Aug. 10, 1965 J. C. KINLEY 3,199,593

WIRE LINE SHOOTING TOOL

Filed Aug. 9, 1963

Fig. 1B

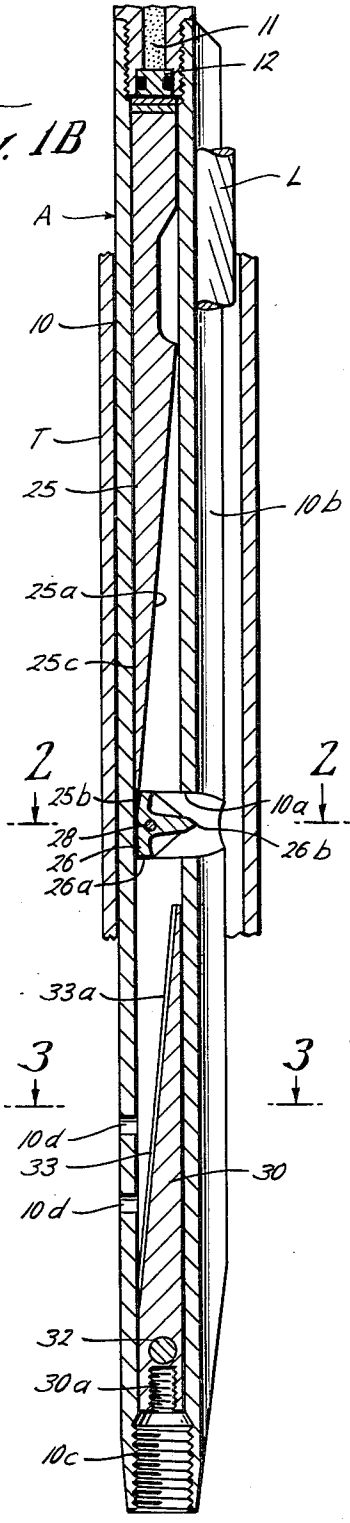


Fig. 2

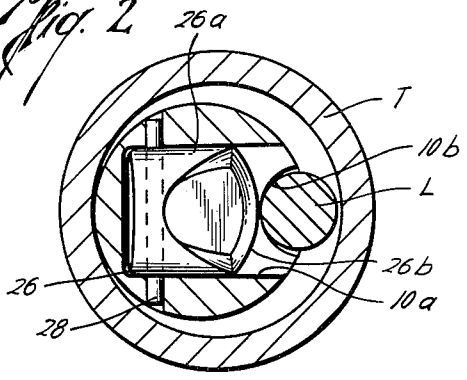


Fig. 1A

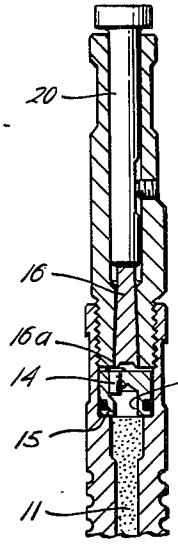


Fig. 3

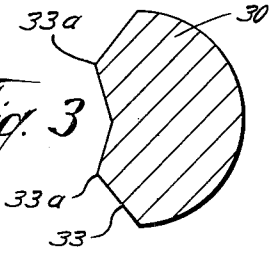
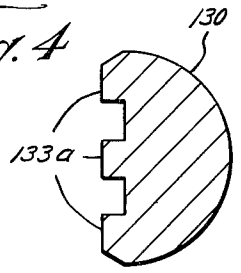


Fig. 4



John C. Kinley
INVENTOR.

BY Hayden & Pravel

ATTORNEYS

United States Patent Office 3,199,593 Patented Aug. 10, 1965

3,199,593

WIRE LINE SHOOTING TOOL

John C. Kinley, 5815 Royalton St., Houston, Tex.

Filed Aug. 9, 1963, Ser. No. 300,939
6 Claims. (Cl. 166—54.6)

This invention relates to new and useful improvements in wire line shooting tools.

