July 6, 1965 J. D. WHITESIDE 3,193,013

WIRE LINE CUTTER

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Fig. 1

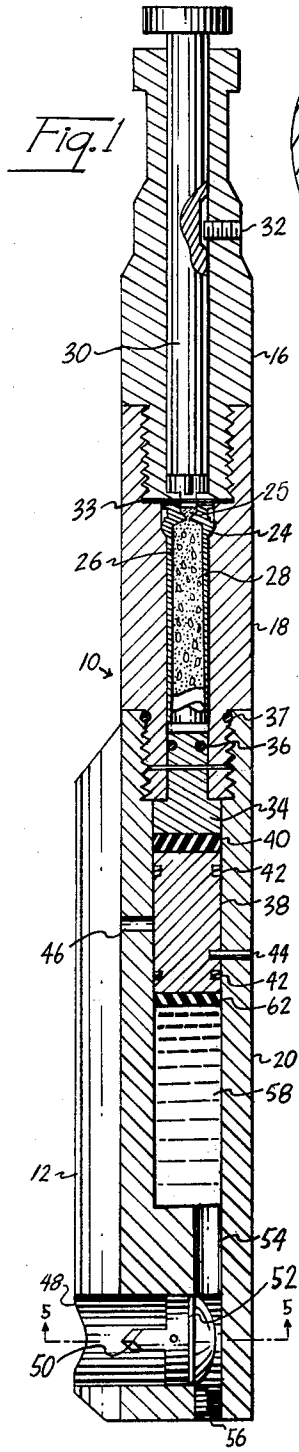


Fig. 3

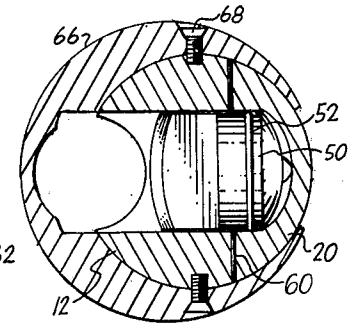


Fig. 4

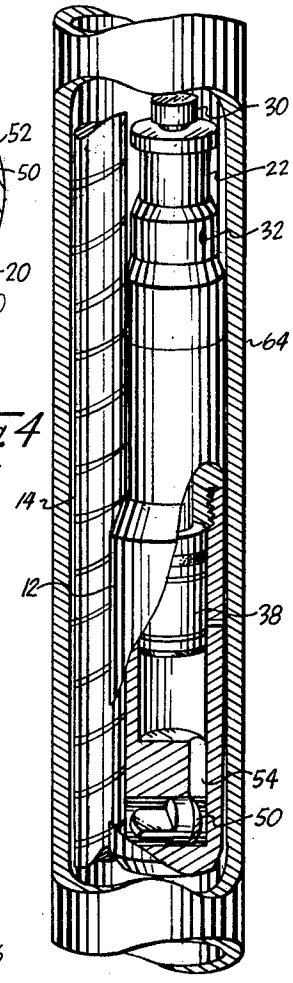


Fig. 2

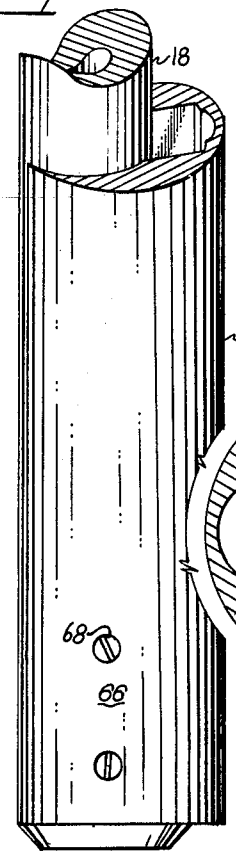
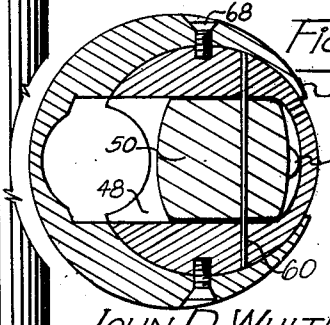


