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Garrett

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[54] **WELL BORE BLOCKING METHOD**

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Related U.S. Application Data

[62] Division of Ser. No. 55,439, July 16, 1970, Pat. No. 3,684,008.

[52] **U.S. Cl.** **166/297,** 166/299

[51] **Int. Cl.** **E21b 29/02**

[58] **Field of Search** 166/55, 55.1, 297, 166/299, 63, 75

[56] **References Cited**

UNITED STATES PATENTS

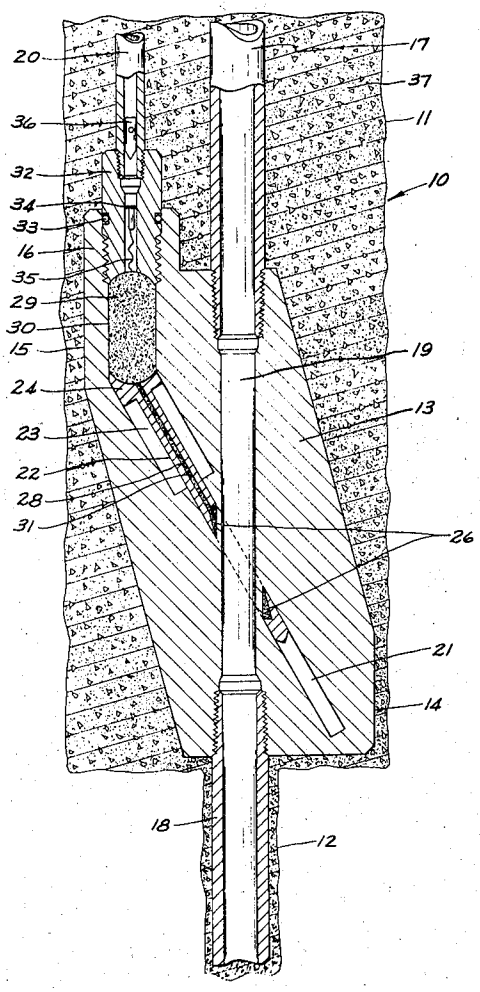
1,851,894	3/1932	Clough	166/55
3,590,920	7/1971	Orund et al	166/55
3,603,387	9/1971	Schoeffler	166/55

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Attorney—Ralph R. Browning

[57] **ABSTRACT**

A blow-out preventer comprising a relatively large body means which is placed in a well bore. The body means is provided with a bore through which drill pipe and the like can extend. Traversing the bore through the body is a slideway in which is mounted a slide or blocking means. Using a suitable means of propulsion, the slide or blocking means can be moved from a position from within the slideway of non-engagement with the bore extending through the body to a position where the slide completely intersects or blocks the bore in the body. The propulsion means can be activated automatically or manually from the surface or automatically from below the surface. When the blow-out preventer is used in well bores wherein drill strings or production tubing extend through the body, the apparatus is provided with a severing means which first acts to sever the pipe extending through the bore at which point the slide or blocking means is forced through the space between the severed end to completely seal off the well bore. In cases where no drill pipe or the like extends through the bore of the body means, the severing means can be dispensed with and the well bore blocked off simply by propelling the slide into the closed position, i.e. intersecting the bore.

