

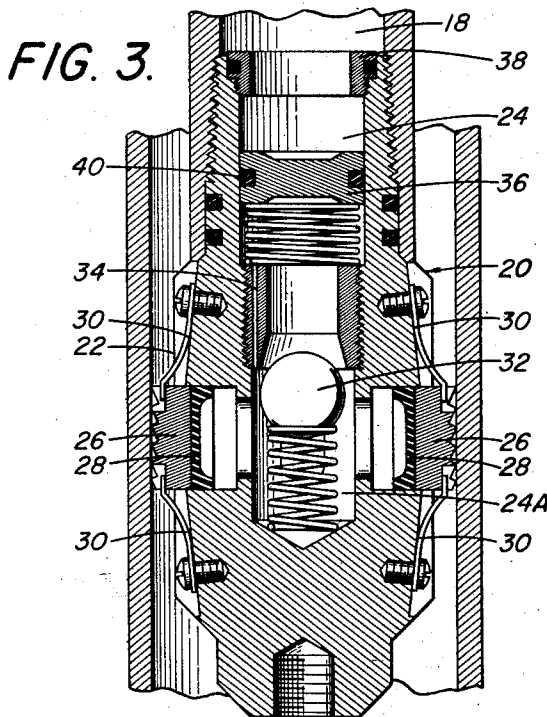
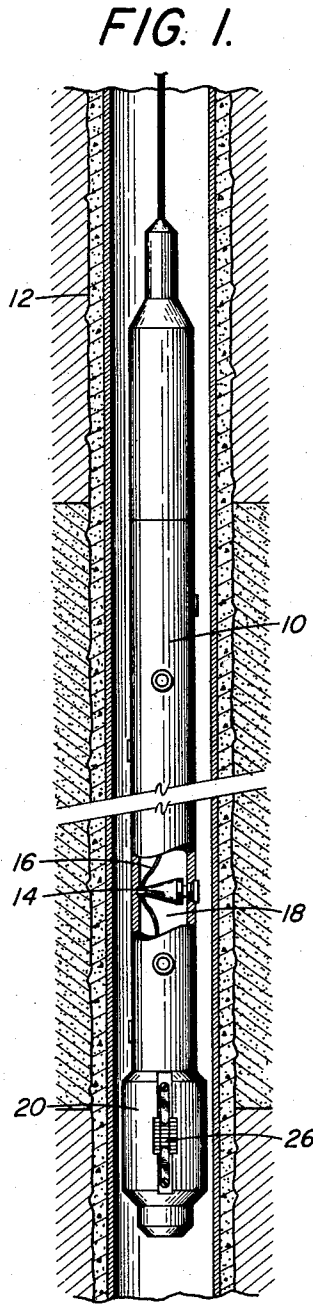
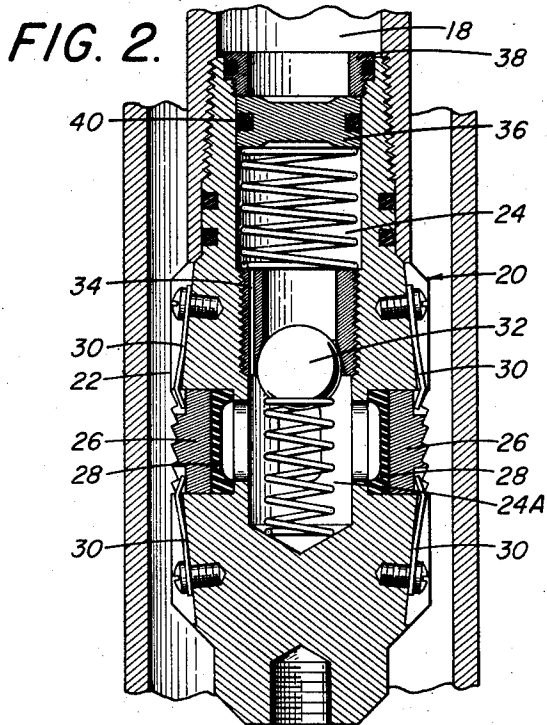
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STABILIZER FOR WELL CASING PERFORATOR

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1

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STABILIZER FOR WELL CASING PERFORATOR

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This invention generally relates to apparatus for perforating well casing by means employing the Munroe effect of shaped explosive charges and more particularly relates to apparatus which will retain the main body of such apparatus in firing position during and immediately after detonating such charges.