Fig. 5



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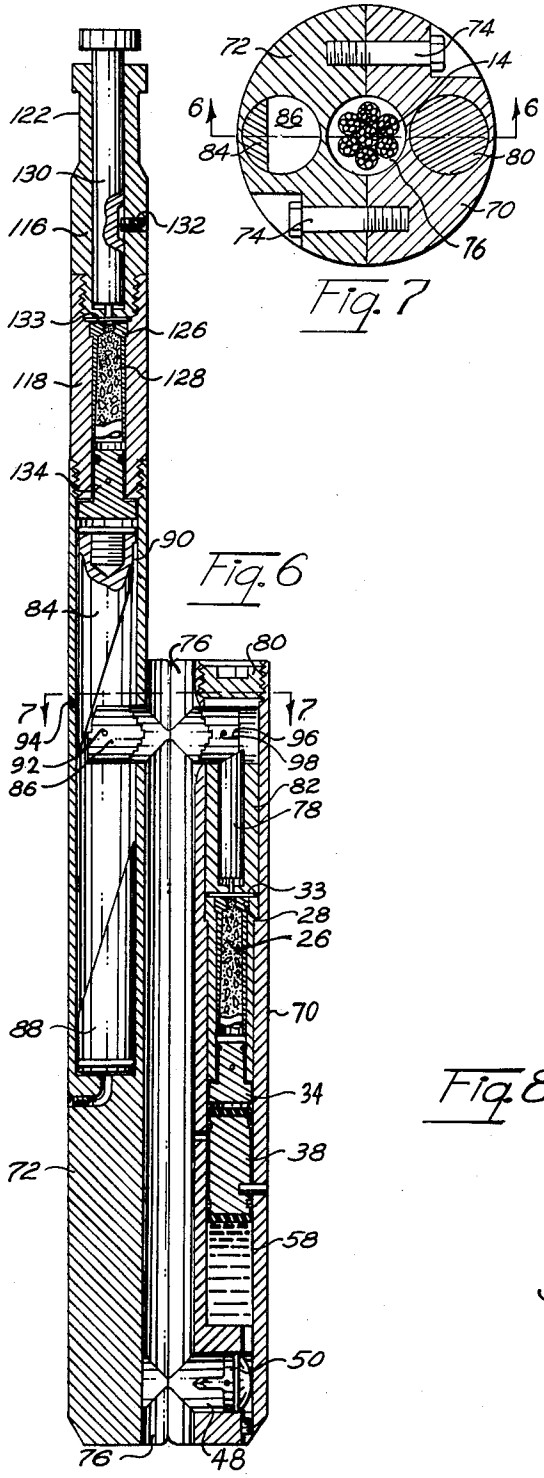


Fig. 6

Fig. 7

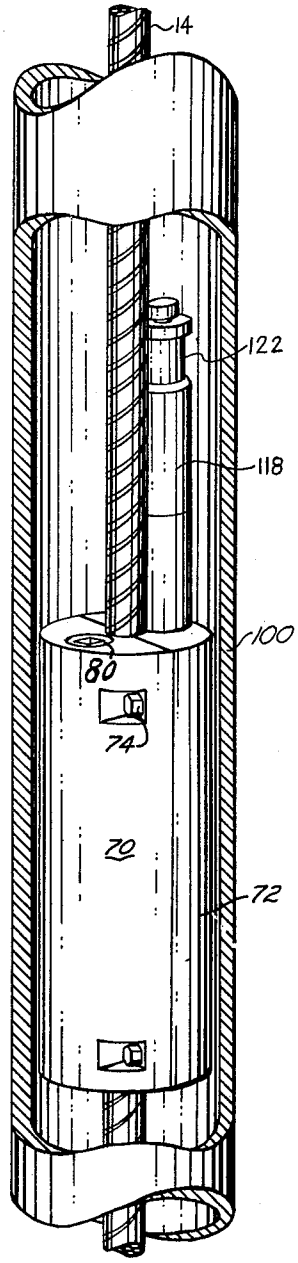


Fig. 8

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WIRE LINE CUTTER

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2 Claims. (Cl. 166—54.5)

This invention relates to wire line cutters adapted for use in wells.

In drilling and producing wells often tools are lowered on wire lines or cables into the well. Sometimes these tools become stuck within the well. In such cases often it is desirable to cut the wire line at the top of the tool so that the wire line may be removed. After which time, the tool may be fished from the well.

Sometimes the tools are lowered into tubing within the well. By tubing we mean pipes of relatively small diameter, e.g. two or three inches inside diameter. At other times the tools may be lowered within casing. By casing we mean pipes of larger diameter. When the tool is within tubing generally there is no attempt made to retrieve the cutter with the wire line, but it is left within the tubing. The cutter is then retrieved by pulling the tubing and removing the cutter from the bottom of the tubing after it has been pulled from the well. However, when the wire line has been cut within casing it is desirable to remove the cutter with the wire line which it has cut.