5 Claims, 6 Drawing Figures



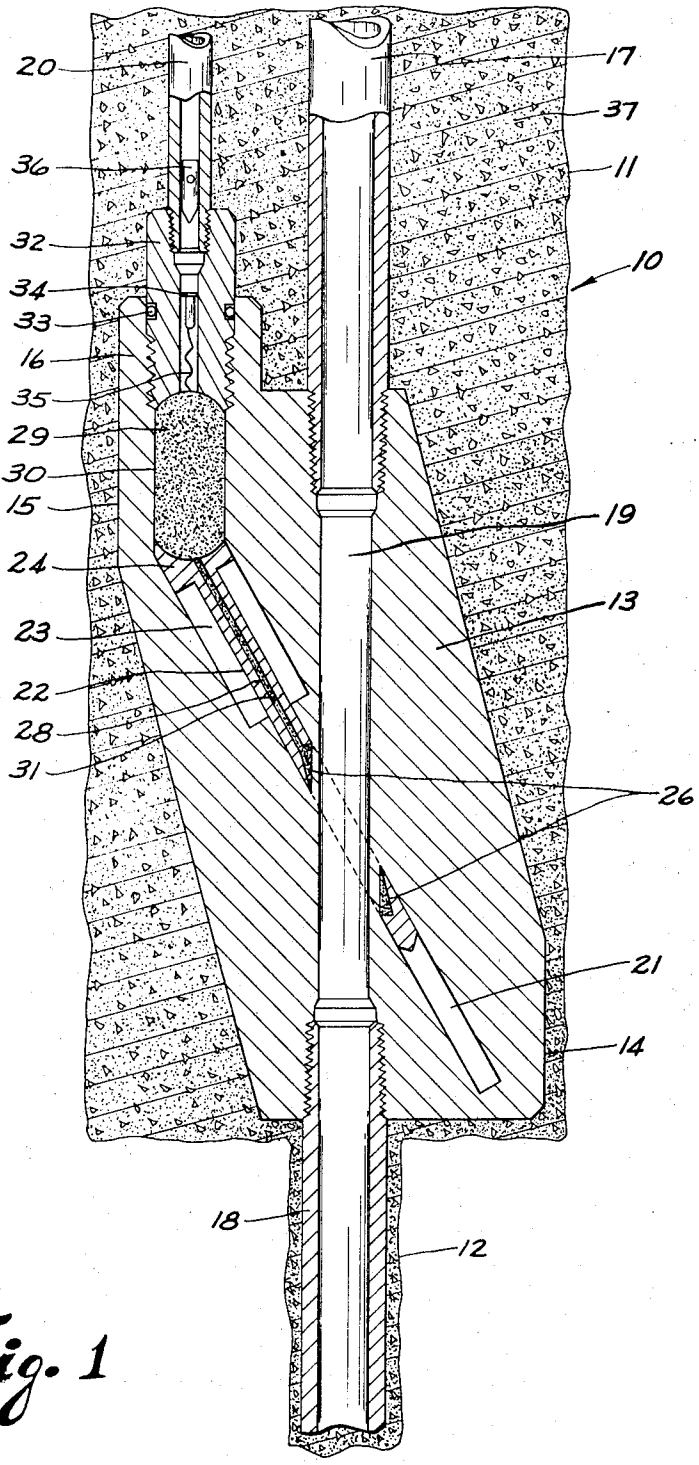

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Fig. 1

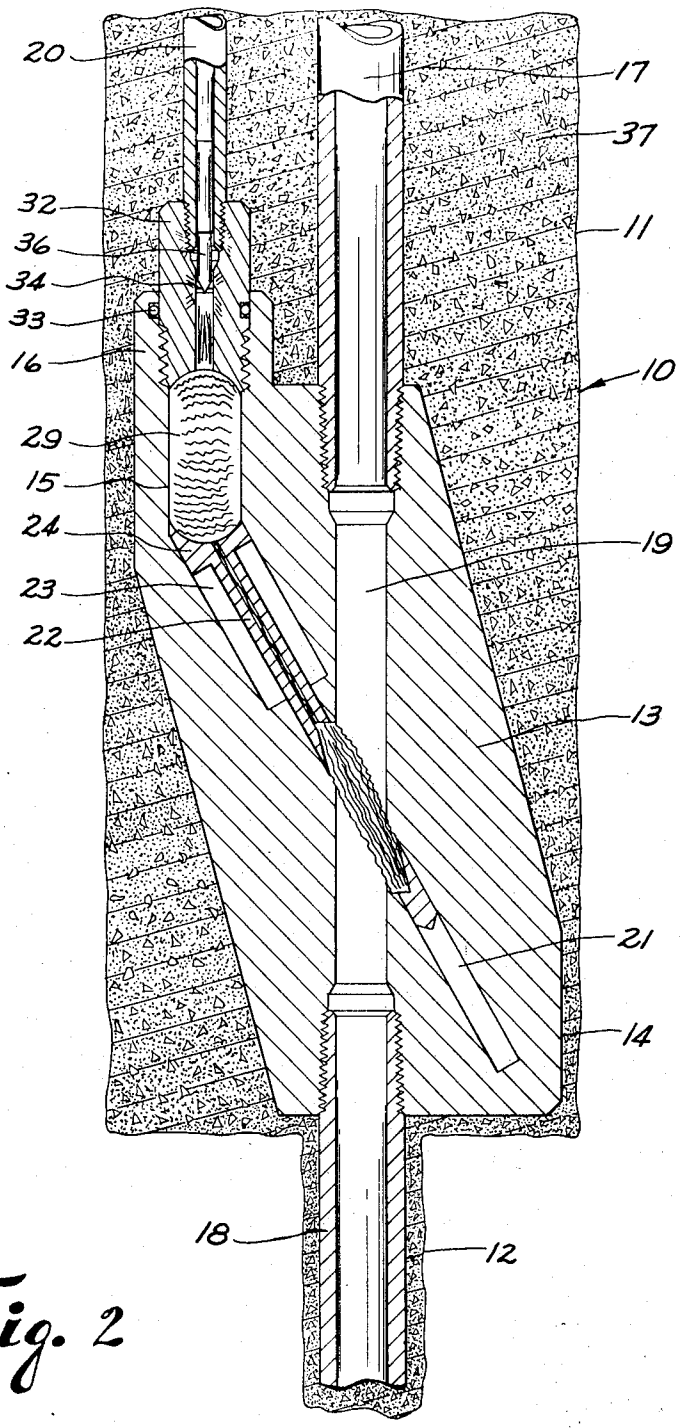


Fig. 2

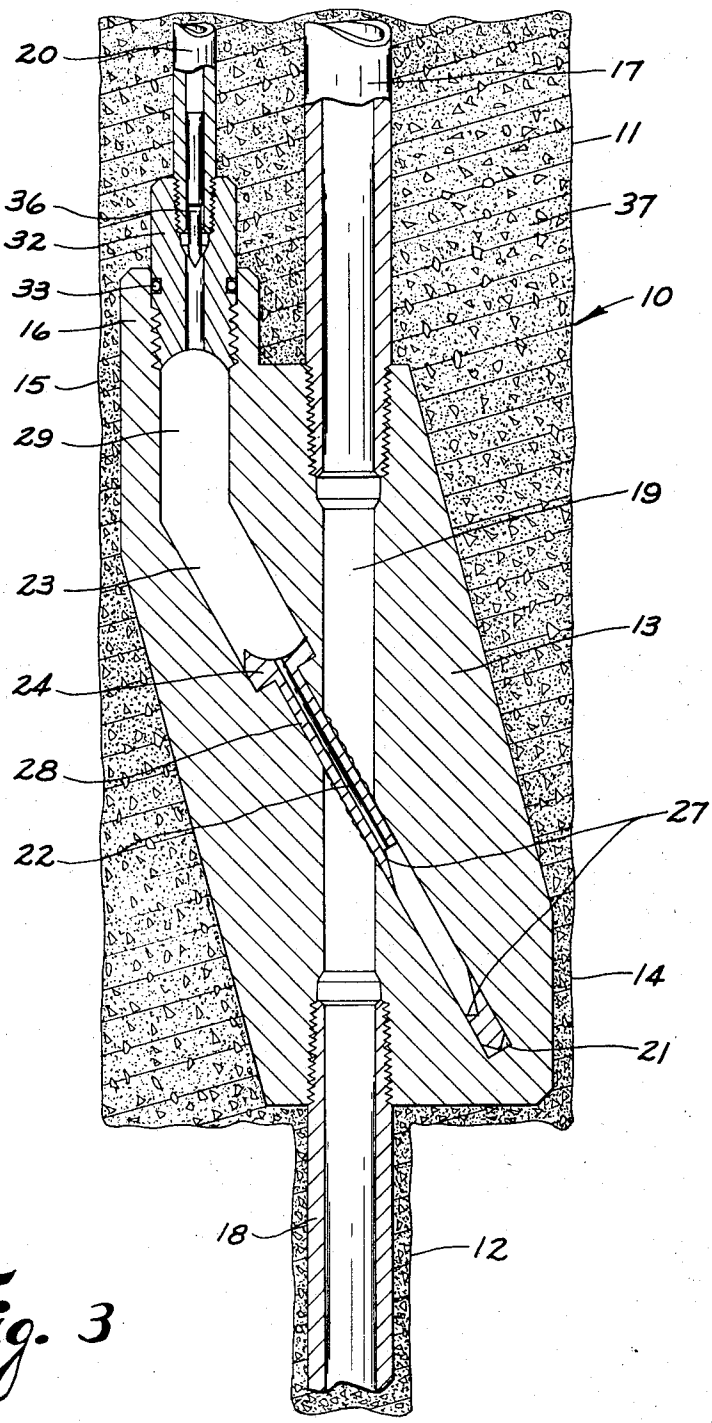


Fig. 3

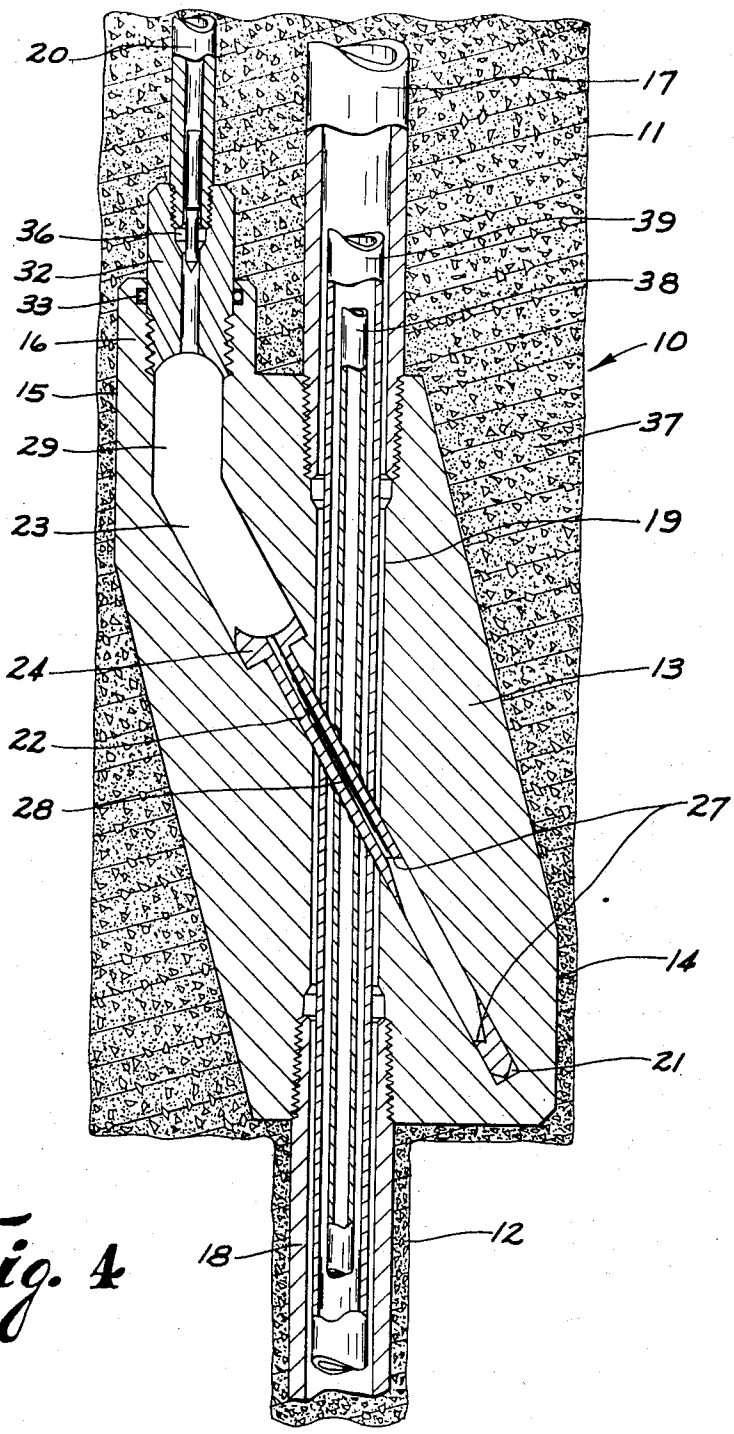


Fig. 4

Fig. 5

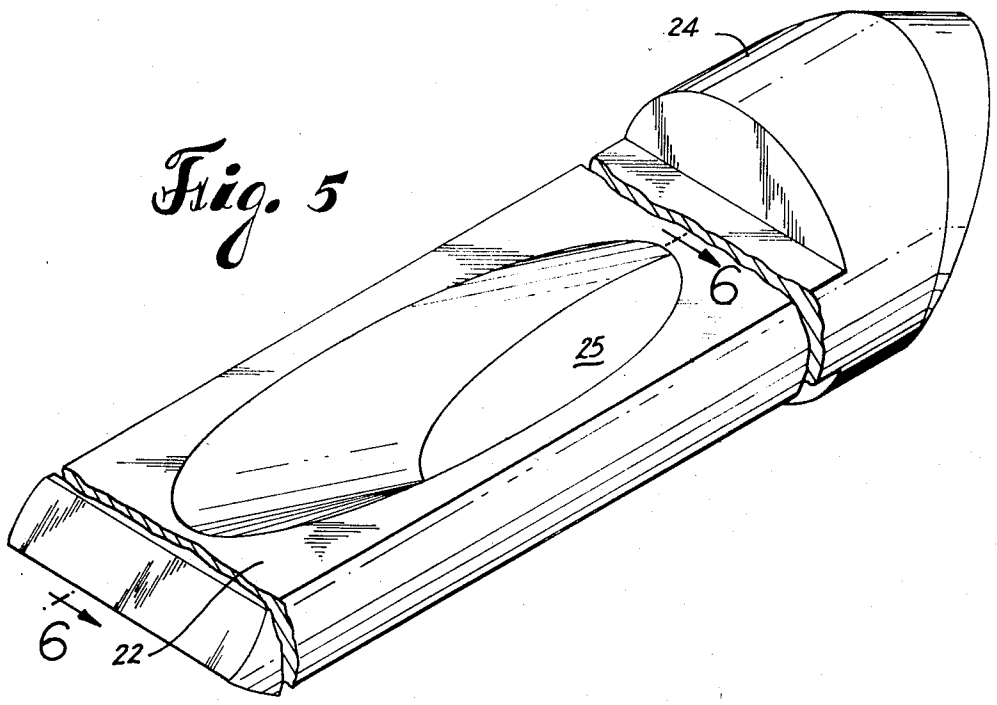
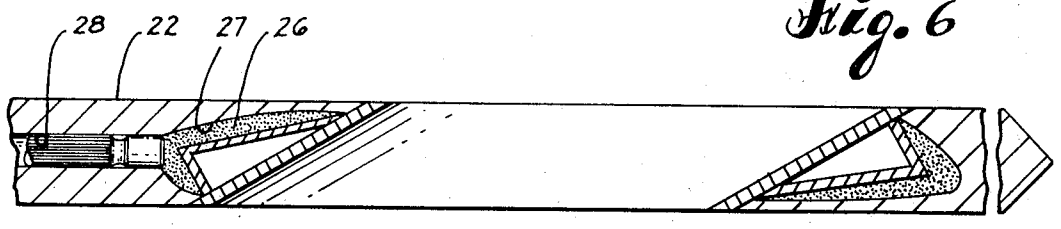


Fig. 6



WELL BORE BLOCKING METHOD

This is a division of application Ser. No. 55,439, filed July 16, 1970.

BACKGROUND OF THE INVENTION

The present invention relates to an apparatus and method for the down-hole closing off of a well bore and more particularly to an apparatus and method for preventing blowouts in an oil well.

One of the problems encountered in oil well drilling is the possibility of what is commonly referred to as a "blowout." It is normal practice in oil field operations, as the drilling is proceeding and when a producing formation is encountered, to pump drilling mud and the like down the well to create sufficient hydrostatic pressure to keep the oil and/or gas from suddenly and uncontrollably being released from the formation. It not infrequently happens however that as a high pressure gas zone is encountered, the gas will begin to escape into the drilling mud which reduces its density. Reducing the density of the drilling mud causes a corresponding reduction in the hydrostatic pressure above the producing formation with the result that the drilling mud is no longer able to maintain the oil and/or gas from an uncontrollable escape from the well. When this occurs, the results can be disastrous. For example, a blowout in an offshore oil rig quickly result in a severe pollution problem caused by the escape of massive quantities of oil into the water. While above-surface blowout preventers are available, these are not always satisfactory since they may be damaged by a resulting fire or explosion triggered by the blowout or in the case of offshore wells by a storm with the result that they are rendered useless in preventing the blowout.