"Jet" guns employing shaped charges are well developed and extensively used. Therefore, such guns need not be herein described in detail. Reference may be had to Patent No. 2,494,256 to Muskat et al. for embodiments of such guns with which the apparatus of this invention may be advantageously used.

In use such guns are lowered into a well bore to a level of the formation which is to be produced and then fired by electrical or mechanical means. Upon firing, all the charges detonate at substantially the same instant. The firing of such charges creates considerable recoil which usually causes the gun to "buck" or bounce upwardly in the well bore. This bucking does not affect the perforating efficiency of the gun, but can be detrimental to the cable from which the gun is suspended. On occasion the travel upward and the subsequent drop of the gun has been sufficiently pronounced to seriously kink, knot, or part the cable. The usual effort to circumvent this problem has been to increase the mass of the gun proper or to attach weights to the gun. Such efforts have proved helpful, but require stronger cable to support such apparatus. For long sections of guns having large numbers of charges the necessary extra strength can require excessively expensive hoisting cable.

It is, therefore, the general objects of this invention to provide an apparatus with which the gun may be steadily supported after firing, which will be relatively light and easily handled, and which may be used repeatedly without manual resetting.

Briefly described, the stabilizer comprises a body adapted to be attached to a jet perforator and in pressurable communication with the chamber containing the explosive charges. Adapted to engage said body in supporting contact with a well casing wall are one or more pressure actuated slip wicker members. Hydraulic pressure transmitting means including provision for substantially instantaneous fluid transfer from said chamber to said wickers and minute transfer for fluids returning from said wickers to said chamber is provided intermediate said chamber and said wickers. The arrangement is such that a pressure created in said chamber immediately expands and sets said wickers, and then, as the pressure diminishes, said wickers gradually release and retract to their original position, thus allowing the gun to be removed from the well bore.

The invention may be more fully understood by reference to the accompanying drawing in which:

Figure 1 illustrates a cross section of a cased well bore in which the invention, in combination with a jet perforating gun, is positioned.

Figure 2 is a cross sectional elevation of the invention in the normally retracted position.

2

Figure 3 is a cross sectional elevation of the invention in the expanded position.

Now referring to Figure 1, a jet perforating gun 10 is shown in position for firing in a cased and normally liquid filled well bore 12. For clarity a portion of the gun 10 is shown in cross section. Illustrated in this section is one of the shaped charges 14 which has a primacord detonating means 16 threaded therethrough in common with the remaining charges. The upper end of this cord 16 is attached to an electrical or percussion type blasting cap which may be detonated at will. Also shown in this cross section is the interior chamber 18 of the gun. Prior to firing this chamber is isolated from and free of well fluids.

In referring to Figures 2 and 3, it is seen that the lower end of chamber 18 is in pressurable communication with the upper portion of a stabilizer 20 provided by this invention. Forming this stabilizer 20 is a generally cylindrical body 22 having a blind bore 24 therein which terminates near the lower end of said body. Radially disposed about the axis of body 22 are one or more slip wickers 26. Said wickers are mounted in the body 22 in closely fitted fashion and backed by resilient pressure pads 28. Pressure communication is provided from the underside of pads 28 to bore 24. The arrangement is such that pressure applied under said pads will force said wickers to extend out into contact with the casing wall. Retainer springs 30 are provided to normally support wickers 26 in a retracted position and to forceably retract said wickers from such an extended position.

Located within the bore 24 and immediately above the passages provided to pads 28 is a one way flow means, for example, a spring loaded ball check valve 32. As provided, the valve 32 readily allows fluid passage into that portion of the bore 24, hereinafter called 24A, communicating with the wickers 28, but prevents fluid return therefrom.