In United States Patent No. 2,175,303, granted to M. M. Kinley, a wire line shooting tool is disclosed. Such tool is adapted to be dropped in a well so that it slides down a wire line or sand line to a rope socket or other point at which the line is to be cut. The cutting is effected in the well by detonating an explosive which serves to force a knife through the line to sever same. Thus, with such tool, a wire line can be cut at any depth in a well so as to make it possible to remove from the well the portion of the line above the cut, while making any equipment formerly on such line more accessible for a fishing operation.

It is an object of this invention to provide a new and improved wire line shooting tool having all of the advantages of the tool disclosed in said Patent No. 2,195,303, and in addition thereto, having a new and improved stop means for absorbing the shock of the knife-actuating wedge in the tool to thereby reduce the danger of splitting the tool barrel.

An important object of this invention is to provide a new and improved tool for cutting a wire line in a well, wherein a drive wedge is moved longitudinally in the tool barrel by the force of an explosion created within the tool, wherein the longitudinal movement of the drive wedge is stopped after it has driven a knife through a wire line or performed a similar function, and wherein the means for stopping the drive wedge is a stop wedge having one or more shock absorbing ridges on the face thereof which ridges are adapted to be displaced by the drive wedge to assist in absorbing the shock of stopping the drive wedge.

A particular object of this invention is to provide a new and improved wire line shooting tool of the type disclosed in U.S. Patent No. 2,185,303, wherein the drive wedge and stop wedge have their co-acting faces at a converging angle to each other to cause such faces to engage at their upper portions first, and wherein the stop wedge has one or more ridges on its face of a material which is softer than the material on the face of the drive wedge so as to cause a displacement of the material of the ridges by the contact of the drive wedge therewith.

The preferred embodiment of this invention will be described hereinafter, together with other features thereof, and additional objects will become evident from such description.

The invention will be more readily understood from a reading of the following specification and by reference to be accompanying drawings forming a part thereof, wherein an example of the invention is shown, and wherein:

FIGS. 1A and 1B are vertical sectional views, partly in elevation, which together illustrate the tool of this invention as it is lowered in a tubing or pipe for the cutting of a wire line or the like;

FIG. 2 is a horizontal sectional view taken on line 2—2 of FIG. 1B further illustrate the construction of the cutting knife of the tool of this invention;

FIG. 3 is a horizontal sectional view taken on line 3—3 of FIG. 1B to illustrate in particular the improved stop wedge construction; and

FIG. 4 is a horizontal sectional view similar to FIG. 3, but illustrating a modified form of the stop wedge employed in the tool.

In the drawings, the letter A designates generally the tool of this invention which is adapted to be dropped in a pipe or tubing T to a point at which a wire line, sand line, cable, or the like designated with the letter L is cut or severed.

The tool A has been illustrated in the drawings in a simplified form which includes a tubular barrel or body **10**, normally made up of several connected parts for ease of manufacture and assembly. The barrel **10** has an upper chamber **11** (FIGS. 1A and 1B) in which explosive powder is disposed, with a suitable retaining seal **12** at the lower end. One or more shotgun shells **14**, preferably three in number, are disposed above the explosive powder charge **11**. When three shells **14** are employed, a retaining cap **15** having a central bore **15***a* communicating with each of the shells **14** and with the powder **11** therebelow is provided. A firing pin **16** disposed above the shell or shells **14**, such pin **16** having a point or points **16***a* for contact with the shell or shells **14** so as to detonate same upon a downward blow on the pin **16**.

The downward blow on the pin **16** is provided by a firing head **20** which is slidably mounted in the upper end of the barrel **10**. During the normal use of the apparatus T, a weight (not shown) is dropped down the well within the tubing or pipe T so as to strike a blow on the firing head **20** and thus causing the firing pin **16** to detonate the shell or shells **14**, which results in the detonation or explosion of the explosive in the chamber **11**.

