June 9, 1959 A. B. HILDEBRANDT 2,889,885

UNDERWATER CONTROL OF WILD WELLS

Filed Oct. 25, 1955 4 Sheets-Sheet 1

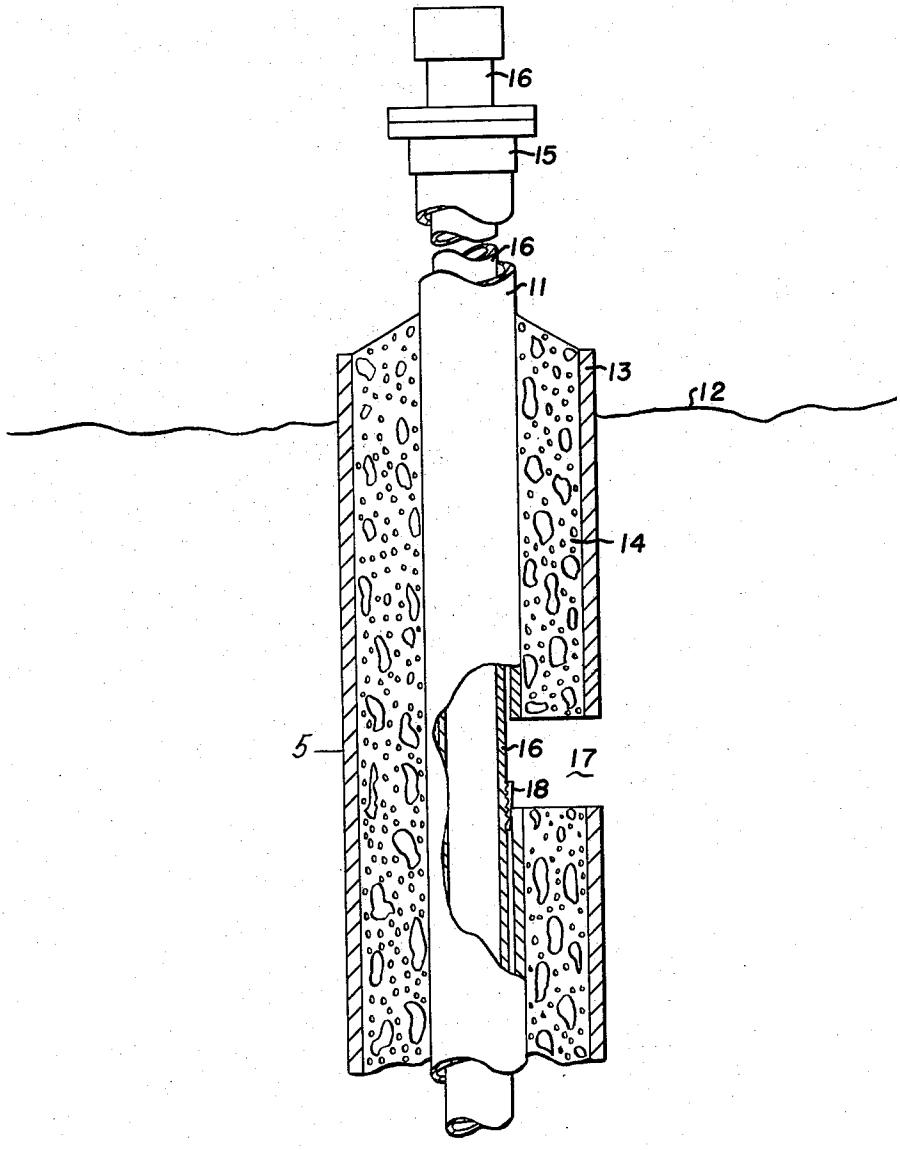


FIG.-1

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