Previous to this invention wire line cutters have been known which use an explosive charge to actuate mechanical means which operate a knife to cut the line. Also previous to this invention cutters have been used with a single explosive charge which both operate a clamp to clamp the cutter to the cut line and also cut the line.

Generally the wire line is taut when cut. Therefore difficulty is experienced in the wire line cutters of the prior art in attaching them to this taut line inasmuch as often the line jumps from the cutter before it is firmly attached to the wire line.

In general this cutter has an explosive charge which through fluid or hydraulic means operates a knife to cut the line.

Also this invention relates to a new means for clamping the cutter to the line wherein two explosive charges are used. One explosive charge is to cut the line. A second explosive charge is detonated before the other and is used both to actuate a clamp and detonate the other explosive charge.

An object of this invention is to provide an improved wire line cutter for wells.

Another object of this invention is to provide an improved wire line cutter for wells operating with a hydraulic principle.

Another object of this invention is to provide an improved wire line cutter clamping the cutter to the line before the line is cut.

A further object of this invention is to provide a cutter utilizing two explosive charges, one explosive charge attaching the cutter to the wire line and the other explosive charge for cutting the line.

Still further objects are to achieve the above with a device that is sturdy, compact, durable, simple, reliable, and versatile, yet inexpensive and easy to manufacture.

The specific nature of the invention as well as other objects, uses, and advantages thereof will clearly appear from the following description and from the accompanying drawing, the different views of which are not necessarily to the same scale, in which:

FIG. 1 is an axial, sectional view of one embodiment of a wire line cutter according to this invention adapted to be used within tubing.

FIG. 2 is a partial elevational view of the embodiment of FIG. 1 shown with an adapter to use it in a larger size tubing.

FIG. 3 is a sectional view showing the end of the adapter substantially taken on line 3—3 of FIG. 2.

FIG. 4 is a perspective view, partially broken away, showing the embodiment of FIG. 1 within tubing; the view somewhat fore-shortened for better illustration.

FIG. 5 is a sectional view of the knife taken on line 5—5 of FIG. 2.

FIG. 6 is an axial sectional view of another embodiment which would be adapted to be used in casing inasmuch as the cutter is clamped to the line.

FIG. 7 is a cross-sectional view taken on line 7—7 of FIG. 6.

FIG. 8 is a perspective view of the embodiment of FIG. 6 shown within casing, the casing broken away for clarity, also somewhat fore-shortened.

Referring to the first embodiment shown in FIGS. 1–5, it may be seen that the cutter includes an elongated cylindrical body 10. Along the lower portion of the body there are wings 12 which extend outward from the body to at least partially encircle wire line 14 to guide the body along the wire line. The body has three sections, upper section 16, middle section 18, and lower section 20, which are threaded one to the other. The wings 12 are attached to the lower section 20. Near the top of the upper section 16 is a fishing neck 22 so the tool may be fished from the well if this becomes necessary.

The top of the middle section 18 has a threaded box by which a threaded pin on the lower part of section 16 may be threaded into it. Just below the box there is an upward facing shoulder 24 to receive blank rifle cartridge 26. I choose to use a blank rifle cartridge to contain explosive charges 28 inasmuch as they will hold sufficient powder, are inexpensive, and are readily available on the market. The cartridge 26 fits within a longitudinal bore within the middle section 18. This bore communicates with a bore in the lower section 20 which is also longitudinal thereof.

Firing pin 30 is mounted for rectilinear motion within a bore in the upper section 16. It is normally held in upper position by set screw 32 which extends through the wall of the upper section 16 and into a hole within the firing pin 30. The lower part of the firing pin has a nipple which is aligned with primer 25 of the cartridge 26. Therefore it may be seen that impact upon the top of the firing pin 30 will detonate the explosive charge 28 if the set screw 32 is released. Brass disc 33 is between the upper section 16 and middle section 18. Sufficient impact must be delivered to the firing pin to rupture this disc before detonation occurs.

Top piston 34 has an upper part of smaller diameter which fits within the bore of middle section 18. This upper section has an rubber O-ring 36 which forms a seal within the bore and also holds the top piston 34 snugly in place. The lower portion of the top piston 34 is within the bore of the lower section 20 which is of larger diameter. Lower piston 38 is separated from the top piston 34 by a flat rubber bumper disc 40. The lower piston 38 forms a fluid-tight seal with the bore by means of steel rings 42. The lower piston is maintained in place by shear pin 44 made of soft metal such as brass. Gas port 46 opposite the shear pin provides an exhaust for the gases resulting from the detonation of the explosive charge 28, after the top piston has moved down thus exposing the port 46 to the bore of the lower section 20.

