United States Patent

[11] 3,599,734

[72] Inventors **Nathandale Farris**
1500 North Woodland Road;
Tibor O. Edmond, 304 North Sixth St, both of Ponca City, Okla. 74601

[21] Appl. No. **847,913**
[22] Filed **Aug. 6, 1969**
[45] Patented **Aug. 17, 1971**

[54] **NOTCHING TOOL**
3 Claims, 4 Drawing Figs.

[52] **U.S. Cl.** **175/173,** 175/272, 175/285
[51] **Int. Cl.** **E21b 9/26**
[50] **Field of Search** ..... 175/173, 202, 258—261, 263, 265, 272, 273, 279—281, 284—286, 77, 78; 166/55.6, 55.7; 30/103, 107

[56] **References Cited**

UNITED STATES PATENTS

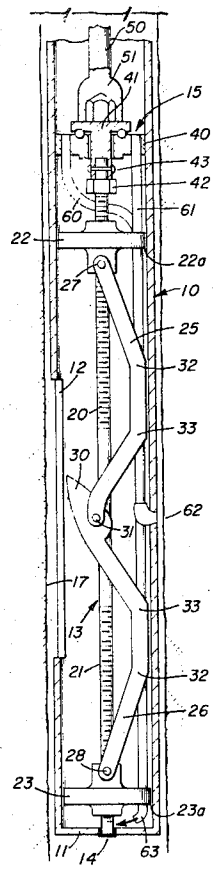
84,852	12/1868	Beach	175/272 X
821,816	5/1906	Myrick	30/107
1,561,523	11/1925	Riedle	175/285 X
1,614,368	1/1927	Kergan	175/202
1,822,216	9/1931	Hartson	175/272
2,372,875	4/1945	Benke	175/78

FOREIGN PATENTS

331,945	7/1930	Great Britain	175/202

Primary Examiner—David H. Brown
Attorneys—Joseph C. Kotarski, Henry H. Huth, Jerry B. Peterson, William J. Miller and David H. Hill

ABSTRACT: An apparatus for forming a biconical notch by moving a symmetrical extendable cutter out of a rotating drill casing into the formation. Once the biconical notch is completed, the extending device can be retracted back into the drill casing and the casing removed.