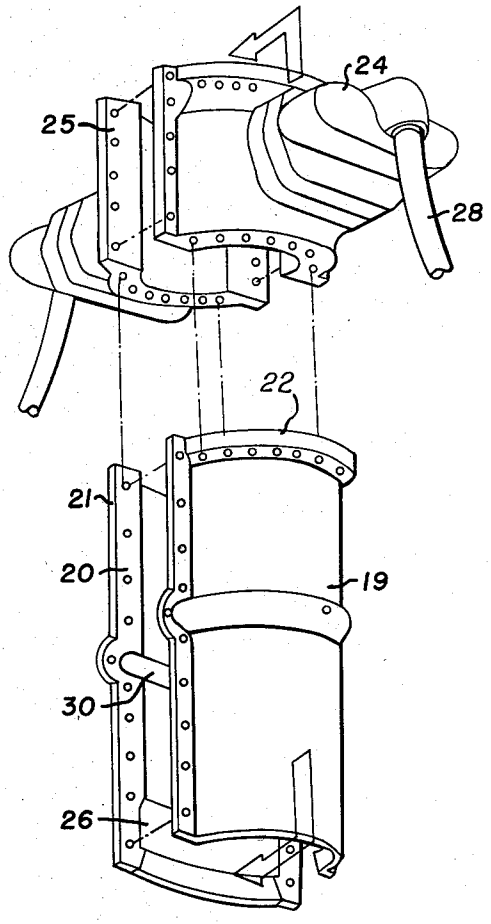


FIG.-2

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UNDERWATER CONTROL OF WILD WELLS

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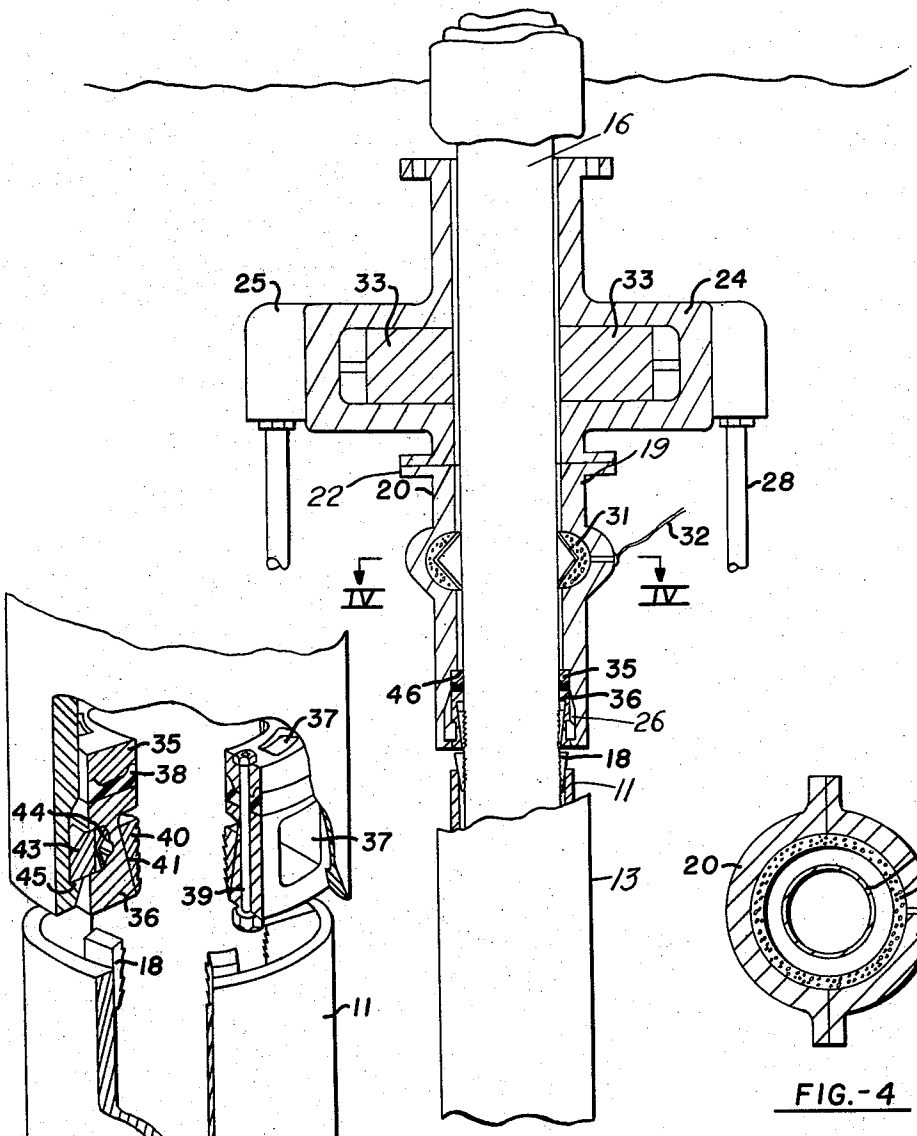