O-ring 37 insures a gas-tight fit along the threads between the middle section 18 and lower section 20.

A transverse opening 48 extends normal to the axis of the body 10 at the lower end thereof. It is of circular cross-section. Knife 50 is mounted within this transverse

opening with the blade pointed outward. The back of the knife has a circular cross-section which is correlative in shape to the transverse opening and therefore forms a fluid-tight seal therewith. This seal is enhanced by steel ring **52**. Drill hole **54** extends from the bottom of the lower section **20** of body **10** into the bore of the lower section **20**. It is closed at the bottom by plug **56**. The drill hole **54** provides means for loading grease **58** into the bore and forms a means of communication from the bore to the transverse opening behind knife **50**. The knife **50** is held in place by shear pin **60**. The bore is loaded with the grease **58**. Rubber disc **62** is between the lower piston **38** and the grease **58**.

In operation the cutter is assembled and loaded as shown. To use, it is dropped within tubing **64** with the wings **12** partially surrounding the line **14**. The line **14** is drawn taut so that the cutter makes a free fall along the line to the bottom of the well. The set screw **32** is loosened before the cutter is dropped within the tubing **64**. The free fall of the cutter will continue until the bottom of the cutter strikes the tool on the bottom of the cable **14**. It may be that the impact of the cutter upon the tool (not shown) will be sufficient to drive the firing pin into the primer **25** of the cartridge **26** thus detonating the explosive charge **28**. However, if this does not occur a metal rod is dropped within the tubing **64** to impact against the top of the firing pin **30** to drive it into the primer thus detonating the charge **28**. The expanding gases resulting from the detonation of the explosive charge **28** will drive the piston downward thus forcing the grease **58** downward which will force the knife **50** outward cutting the line **14**. The force of the expanding gases will be sufficient to shear the pins **44** and **60**. When the pistons reach their lower point the port **46** will be opened to expel the spent gases so that it is not dangerous to dissemble the tool at a later time.

It may be seen that the tool may be loaded and stored for long periods of time without deterioration or danger. With the set screw **32** firmly screwed in place there is no danger of detonating the explosive charge **28** prematurely. Likewise the steel rings and O-rings around the piston together with the rubber discs **40** and **62** prevent the grease **58** from contaminating the explosive charge **28**.

As may be seen the operation of the cutter in falling down the tubing **64** along wire line **14** depends on somewhat filling the space within the tubing **64**. If there is too much clearance it is possible that the cutter would not be guided along the line **14** in its fall. To prevent making a different size cutter for each size tubing **64** I have designed a sleeve **66** to fit around the body **10** or more particularly the lower section **20** of the body **10** when it is to be used in a larger sized tubing **64**. This sleeve has a generally cylindrical outside configuration as the body **10** does. In cross-section it is generally U-shaped. The inside dimensions are approximately the same as the outside dimensions of the lower section **20** which it fits around. It is held in place by two set screws **68**. In use it forms a complete enclosure for wire line **14** and the line is cut against the sleeve rather than against the tubing.

Referring now to the embodiment shown in FIGS. 6, 7, and 8, it will be seen that this cutter is generally in two parts; cutter section **70** and clamp section **72** which are attached together by bolts **74** to form a unitary cutter having a generally cylindrical outline inasmuch as each is generally hemi-cylindrical. It will also be seen that each of the parts **70** and **72** have a longitudinally extending concave groove **76** between them so that wire line **14** may be guided between them.

The cutter section **70** is quite similar to the cutter of the embodiment of FIG. 1 inasmuch as it has a knife **50** which is within a transverse opening which is activated by grease **58** which is compressed by piston **38**. The piston **38** is pushed down by explosive charge **28** within a cartridge **26**. Firing pin **78** detonates the cartridge. The firing pin **78** is mounted for rectilinear motion within the upper portion of the bore within the body or part **70**. In this regard it may be seen that in both embodiments the body has a longitudinal bore with the explosive charge **28** in one end and the knife **50** at the other end and that both ends of the bore are closed. Also it will been seen that although I prefer to use grease that other fluid-like substances would be adaptable for use herein. However, I particularly prefer a jelly-like fluid inasmuch as it is less likely to leak around the pistons. In this regard the grease might also be described somewhat as a readily extrudable plastic material. Also grease is easier to contain by ring **52** around knife **50** than thinner fluids.