The explosion of the powder charge **11** is transmitted to a drive wedge **25** having an inclined or tapered surface **25***a*. The drive wedge **25** is disposed in the tubular body below the packing or seal **12**. The tapered surface **25***a* of the drive wedge **25** extends downwardly to a point **25***b* which is disposed partially behind a knife or cutting element **26**. The knife **26** is releasably secured in the bore of the tubular barrel or body **10** by means of a shear pin **28**. The knife **26** has a generally cylindrical body portion **26***a* which fits within and permits sliding in a laterally extending bore **10***a* so that upon a movement of the drive wedge **25** downwardly and a shearing of the pin **28**, the knife **26** is adapted to move laterally in such bore **10***a*. The knife edge **26***b* is preferably curved or arcuate, as best seen in FIG. 2, for more effectively cutting the cable or wire line L.

In the usual case, the tubular body or barrel **10** is provided with an external longitudinally extending guide groove **10***b* in which the wire line or cable L is positioned as the tool A slides down such line L in the pipe or tubing T. The line L is thus positioned for positive engagement by the knife edge **26***b* when the knife **26** is forced laterally through the line L by the drive member or wedge **25**.

A stop wedge or member **30** is mounted in the bore of the tubular body **10** below the knife **26** so as to stop the downward movement of the drive member **25** after it has forced the knife **26** laterally for the cutting of the line L. The stop wedge **30** is removably mounted in the bore of the body **10** by a retaining pin **32** which extends through the stop wedge **30** and the wall of the body or barrel **10**. Internal threads **30***a* are provided at the lower end of the stop wedge **30** in the usual case to facilitate removal of the wedge **30** if such becomes necessary or desirable. Internal threads **10***c* are provided in the lower end of the barrel or body **10** for receiving a plug or similar closure if desired.

The stop wedge **30** has a tapered or inclined surface **33** which is generally formed at an angle corresponding

substantially to the angle of the tapered or inclined surface 25*a* of the drive wedge 25. However, it is preferable to make the surfaces 33 and 25*a* extend at such angles that they are converging so that the upper portion of the surface 25*a* engages the upper portion of the inclined surface 33 prior to the engagement of the lower portions of such surfaces when the stop member 30 is acting to stop the downward movement of the drive wedge 25. For example the inclination of the tapered surface 25*a* may be approximately seven degrees with respect to the vertical axis of the barrel 10 while the inclination of the surface 33 may be six degrees with respect to such vertical axis.

Additionally, as best seen in FIG. 3, the inclined surface 33 is formed with one or more ridges 33*a* extending longitudinally on such surface 33. When the angles of the surfaces 33 and 25*a* are converging as explained above, the upper portions of the ridges or runners 33*a* are contacted first by the tapered surface 25*a*. The material of the stop member 30, or at least the face portion 33 thereof, is brass or a relatively soft material as compared to the material used for the drive wedge 25. Normally, the drive wedge 25 is made from hardened steel so that when the face 25*a* contacts the ridges 33*a*, they are flattened or displaced to absorb some of the shock of the downward movement of the drive member 25. Successive uses of the drive wedge 25 are possible without replacing the stop member 30 so that the ridges 33*a* may become progressively flattened or displaced downwardly along the upper portion of the surface 33 until they are no longer effective.

Although the ridges 33*a* are preferably constructed as illustrated in FIGS. 1B and 3, various modifications may be made within the scope of the teaching of this invention. For example, the face 33 may be formed with a single ridge 33*a* or a plurality of such ridges 33*a*, such ridges 33*a* being shown as triangular in cross-section in FIG. 3. The ridges 33*a* may be formed with flat surfaces and a rectangular shape in cross-section as indicated at 133*a* in FIG. 4. Thus, so long as the contacting ridge or ridges are formed to enable the material thereof to be displaced or flattened for absorbing the shock of the drive member 25, the particular configuration may vary as illustrated in connection with the forms of the stop members 30 and 130 shown in FIGS. 3 and 4, respectively, or as otherwise provided to accomplish such objectives.