FIG.-3

FIG.-5

FIG.-4

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UNDERWATER CONTROL OF WILD WELLS

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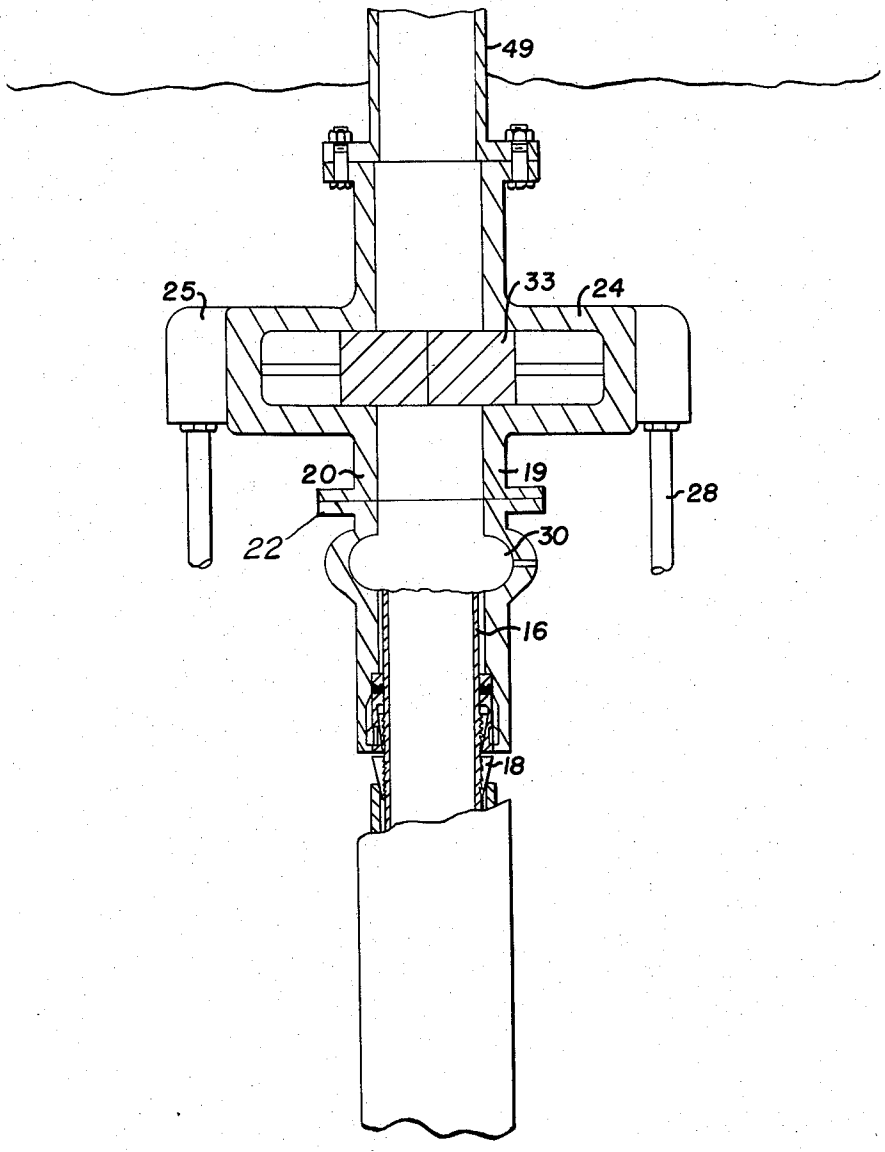


FIG. - 6

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UNDERWATER CONTROL OF WILD WELLS

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Application October 25, 1955, Serial No. 542,639

2 Claims. (Cl. 166—55)

The present invention concerns novel methods and apparatus for closing off a wild petroleum well in a marine location. In particular the invention is concerned with the bringing of such a well under control while working completely under water so as to reduce or eliminate the fire hazard.

A danger always exists with high pressure producing wells in that such wells may get out of control and cannot then be closed off with the equipment present at the well site. Such wells may get out of control when being drilled or repaired as a result, for example, of the pressure control equipment becoming damaged or broken off. The consequence is that the pressure can no longer be confined, permitting the escape of gas and oil with the accompanying hazards of fire and danger to human life and surrounding property as well as the economic waste of the escaping natural resources. The danger of well blowouts is particularly great in marine locations where damage to control equipment may occur as a result of collision by barges or other vessels or as a result of casing failure caused by corrosion. Control of a wild well in off-shore locations is particularly difficult not only because of the numerous maneuvers required but also because the danger of fire is much greater than with a land location, it being much more difficult to cope with fire once it has started. Hence it is highly desirable to bring a marine well under control with a minimum of exposure to fire hazards and this can be done most effectively by carrying out the operations beneath the surface of the water.