The bore within the part **70** extends on through the top and is closed at the top by plug **80** which is threaded into the top of the bore. Sleeve **82** fits between the bore and the firing pin **78** to hold the firing pin snugly in place. The firing pin **78** is mounted for vertical motion.

The part **72** has an upper section **116** carrying a firing pin **130** normally held in place by set screw **132** and a fishing neck **122** all of correlative design and like function to those parts bearing similar numbers in the embodiment described in FIG. 1. The clamp part **72** also has a middle section **118** carrying a cartridge **126** and explosive charge **128** with similar function to those correlative parts of the embodiment of FIG. 1. There is a piston **134** corresponding in design and function to the like piston of the former embodiment.

The piston **134** on its downward travel drives wedge **84** which activates male clamp member **86** to move transversely of the cutter. Inclined surface **88** stops the wedge **84** and prevents the wedge from damaging the cutter in case it still has energy remaining after it has driven the clamp member **86** to its full extended position. The movement of the clamp member **86** by the wedge **84** is somewhat similar to the operation of Kinley's cutter disclosed in the United States Patent 2,185,303, issued January 2, 1940, and it will be understood by those skilled in the art without additional explanation here. At the top of the incline plane of wedge **84**, there is a flat portion **90** which mates with a flat portion at the back of the clamp member **86** so that when the wedge **84** is driven all the way down the wedge **86** is locked in place to firmly clamp the cutter to the wire line **14**. Normally the clamp member **86** is maintained in place by shear pin **92** until it is driven forward. Gas port **94** permits escape of gases as explained before.

Female clamp member **96** is maintained in place within the cutter part **70** by shear pin **98**. The clamp member **96** is opposite the clamp member **86**. The bottom of the clamp member **96** has an inclined surface which is correlative to an inclined surface at the top of the firing pin **78**.

In operation the cutter is assembled around a line **14** and allowed to drop down the line within a casing **100**. When it reaches the bottom of the hole the explosive charge **128** is detonated as in the previous embodiment. This drives the wedge **84** down moving the clamp member **86** across. The clamp members **86** and **96** securely clamps the cutter to the line **14**. Only when the cutter is securely clamped to the line **14** and the female clamp member **96** moved back is the firing pin **78** driven down. The firing pin **78** is driven down by the action of the inclined surface on clamp member **96** moving over the inclined surface on the firing pin **78**. The downward movement of the pin **78** detonates the charge **28** to produce motion which is transmitted to the knife **50** to cut the wire. Therefore I have provided means for securely clamping the cutter to the wire before the knife cuts the wire.

It will be apparent that the embodiments shown are only exemplary and that various modifications can be made in construction, materials, and arrangement within the scope of the invention as defined in the appended claims.

I claim as my invention:

1. A wire line cutter comprising:
(a) an elongated body,
(b) a longitudinal opening through said body adapted for a line to be cut to pass through,
(c) an explosive charge within said body,
(d) a knife within said body,
(e) means responsive to detonation of the said explosive charge for moving said knife into said longitudinal opening whereby movement of said knife cuts a line therein,
(f) a second explosive charge in said body,
(g) clamp means adjacent said longitudinal opening for clamping a line within said opening to said body,
(h) means responsive to detonation of said second explosive charge for actuating said clamp means, and
(i) means responsive to said detonation of said second explosive charge and said actuating of said clamp means for initiating the detonation of said first mentioned explosive charge.

2. A wire line cutter comprising:
(a) a body with a generally cylindrical outside configuration,
(b) means along said body for guiding said body along a wire line,
(c) said body having a bore extending longitudinally thereof within said body,
(d) an explosive charge at the top of said bore,
(e) a firing pin extending from the top of said body,
(f) means between the firing pin and explosive charge for detonating the explosive charge responsive to an impact upon said firing pin,
(g) said body having a transverse opening at the bottom thereof,

(h) said transverse opening being in communication with said longitudinal bore,
(i) a knife within said transverse opening,
(j) said knife having a portion of correlative shape to said transverse opening so that said knife forms a fluid tight seal within said opening,
(k) said knife being mounted for sliding movement within said transverse opening,
(l) said knife positioned to be opposite a wire line within the means for guiding the body along a wire line,
(m) a fluid-like substance within said bore and opening so that when the explosive charge is detonated the knife is forced outward to cut a wire line,
(n) said body having a second longitudinal bore therein,
(o) a second explosive charge within said second bore,
(p) means within said body responsive to detonation of said second charge for clamping said body to a line within said guiding means, and
(q) means for actuation of said firing pin responsive to the firing of said second explosive charge and the clamping of said body to said line.

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