SUMMARY OF THE INVENTION

It is therefore an object of the present invention to provide an apparatus for blocking off a well bore.

Another object of the present invention is to provide an apparatus for preventing blowout of an oil well.

Still another object of the present invention is to provide an apparatus for the sub-surface prevention of a well blowout.

Another object of the present invention is to provide a sub-surface blowout preventer which can be operated from the surface manually or automatically upon the occurrence of some pre-selected event.

Yet another object of the present invention is to provide an apparatus for the sub-surface severing and sealing of drill pipes and the like in well bores.

Another object of the present invention is to provide a method for the sub-surface prevention of a well blowout.

These and other objects and advantages which are provided by the present invention will become apparent from the description given herein, the drawings and the appended claims.

The blowout preventing apparatus of the present invention comprises a body means placeable in the well bore and having therethrough a bore for the passage of drill pipe and the like. Within the body and intersecting the bore is a passageway or slideway in which is slidably mounted a blocking or slide means which can be activated by a propulsion means to move the slide or blocking means in the slideway. In its unactivated state, the slide is positioned such that the bore through the body is open. When activated, the slide or blocking means is moved through the slideway in such a manner that it serves to completely block off the bore extending through the body. In its more preferred embodiment, the apparatus is equipped with a pipe severing means located so it has to sever the pipe at a location which lies within the body. In this latter preferred embodiment, upon severance of the pipe, the slide or blocking means is propelled through the space between the severed ends of the pipe or pipes to therefore block off the well bore.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is an elevational view in cross-section of the apparatus of the present invention positioned in a well bore and with the apparatus in the unactivated state.

FIG. 2 is a view similar to FIG. 1 showing the action of the apparatus at the instant of activation of the propelling means and the pipe severing means.

FIG. 3 is a view similar to FIGS. 1 and 2 showing the apparatus after it has been activated.

FIG. 4 is a view similar to FIG. 3 showing the apparatus after it has been activated with several extensions of drill pipe extending through the bore in the body having been severed.

FIG. 5 is an enlarged isometric view of the slide or blocking means of the present invention.

FIG. 6 is a cross-sectional view taken along the line 6—6 of FIG. 5.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

Referring first to FIG. 1, there is shown a well bore indicated generally at 10 having a section 11 of relatively large diameter in communication and generally coaxial with a smaller section 12 of considerably smaller diameter. Positioned within the enlarged section 11 of well bore 10 is a body or member 13 which for purposes of illustration has a cross-section somewhat approaching a parallelogram but having diagonally opposite and generally parallel facets 14 and 15. A segment of surface casing 17 extends downwardly into well bore 10 being threadedly connected to body 13 at its upper end. A second segment of surface casing 18 is threadedly connected to body 13 at the lower end thereof, lower referring to the relative position in the well bore 10. Segments 17 and 18 threadedly connect to body 13 at opposite ends of a bore 19 extending through body 13. Body 13 also has a neck portion 16 extending upwardly in the well bore and which is threaded to receive a reducer coupling 32. Threadedly connected to body 13 via reducer coupling 32 is a segment of pipe 20 which extends to the surface and whose function will be more fully described hereafter. To provide a seal, O-ring 33 is supplied between neck 16 and coupling 32.

Within body 13 is a slideway or guideway 21 which runs throughout the greater length of body 13 and which inter-sects or passes through bore 19. A slide or blocking means 22 is positioned partly within slideway 21, a portion of slide means 22 extending out of guideway 21 and into piston chamber 23. Slide means 22 is substantially flat and terminates on one end in a wedge shaped edge and terminates at its upper end in a piston 24 which while as shown is integral with slide means 22 could of course be a separate part and simply be attached to the upper end of slide means 22. As best seen in FIG. 5, slide means 22 has an opening 25 therein,

opening 25 being positionable in register with bore 19 by movement of slide means 22 in slideway 21. Opening 25 has a shape such that when it is in register with bore 19 through body 13, bore 19 is unobstructed by any portion of slide means 22.