Provided adjacent to the seat of check valve 32, in such manner as to shunt return flow past the valve, is a restrictive passage 34. This passage allows only a minute flow therethrough and provides the sole return of fluids trapped by check valve 32.

Forming a chamber in bore 24 and above valve 32 is a pressure responsive member, exemplified by a spring loaded piston 36, which is retained in said bore by a retaining ring 38. Escape of fluids past piston 36 is prevented by sealing means, exemplified by an O ring 40.

That entire chamber formed by bores 24 and 24A, the passages to pads 28, and piston 36 is completely filled with some incompressible hydraulic fluid, such as oil.

In operation the stabilizer 20 is attached to the gun 10 in the position illustrated in Figures 1 and 2. The gun 10 is then lowered to a desired depth and fired. The detonation of the charges 14 blast away their retaining caps and perforate through the casing and into the well formation. This detonation also creates a tremendous initial pressure within chamber 18 which may be several times greater than the hydrostatic pressure caused about gun 10 by the well bore liquids. This detonation pressure soon subsides through the now open perforating ports until chamber 18 and well bore 10 are at a common pressure.

This initial pressure immediately forces the piston 36 down in bore 24, transmitting such force through said hydraulic fluid which displaces said fluid through check valve 32 and to the pads 28. As best illustrated in Figure 3, the wickers 26 are expanded thereby into extremely forceful contact with the well casing wall, and thus effectively prevent movement of gun 10. It has been found that the relative inertia of gun 10 to that of the internal components of stabilizer 20 is such that the wickers 26 are expanded and set into supporting contact

3

with the well casing wall before any appreciable movement of the gun 10 has occurred.

As the pressure gradually subsides from chamber 18 the fluid trapped in chamber 24A by check valve 32 remains at the initial detonating pressure and thus seeks the subsiding pressure level found in the chamber 24 through restriction 34. A minute fluid flow then commences from chamber 24A through restriction 34 to chamber 24, gradually relieving the pressure under the pads 28. The spring loading of piston 36, aided by the hydraulic fluid returning to chamber 24, returns the piston to its initial position, as illustrated in Figure 2. As the hydraulic fluid leaves chamber 24A, the pressure across pads 28 becomes equal. The wickers 26 thereon lose forceful contact with the well bore walls and are forced to retract, in response to the springs 30, into the position also illustrated in Figure 2. The gun may now be withdrawn from the well for reloading and reuse. It is pointed out that Figure 3 illustrates the check valve 32 while fluid is being forced into chamber 24A. It is seen that the valve will immediately close when the full pressure has been applied and becomes equal in chambers 24 and 24A.

It is to be noted that the stabilizer 20 is readied for repeated use in an automatic fashion and requires no manual resetting. Also to be noted is that any mud or detritus entering the chamber 18 through the open perforating ports of the gun 10 is effectively isolated from the interior of the stabilizer 20 by means of piston 36.

While various changes and modifications may be made in the embodiment of the invention disclosed herein, all such changes which will fall within the scope of the appended claims are intended to be embraced thereby.

That which is claimed is:

1. A device for perforating casing in well bores, comprising, a jet perforating gun having shaped explosive charges positioned in a fluid tight chamber in said gun, a hollow cylindrical body connected to said gun in pressurable communication with said gun chamber at one end of said body, said body being closed at the other end, one or more retractable wicker members radially disposed about said body and radially movable in response to pressure applied from within said body, hydraulic means in said body to provide pressure communication from said gun chamber to said wickers, and a flow control means disposed in said body intermediate said gun chamber and said wickers including means to provide an immediate pressure transfer through said hydraulic means from said gun chamber to said wickers and means to provide a retarded pressure transfer through said hydraulic means from said wickers to said gun chamber.