The barrel or body 10 may have one more vent holes 10*d* through the wall thereof opposite the inclined surface 33 so as to permit the escape of most of the air or gas below the drive wedge 25 as it is forced downwardly. A small amount of the air or gas may be trapped below the lowermost hole 10*d* by closing same with the semi-cylindrical surface 25*c* of the wedge 25 as it moves downwardly to thereby form a gas cushion to further absorb the shock of stopping the drive wedge.

In the use or operation of the apparatus or tool A of this invention, such apparatus or tool A is positioned in the tubing T at the upper end of the well so as to slide downwardly on a wire line L or similar line in the well tubing T. Normally, the line L is connected to a piece of equipment that is stuck or is otherwise disposed at a relatively low elevation in the tubing T, and the apparatus A is thus lowered or dropped for the purpose of cutting the wire line L at a point near the rope socket or upper end of such piece of equipment. Thus, the apparatus or tool A falls by gravity and is guided along in the tubing T by the line L. When the tool A reaches the rope socket or the upper end of the equipment E and is thus stopped in its downward descent, the explosive 11 is actuated by dropping a weight (not shown) in the well. Such weight hits the firing head 20 and moves the firing pin 16 to initially detonate one or more shells 14. The shells in turn explode the explosive 11 and such explosion results in the driving of the wedge 25 downwardly.

Initially the downward movement of the wedge 25 severs the shear pin 28 and then the continued downward movement of the drive member 25 forces the knife 26 laterally through the line L to cut same. The downward movement of the drive wedge 25 is stopped by the engagement of the surface 25*a* and the ridges 33*a*, as explained above. Because of the particular construction of the stop wedge 30 as described above, the shock of stopping the wedge 25 is absorbed by the stop wedge to reduce the danger of splitting the barrel 10 or jamming the wedge 25 so tightly against the wedge 30 as to prevent release thereof for a subsequent use of the tool A.

The apparatus or tool A is then retrieved from the well with a conventional fishing tool or other suitable equipment (not shown). In some instances, it may be desirable to incorporate a gripping element for gripping the tool A to the line L, as illustrated in the prior Kinley Patent 2,185,303. In such case, the use of the fishing tool to retrieve the apparatus A may be unnecessary since the wire line L itself may be used for pulling the tool A out of the pipe or tubing T. Also, in some instances, where the tubing is of a considerably larger internal diameter than the combined cross-sectional dimensions of the line L and the tool A, a guide sleeve which fits around the cable or line L as shown in said Kinley patent may be used and mounted as a part of the body or barrel 10.

The foregoing disclosure and description of the invention is illustrative and explanatory thereof and various changes in the size, shape and materials, as well as in the details of the illustrated construction, may be made within the scope of the appended claims without departing from the spirit of the invention.

What is claimed is:

1. A wire line shooting tool for cutting a wire line in a well, comprising:
   (a) a tool barrel having an explosive charge therein,
   (b) a knife mounted in the barrel for lateral movement to effect a cutting of a wire line,
   (c) a drive wedge disposed in said barrel below said explosive charge and above said knife for longitudinal movement downwardly to drive the knife laterally when the explosive charge is detonated,
   (d) a stop wedge disposed in said barrel below said drive wedge,
   (e) said drive wedge and said stop wedge having inclined co-acting faces with substantially the same angle of inclination for contact to stop the longitudinal movement of the drive wedge in the tool barrel, and
   (f) said stop wedge having a longitudinally extending ridge on its inclined face which is made of a deformable metal and is adapted to be deformed upon contact by the face of the drive wedge to assist in absorbing shock as the longitudinal movement of the drive wedge is stopped.

2. A wire line shooting tool for cutting a wire line in a well, comprising:
   (a) a tool barrel having an explosive charge therein,
   (b) a knife mounted in the barrel for lateral movement to effect a cutting of a wire line,
   (c) a drive wedge disposed in said barrel below said explosive charge and above said knife for longitudinal movement to drive the knife laterally when the explosive charge is detonated,
   (d) a stop wedge disposed in said barrel below said drive wedge,
   (e) said drive wedge and said stop wedge having inclined co-acting faces with substantially the same angle of inclination for contact to stop the longitudinal movement of the drive wedge in the tool barrel, and
   (f) said stop wedge having a plurality of longitudinally extending laterally spaced inclined ridges on its inclined face which are made of a deformable metal which is adapted to be deformed upon contact by the face of the drive wedge to assist in absorbing shock as the longitudinal movement of the drive wedge is stopped.