It is an object of this invention to provide suitable methods and apparatus for bringing a wild marine well under control while working completely under water and at the same time making provision for re-entering the casing so that the well can be subsequently worked over.

In accordance with this invention a split cylindrical housing is provided which can be attached to a submerged section of the well casing and to which a specially designed blowout preventer is attached. Shaped explosive charges positioned within the cylindrical housing can be detonated to sever the casing above the point of attachment of the housing to the casing so that the severed casing can be blown free of the blowout preventer by the force of the fluids escaping through the casing after which the rams of the blowout preventer can be closed to shut in the well.

The nature and objectives of this invention will be more readily understood when reference is made to the accompanying drawings in which:

Figure 1 is an elevational view in section showing the concentric strings of casing emerging from the well and illustrating the manner in which preparation is made to use the apparatus of this invention;

Figure 2 is an exploded perspective view of the several sections of the apparatus prior to assembly about the well casing;

Figure 3 is an elevational view in section showing the apparatus in place;

Figure 4 is a cross section taken on line IV—IV of Figure 3;

Figure 5 is a perspective view, partly in section, of a portion of the apparatus of Figure 3, showing details of the slip and seal assembly; and

Figure 6 is an elevational view similar to Figure 3 showing the well casing and apparatus after the explosive charges have been detonated and the blowout preventer rams have been closed.

With particular reference to Figure 1, a portion of a well in a marine installation is shown in sectional elevation. The well has three concentric strings of casing **11**, **13** and **16** extending out of a lake bed to a region above the surface of the water **12**. The surface casing **11** is surrounded by an outer casing or conductor pipe **13** and the annulus between the surface casing and the conductor pipe is filled with cement **14**, which is common practice for wells in marine installations in order to prevent salt water attack on the surface casing. An inner string of casing **16** is supported within the surface casing by a casing head **15**. Fluids are escaping from the wild well from the inner casing **16**.

As a first step in the practice of the present invention it is necessary for a diver to descend below the surface of the water and cut through the conductor pipe, cement and surface casing, as for example at point **5**, and insert a plurality of slips **18** to support the inner string of casing **16** below the point at which the casing **16** will subsequently be severed. As shown in Figure 1, the outer strings of casing will be cut away a portion at a time, for example over each fourth of the circumference, and then one of the slips **18** will be inserted through the hole **17** and between the casing **16** and **11**. The outer strings of casings **11** and **13** will then be cut away for an appreciable distance above the slips **18** as is shown in Figure 3 and then the assembly of cylindrical housing and blowout preventers about to be described will be attached to the inner string of casing. A portion of the outer casing **13** below the slips **18** may also be removed as in Figure 3 to facilitate subsequent operations.

Referring now to Figure 2, the apparatus that is attached to the inner casing is illustrated in exploded perspective. A cylindrical housing is provided that is made up of at least two circumferentially separable sections **19** and **20** that can be fastened together by means of bolts inserted through the holes in the flanges **21**. The housing has an upwardly facing flange **22** at its upper end to which a blowout preventer arrangement may be attached. The blowout preventer is of a conventional hydraulically operated type, but is separable into at least two circumferentially separable sections **24** and **25**, which may be fastened together by the flanges provided. Conveniently the apparatus may be attached to the casing **16** by assembling the apparatus into separate halves; thus one half **24** of a blowout preventer may be attached to one half **19** of the cylindrical housing and the other blowout preventer half **25** attached to housing section **20**. The two halves of the assembled device can then be lowered into place on opposite sides of the casing **16**, fastened together about the casing and then supported on the casing by a specially designed hold down and seal arrangement that fits within the housing adjacent the recess **26**. Details of this arrangement are explained below in connection with Figure 5. It is preferred to use such an arrangement rather than to fasten the housing to the casing by welding in view of the dangers inherent in the latter procedure.