2. In combination with a jet perforating gun having shaped explosive charges positioned in a fluid tight chamber in said gun, a stabilizer body connected to said gun in pressurable communication with said chamber, said body comprising, one or more retractable wicker members therein movable to engage a well bore casing in response to pressure applied from within said body, and hydraulic means intermediate said wickers and said chamber for transmitting pressure from said chamber to said wickers, said hydraulic means having means therein for providing large flow from said chamber to said wickers and providing a minute return flow from said wickers to said chamber.

3. In a jet perforator for use in oil wells or the like, the combination of a gun body having a chamber therein, shaped explosive charges mounted in said body in such manner as to create, upon ignition, an initial pressure in said chamber in addition to the creation of the perforating jet, pressure responsive wickers mounted on said body being adapted to anchor said body to the casing in the well during the detonation of said charges, and hydraulic means in connection with said chamber and said wickers being adapted to cause said wickers to immediately grip said casing in response to the in-

4

itial pressure created in said chamber upon the ignition of said charges and to release said casing following the detonation of said charges.

4. Well casing perforating apparatus including, a jet perforating gun having an explosive charge chamber therein, a stabilizer body having a chamber therein, means for connecting said body to said gun in pressure transferring relation of said body chamber to said gun chamber, a pressure actuated extendable and retractable retaining means including a wicker member disposed in said body in pressure transferring relation with said body chamber for extending into retaining engagement with a well casing upon application of a differential pressure applied from within said gun chamber to within said body chamber and retracting from said casing upon removal of said pressure, hydraulic pressure transfer means disposed within said body chamber for transferring differential pressure from said gun chamber to said retaining means, and pressure control means disposed within said body chamber intermediate said retaining means and said connecting means including means for providing immediate transfer of fluid pressure to said retaining means and means for providing extremely retarded fluid pressure transfer from said retaining means.

5. In jet perforating apparatus the combination including, a jet perforating gun having an explosive charge chamber therein, a stabilizer body having a chamber therein, means for connecting said body chamber in pressure transferring relation to said gun chamber, at least one fluid pressure actuated wicker member disposed in extendable and retractable relation within said body for forceably engaging a well casing in response to fluid pressure applied from said gun chamber to within said body and retracting from said casing upon removal of said pressure, hydraulic pressure transfer means disposed in said body intermediate said wicker member and said connecting means for transferring fluid pressure to said wicker member, and flow control means for controlling said hydraulic means including means for providing immediate flow transfer of said hydraulic means to transfer pressure to said wicker member and means for providing extremely slow return flow transfer of said hydraulic means for pressure transfer from said wicker member.

6. Jet perforating apparatus comprising, a jet perforating gun having an explosive charge chamber therein, a body having a chamber therein, means for connecting said body chamber in pressure transferring relation to said gun chamber, a pressure actuated extendable and retractable retaining means including a wicker member disposed in said body in pressure transferring relation with said connecting means for extending into retaining engagement with a well casing upon application of a differential pressure applied from said gun chamber to within said body and retracting from said casing upon removal of said pressure, hydraulic fluid disposed within said body chamber, and fluid pressure control means disposed within said body chamber intermediate said retaining means and said connecting means for controlling the passage of said hydraulic fluid including means for providing immediate transfer of hydraulic fluid pressure to said retaining means and means for providing extremely retarded hydraulic fluid pressure transfer from said retaining means.

7. Apparatus as described comprising, a jet perforating gun having an explosive charge chamber therein, a body having a chamber therein, means for connecting said body chamber in pressure transferring relation to said gun chamber, at least one fluid pressure actuated wicker member disposed in extendable and retractable relation within said body for extending into forceable engagement with a well casing in response to fluid pressure applied from said gun chamber to within said body and retracting to said body upon removal of said pres-

5

sure, hydraulic fluid disposed within said body, and fluid pressure control means disposed within said body for controlling the passage of said hydraulic fluid including means for providing immediate transfer of hydraulic fluid pressure to said wicker member and means for providing extremely retarded return transfer of hydraulic fluid pressure from said wicker member for gradual release of said wicker member from said casing.

5

6

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