below the induction coil device (20);
- wherein said pipe ram (36) is structured for optional activation and enclosing of the object (14) when located vis-à-vis the pipe ram (36); and
- wherein the pipe ram (36) is structured in a manner allowing it to be connected to at least one power source for supply of activation power for said activation and enclosing.
3. The cutting device (16) according to claim 1, c h a r a c t e r i z e d i n that the cutting device (16) also comprises at least one shear ram (28) disposed in said housing (10) and in vicinity of the induction coil device (20) for co-operation therewith;
- wherein said shear ram (28) is structured for optional activation and mechanical cutting of the object (14) when located vis-à-vis the shear ram (28); and
- wherein the shear ram (28) is structured in a manner allowing it to be connected to at least one power source for supply of activation power for said activation and mechanical cutting.

4. The cutting device (16) according to claim 3, c h a r a c t e r i z e d i n that the cutting device (16) also comprises at least one pipe ram (36) disposed in said housing (10), and below the shear ram (28);
- wherein said pipe ram (36) is structured for optional activation and enclosing of the object (14) when located vis-à-vis the pipe ram (36); and
- wherein the pipe ram (36) is structured in a manner allowing it to be connected to at least one power source for supply of activation power for said activation and enclosing.
5. The cutting device (16) according to any one of claims 1-4, c h a r a c - t e r i z e d i n that the induction coil device (20) is structured so as to be radially movable relative to said bore (12), thereby allowing the distance between the induction coil device (20) and the object (14) to be adjusted.
6. The cutting device (16) according to any one of claims 1-5, c h a r a c - t e r i z e d i n that the cutting device (16) is formed as at least one module (18) structured for incorporation in said safety valve (2).
7. A safety valve (2) for a well (4), wherein the safety valve (2) is structured for severing a pipe-string-related object (14) in the safety valve (2), and wherein the safety valve (2) comprises a housing (10) having a through bore (12) structured for passing said object (14) therethrough, c h a r a c t e r i z e d i n that the safety valve (2) comprises at least one induction coil device (20) disposed in said housing (10), and around at least a portion of the bore (12) of the housing (10);
- wherein said induction coil device (20) is directed inwards in the direction of the bore (12);
- wherein the induction coil device (20) is structured for optional, cutting-promoting heating, hence thermal structural weakening, of the object (14) when located vis-à-vis the induction coil device (20);
- wherein the induction coil device (20) is connected to at least one electric power source for supply of electric power for said heating; and
- wherein the housing (10) comprises a heat-insulating portion disposed between the induction coil device (20) and the housing (10).
8. The safety valve (2) according to claim 7, c h a r a c t e r i z e d i n that the safety valve (2) also comprises at least one pipe ram (36) disposed in said housing (10), and below the induction coil device (20);
- wherein said pipe ram (36) is structured for optional activation and enclosing of

the object (14) when located vis-à-vis the pipe ram (36); and

- wherein the pipe ram (36) is connected to at least one power source for supply of activation power for said activation and enclosing.

9. The safety valve (2) according to claim 7, c h a r a c t e r i z e d i n
5 that the safety valve (2) also comprises at least one shear ram (28) disposed in said housing (10) and in vicinity of the induction coil device (20) for cooperation therewith;

- wherein said shear ram (28) is structured for optional activation and mechanical cutting of the object (14) when located vis-à-vis the shear ram (28); and

10 - wherein the shear ram (28) is connected to at least one power source for supply of activation power for said activation and mechanical cutting.

10. The safety valve (2) according to claim 9, c h a r a c t e r i z e d i n
that the safety valve (2) also comprises at least one pipe ram (36) disposed in said housing (10), and below the shear ram (28);

15 - wherein said pipe ram (36) is structured for optional activation and enclosing of the object (14) when located vis-à-vis the pipe ram (36); and

- wherein the pipe ram (36) is connected to a power source for supply of activation power for said activation and enclosing.

11. The safety valve (2) according to any one of claims 7-10, c h a r a c t e r -
20 i z e d i n that the induction coil device (20) is structured so as to be radially movable relative to said bore (12), thereby allowing the distance between the induction coil device (20) and the object (14) to be adjusted.

12. The safety valve (2) according to any one of claims 7-11, c h a r a c t e r -
25 i z e d i n that at least said induction coil device (20) is incorporated as a module (18) in the safety valve (2).

13. The safety valve (2) according to any one of claims 7-12, c h a r a c t e r -
i z e d i n that the safety valve (2) also comprises at least one shut-off valve for said bore (12), wherein the shut-off valve is disposed above the induction coil device (20), thereby allowing the bore (12) of the safety valve (2) to be
30 shut off upon severing and withdrawing an upper part of the object (14).

14. The safety valve (2) according to any one of claims 7-13, c h a r a c t e r -
i z e d i n that the safety valve (2) is comprised of a blowout preventer.

15. The safety valve (2) according to any one of claims 7-13, c h a r a c t e r -
i z e d i n that the safety valve (2) is comprised of a Christmas tree.
16. A method for severing a pipe-string-related object (14) in a safety valve (2) for a
well (4), wherein the safety valve (2) comprises a housing (10) having a through
5 bore (12) structured for passing the object (14) therethrough, c h a r a c -
t e r i z e d i n that the method comprises the following steps:
(A) disposing at least one induction coil device (20) in said housing (10),
and around at least a portion of the bore (12) of the housing (10), the housing
(10) also comprising a heat-insulating portion located between the induction coil
10 device (20) and the housing (10);
(B) structuring the induction coil device (20) for optional, cutting-
promoting heating, hence thermal structural weakening, of the object (14);
(C) connecting the induction coil device (20) to at least one electric
power source for supply of electric power for said heating; and
15 (D) for severing the object (14) when located in the safety valve (2) vis-
à-vis the induction coil device (20), activating the induction coil device (20) and
heating the object (14) until at least one of the following two conditions exist:
- the object (14) melts and is separated into an upper part (38) and a lower
part (40); and
20 - the object (14) is sufficiently weakened thermally and structurally to allow
at least one shear ram (28) in the safety valve (2) to sever the object (14) and
separate it into an upper part (38) and a lower part (40).
17. The method according to claim 16, c h a r a c t e r i z e d i n that the
method also comprises the following steps:
25 (E) withdrawing the upper part (38) of the object (14) from the safety
valve (2); and
(F) then shutting off the safety valve (2) by means of at least one shut-
off valve disposed above the induction coil device (20) in the safety valve (2).
18. Use of a cutting device (16) according to any one of claims 1-6 for severing a
30 pipe-string-related object (14) in a safety valve (2) for a well (4).
19. Use of a safety valve (2) according to any one of claims 7-15 for severing a pipe-
string-related object (14) in the safety valve (2).
20. Use of a method according to claim 16 or 17 for severing a pipe-string-related
object (14) in a safety valve (2) for a well (4).