3. A wire line shooting tool for cutting a wire line in a well, comprising:
(a) a tool barrel having an explosive charge therein,
(b) a knife mounted in the barrel for lateral movement to effect a cutting of a wire line,
(c) a drive wedge disposed in said barrel below said explosive charge and above said knife for longitudinal movement to drive the knife laterally when the explosive charge is detonated,
(d) a stop wedge disposed in said barrel below said drive wedge,
(e) said drive wedge and said stop wedge having inclined co-acting faces with substantially the same angle of inclination for contact to stop the longitudinal movement of the drive wedge in the tool barrel, and
(f) said stop wedge having a plurality of longitudinally extending laterally spaced inclined ridges on its face each of which is made of a deformable metal and has a substantially triangular shape in cross-section.

4. A wire line shooting tool for cutting a wire line in a well, comprising:
(a) a tool barrel having an explosive charge therein,
(b) a knife mounted in the barrel for lateral movement to effect a cutting of a wire line,
(c) a drive wedge disposed in said barrel below said explosive charge and above said knife for longitudinal movement to drive the knife laterally when the explosive charge is detonated,
(d) a stop wedge disposed in said barrel below said drive wedge,
(e) said drive wedge and said stop wedge having inclined co-acting faces with substantially the same angle of inclination for contact to stop the longitudinal movement of the drive wedge in the tool barrel, and
(f) said stop wedge having a plurality of longitudinally extending laterally spaced inclined ridges on its face each of which is made of a deformable metal and has a substantially rectangular shape in cross-section.

5. A wire line shooting tool for cutting a wire line in a well, comprising:
(a) a tool barrel having an explosive charge therein,
(b) a knife mounted in the barrel for lateral movement to effect a cutting of a wire line,
(c) a drive wedge disposed in said barrel below said explosive charge and above said knife for longitudinal movement to drive the knife laterally when the explosive charge is detonated,
(d) a stop wedge disposed in said barrel below said drive wedge,
(e) said drive wedge and said stop wedge having co-acting inclined faces for contact to stop the longitudinal movement of the drive wedge in the tool barrel,
(f) the co-acting inclined face of the drive wedge being formed at greater angle with respect to vertical than the inclined face of the stop wedge to cause said faces to engage at their upper portions first, and
(g) said stop wedge having a longitudinally extending ridge on its inclined face which is made of deformable material adapted to be deformed upon contact of the upper portion of the face of the drive wedge with the upper portion of such ridge to assist in absorbing shock as the longitudinal movement of the drive wedge is stopped.

6. A wire line shooting tool for cutting a wire line in a well, comprising:
(a) a tool barrel having an explosive charge therein,
(b) a knife mounted in the barrel for lateral movement to effect a cutting of a wire line,
(c) a drive wedge disposed in said barrel below said explosive charge and above said knife for longitudinal movement to drive the knife laterally when the explosive charge is detonated,
(d) a stop wedge disposed in said barrel below said drive wedge,
(e) said drive wedge and said stop wedge having co-acting inclined faces for contact to stop the longitudinal movement of the drive wedge in the tool barrel,
(f) said stop wedge having a longitudinally extending ridge on its inclined face which is deformable upon contact by the face of the drive wedge to assist in absorbing shock as the longitudinal movement of the drive wedge is stopped, and
(g) said ridge being formed of a material which is soft as compared to the material on the face of said drive wedge.

References Cited by the Examiner

UNITED STATES PATENTS

870,762	11/07	Burge	173—131
2,426,106	8/47	Kinley	166—55.3 X
2,723,532	11/55	Smith	173—131
2,794,619	6/57	Lawrence et al.	166—54.6

CHARLES E. O'CONNELL, *Primary Examiner.*