Surrounding opening 25 is a shaped charge consisting of a suitable explosive 26 disposed in a substantially V-shaped groove 27 which extends around the periphery of and faces opening 25. Passing longitudinally through slide means 22 and piston 24 is a passageway 28 which connects explosive 26 with explosion chamber 29 located within body 13. Disposed within explosion chamber 29 is a propelling explosive 30. A cord-like explosive 31 such as the common fabric or plastic tube-filled explosives extends through passageway 28 connecting explosive 26, which may be referred to as a severing explosive, and propelling explosive 30. Mounted within reducer coupling 32 is a detonation cap 34 which is connected by means of a cord-like explosive medium 35 (described above) to explosive 30 in explosion chamber 29. A detonation weight or hammer 36 is shown in FIG. 1 as being slightly above detonation cap 34. Detonation weight 36 need not be suspended in pipe 20 but could be inserted in pipe 20 at the surface and simply dropped when desired or it could be mounted down in the well bore in pipe 20 and dropped on a signal from the surface. In any event, the apparatus is placed in the larger diameter section 11 of well bore 10 and is secured in place by means of cement 37 which is pumped into well bore 10 thus maintaining body 13 substantially rigid. With body 13 cemented in place, the sole passageway from the surface of the earth to the bottom of the well bore is by means of bore 19 extending through body 13 and the segments 17 and 18 of surface casing attached thereto. As will be recognized, the inside diameter of casing 17 and 18 and bore 19 in body 13 will be sufficient to accommodate drill pipe and the like.

In the situation depicted in FIG. 1, the apparatus is in its unactivated state. Furthermore, as shown in FIG. 1, no drill pipe or the like extends through casing 17, bore 19 or casing 18. For purposes of illustrating the operation of the apparatus herein, let it be assumed that a segment of drill pipe extends through casing 17, bore 19 and casing 18 and that a drilling or producing operation is being carried on. Let it be further assumed that for some reason a well blowout is about to occur and it is desired to rapidly seal off the well bore by some method. Referring then to FIG. 2, detonator weight or hammer 36 is allowed to drop and strike detonation cap 34. The detonation of cap 34 sets off cord explosive 35 which in turn detonates propelling explosive 30 in explosion chamber 29 which in turn detonates cord explosive 31 in passageway 28 which lastly sets off the shaped charge consisting of explosive 26 in V-shaped groove 27. The ignition of the shaped charge contained within slide means 22 results in a ring of a jet-type penetrating explosive. This ring of jet-type penetrating explosive has sufficient intensity to cut through metal and the like. The action of the jet-type penetrating explosive is to completely sever the pipe in a transverse direction, the plane of the severance being generally co-planar with the long axis of the slide means and transverse to bore 19. It is to be understood that while the action of the apparatus has been explained in stepwise fashion, the above-described sequence of detonations and explosions occurs within a fraction of a second.

Reference is now made to FIG. 3. The ignition of propelling explosive 30 in explosion chamber 29 applies a force to piston means 24 forcing piston 24 downwardly through piston chamber 23 thereby urging slide means 22 through slideway 21 towards the end thereof. In other words, almost simultaneous with the severance of the pipe extending through bore 19, opening 25 in slide member 22 which was initially in register with bore 19 in body 13 is moved out of register with bore 19 and instead a solid portion of slide 22 now engages and substantially closes off bore 19 and any pipe extending therethrough. Thus, almost instantaneously upon being activated, the apparatus severs and seals off any pipe extending into the well bore. This condition is graphically depicted in FIG. 4 where several segments, 38 and 39 respectively, of concentrically disposed drill pipe are shown having been severed and sealed off by the above described action of the apparatus.

While the operation of the apparatus has been described with reference to severing a piece of drill pipe, production tubing or the like extending down through the well bore via bore 19 in the body 13, it is to be understood that the apparatus has much broader application and a severing means is not absolutely necessary. For example, it may occur that the subterranean strata itself acts as the walls of the well bore such that no additional pipe or casing need be placed down through the well bore. Such a situation might arise for example if the well were drilled through relatively large thicknesses of granite, stone or other such hard formations which are self sustaining. In such a situation, the slide would be a solid body having no opening therein.