A recess **30** in the cylindrical housing receives a shaped explosive charge **31** which, as is shown in Figure 3 as

well as in Figure 4, is distributed circumferentially within the housing and is arranged to be detonated by the electrical leads **32**. The shaped charge will of course be suitably positioned within the recess to provide proper standoff distance and cushioning space in accordance with accepted practice. After the apparatus has been fastened in place, the charge may be detonated, thus shearing the inner casing **16** which will be carried up out of the housing by the force of the escaping fluids.

The details of the arrangement for anchoring the blowout preventer housing to the production casing can be seen by reference to Figure 5. The mechanism comprises an upper flat ring **35** and a lower flat ring **36** between which is sandwiched a flat ring-shaped seal **38** of resilient packing material. The rings, which are initially in separate halves, are assembled about the casing and are drawn together by bolts **39** to compress the packing for a tight seal. Preferably the rings **35** and **36** contain cut-out areas **37** to minimize their weight.

The inner bore of ring **36** is provided with a downward and inward taper **41** against which slips **40** are wedged to force them tightly against casing **16** when an upward force is exerted on the assembly. An upward thrust on the blowout preventer housing is transmitted to the ring assembly by the dogs **43** which are urged into recess **26** by the springs **44**, the dogs bearing against upward facing shoulder **45**. The weight of the blowout preventer housing is supported by downward facing shoulder **46** resting on the ring assembly. The ring assembly in turn is supported by the slips **18** as when the upward fluid thrust against the rams **33** is insufficient to support the weight of the preventer and housing assemblies.

To recapitulate briefly, the present invention is carried out as shown in Figure 1, at point **5**, by first cutting through the outer strings of casing **11** and **13** as well as the cement between these strings. This operation is performed in steps, and slips **18** are wedged between the casing strings **16** and **11** so that the casing **16** is fully supported at all times.

Next, the portions of the outer strings of casings **11** and **13** and the intermediate cement above and about point **5** are removed from the inner casing **16** as by means of cutting and chipping operations. The inner casing **16** is then in a condition suitable for receiving the blowout preventer and housing sections, which are assembled and attached as described hereinbefore.

After the apparatus has been fastened in place the shaped charges are detonated, thus shearing off the inner casing **16** which will then be blown up out of the housing by the force of the escaping fluids. Pressure is then applied through the high pressure hose **28** to close the rams **33** of the blowout preventer, thus bring the well under control. After the well has been closed in, a surface connection **49** is connected to the top of the assembly as shown in Figure 6. Suitable well killing fluids can then be injected into the well under pressure.

In place of shaped charges it is also within the contemplation of this invention to employ chemical cutting procedures for severing the inner casing, utilizing halogen fluorides in the manner described in Chemical and Engineering News, vol. 33, page 3395 (August 15, 1955), which would merely require that the housing **19**, **20** be modified slightly to hold the fluoride pressure chamber and the necessary propellant.

It is not intended that this invention be limited to the specific embodiments described herein as many modifications thereof are possible without departing from the spirit and scope of the invention.

What is claimed is:

1. An apparatus for closing off the flow of fluids through the innermost string of casing in a well having at least two strings of casing, which comprises a cylindrical housing separable circumferentially into at least two sections and adapted to fit around the innermost casing, a blowout preventer separable circumferentially into at least two sections and adapted to fit around said innermost casing, means for fastening the sections of said housing together, means for fastening said preventer sections together, means for fastening the lower end of said preventer to the upper end of said housing when both are fitted around the innermost casing, a circumferential recess in the inner wall surface of said cylindrical housing at a point near the lower end of the housing, a slip and seal assembly positioned within said recess and adapted to restrain said housing from moving upward relative to said innermost casing, a plurality of slips insertable between said innermost casing and the next outer casing so as to support said inner casing from said next outer casing, said plurality of slips being located below the housing and having an outer diameter at least as great as the inner diameter of said housing, said plurality of slips being adapted to limit downward movement of said cylindrical housing relative to said innermost casing, cutting means supported within said housing above said slips and seal assembly for severing said innermost casing above said assembly.

2. An apparatus as defined by claim 1 in which the cutting means comprises a shaped explosive charge distributed circumferentially within the housing.

References Cited in the file of this patent

UNITED STATES PATENTS

1,802,565	Lacey	Apr. 28, 1931
1,949,672	Barrier	Mar. 6, 1934
2,587,244	Sweetman	Feb. 26, 1952
2,621,895	Toelke	Dec. 16, 1952