It is to be understood that the particular shape of body 13 shown herein is illustrative only and is not intended as a limitation on the shape or design thereof. It is necessary that body 13 have sufficient strength to withstand the internal explosions occurring during the severing and propelling stages.

When it is necessary to have a severing means incorporated into the apparatus herein, it should be one which is capable of very rapidly cutting through the pipe. This condition is most ideally met by shaped charges which generate rather intense and localized jet-type penetrating explosions. It is to be understood however that the invention is not limited to the use of such shaped charges and other forms of pipe disintegrating means may be employed. Likewise, other means and methods of moving or propelling the slide through the slide-way can be employed. For example, a hydraulic, pneumatic or electrical system could be employed to move the slide or blocking means through the slideway. Propelling the slide by means of the piston-explosion combination is preferable inasmuch as it is simple to activate and, generally speaking, trouble free. Furthermore, the explosive method of propulsion is extremely rapid which is a most desirable advantage.

When an explosive is being used as the propelling or moving means, it is not necessary that it be detonated in the fashion described above. Detonation can be accomplished by an electrical signal from the surface or from some automatic means located within the body which would detonate the explosion upon some preselected event such as an extremely rapid outflow of gas and/or oil indicating an incipient blowout. Such sensing and triggering means can be easily designed

and incorporated into the apparatus herein. Numerous other methods of detonating down-hole explosions can be used and is to be understood that such methods are within the spirit and scope of the invention herein.

While as shown above, the severing explosive is shown as being a shaped charge mounted within the slide means, this is a preferred and not a necessary construction. For example, the shaped charge used as the severing explosive could be disposed within the body proper around and adjacent the intersection of the slideway in the bore extending through the body. Detonation of the shaped charge contained within the body proper could then be accomplished by running passageways through the body to the charges from the explosion chamber much as it is done in the case of passing the cord-type explosive medium through the bore **28** in slide **22.** Obviously, it is required that severance of any pipe extending through the bore **19** take place substantiallly where the slideway intersects the bore such that the slide can pass easily through the space left between the severed ends of the pipe.

While in the above description, the apparatus of the present invention has been shown as being anchored in place in the well bore by means of cement poured therein, other means of anchoring can be employed. Cementing of the body means in place is preferred, however, because of the relative simplicity with which this can be done particularly in the case where the apparatus is used in offshore drilling operations. In the latter situations, other means of anchoring become economically, if not technically, unfeasible.

While not necessary, the angle between the slideway and the upper part of the bore **19** in the body means will generally be an acute angle. Making the angle acute reduces the width of the overall apparatus and therefore reduces the size of the portion of the well bore which must be enlarged to accommodate the apparatus. For example, were the slideway to be at 90° to the bore through body **19,** the overall width of the apparatus would be significantly increased. This would require more reaming of the well bore and increased usage of cement if such is the chosen anchoring means.

As can be readily appreciated from the foregoing, the apparatus of the present invention provides an effective and quick method of preventing a well blowout. Due to the fact that the apparatus is dpsosed below surface, it is not subject to damage due to fires, storms or other catastrophes which could render it inoperable. The advantages of such a system in the prevention of water pollution in offshore drilling rigs are readily apparent.

I claim:

1. A method for sealing off a well bore having at least one pipe extending thereinto comprising

placing in said well bore a body having a bore therethrough for the passage of said pipe,

severing said pipe at a point which is within the bore of said body, and

moving a blocking means through the severance in said pipe, said blocking means serving to completely shut-off the bore in said body and said pipe extending through said bore in said body.

2. The method of claim **1** wherein said body is secured in said well bore by cementing said body therein.

3. The method of claim **1** wherein said blocking means is moved through the severance in said pipe by igniting a propelling explosive and permitting the force of the resulting explosion to move said blocking means through said severance.

4. The method of claim **1** wherein said severing of said pipe is accomplished by subjecting said pipe to a severing explosive.

5. The method of claim **4** wherein said severing explosive comprises a shaped charge.

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