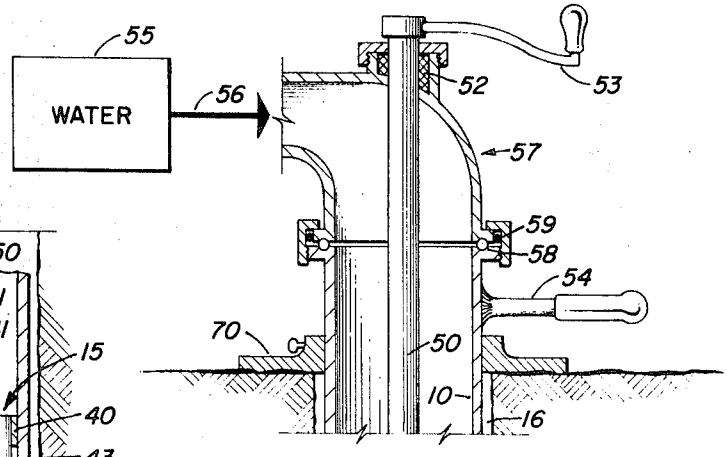


FIG. 3

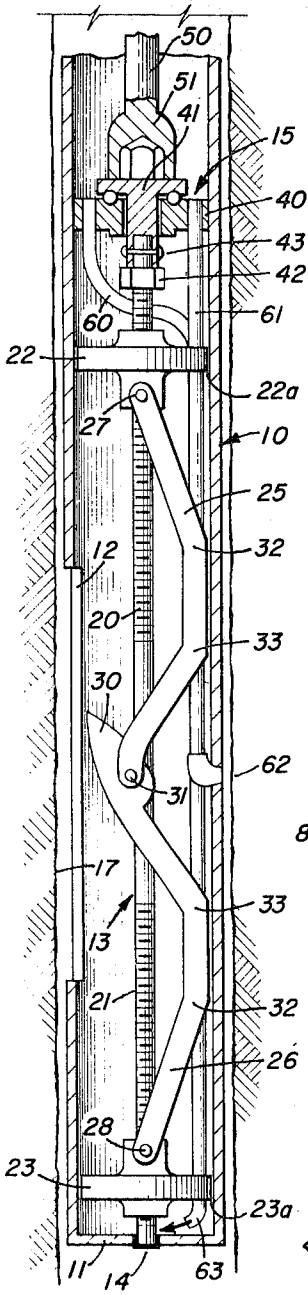


FIG. 1

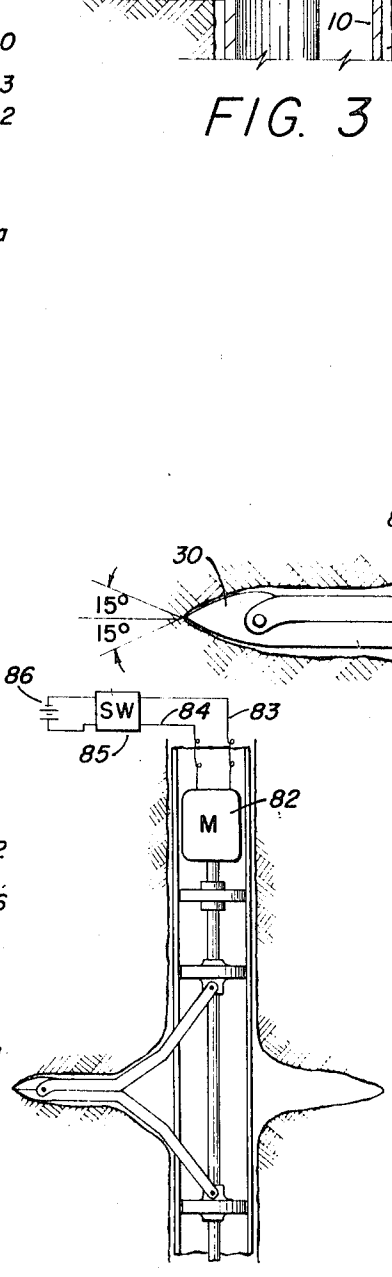


FIG. 4

FIG. 2

INVENTORS
NATHANDALE FARRIS
TIBOR O. EDMOND
BY
ATTORNEY

NOTCHING TOOL

BACKGROUND OF THE INVENTION

Description of the Prior Art

The normal method for causing a horizontal fracture in a formation is to use either a jet, such as fluid impinging on the wall of a well bore at a high velocity and rotating the jet through 360°, or a high-velocity projectile or projectiles. It is normally assumed that the jet will cut a horizontal slice in the formation; however, it has been found that even if the jet does form a horizontal slice, the fracture will not always be horizontal since the forces may not be concentrated properly. It has been discovered, however, that a biconical notch horizontally formed in a formation having a sharp edged periphery will concentrate the forces in a manner to cause a proper horizontal fracture.

SUMMARY OF THE PRESENT INVENTION

This invention will form a biconical notch in a formation providing a superior cross-sectional form for horizontal fracture. The invention essentially consists of a tubular housing having an extendible notching tool confined inside the housing. The notching tool consists of two bars joined at one end by a pivot. The other end is attached to a bearing on an extending and retracting mechanism. A sharp cutting end is attached to one of the bars at the common pivot point. The sides of the bars are formed to shape a notch having a conical cross section in the wall of the bore hole.

This invention has several advantages. First, it can be easily inserted into a bore hole since it can be collapsed to the same diameter as the tubular housing. Second, it forms a nearly ideally shaped notch having conical sidewalls and a sharp periphery so that the concentrated stresses will be equally applied in all directions around the notch, causing the fracture resulting from the stresses to propagate in all directions in a horizontal plane. Further, the notch is cut deeply into the formation and symmetrically about a vertical axis to insure that the fracture will propagate in all directions along the horizontal plane.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 shows a cross-sectional view of the housing, with the extending mechanism shown in full view;

FIG. 2 shows a portion of the notching tool in cross-sectional view with the extending mechanism in full view and fully extended;

FIG. 3 shows one method, up hole, for extending and retracting the notching tool; and

FIG. 4 shows a second method for extending and retracting the notching tool.

DETAILED DESCRIPTION OF A PREFERRED EMBODIMENT OF THE INVENTION

Referring to all of the drawings, but in particular to FIG. 1, the preferred embodiment of a biconical notching tool is shown having a tubular housing **10** which has a bottom **11** and a longitudinally extended notch **12** cut through the wall of the housing. A rod **13** is mounted axially inside of the tube into a bearing **14** formed in the bottom **11** of housing **10** and secured at the other end by assembly **15**. Formed into rod **13** are threads **20** and **21**. Threads **20** and **21** must be of opposite hand, for example, if thread **20** is a right-hand thread, then thread **21** must be a left-hand thread. A pair of extending means **22** and **23** are threaded onto rod **13**. The outer diameter **22A** or **23A** must be sufficient to transmit the cutting forces to permit ease of movement of extender means **22** or **23** longitudinally inside tubular housing **10**. The clearance should also permit free passage of water so that accumulation of mud and chips can escape between extender means **23** and bottom **11**. Bottom **11** is not necessary for the operation of the tool

but in this embodiment does furnish a good bearing mount for the rod. It is obvious, of course, that holes can also be formed through the extender means **22** or **23** to permit passage of liquids. The notching tool consists of a pair of arms **25, 26** and a cutting end **30**. Arm **25** is attached to extender means **22** at pivot **27** and arm **26** is attached to extender means **23** by a pivot **28**. Cutting end **30** is attached to arm **26** and may be made of a hardened steel or edged with tungsten carbide to provide longer life and better cutting action. Arms **25** and **26** are connected to each other by a pivot point **31**.

The assembly can be retracted completely within the housing **10** by virtue of the shape of arms **25** and **26**. The entire assembly is extended or retracted by means of assembly **15** which consists of a mount **40**, a shaft, bearing combination, and hexagonal extension **41**. One end of the shaft **41** is threaded to receive rod **13**. A nut **42** is tightened against shaft **41** to prevent accidental rotation of the shaft and a pin **43** is passed through the entire combination of shaft and rod to further insure that the system will not loosen during use. A turning shaft **50** having a hexagonal socket **51** is slipped down housing **10** and coupled over the hexagonal extension of shaft **41**. Shaft **50** (see FIG. 3) is then passed through a seal **52**, and a handle **53** is affixed to the end of the shaft **50**. Housing **10** also has attached to it a handle **54** for rotation of the housing **10** about bore hole **16**. Cleaning of the down hole equipment, that is, removal of mud and chips, is accomplished by having a water source **55** connected through a pipe **56** to a swivel joint **57** having the usual bearings **58** and seal **59**. The water passes down the inside of housing **10** to a pair of pipes, for example, **60** and **61**. Pipe **61** connects with a jet **62** and pipe **60** has an opening **63** near the bottom **11** of housing **10**.

OPERATION

To form a biconical notch, the entire housing **10** is lowered into a bore hole to a point where the slot **12** is centrally located over the area to be notched. Once the pipe is in the proper location, an anchor plate **70** is secured to the housing to prevent further downward movement of the housing **10**. Other means than anchor plate **70** can be used, for example, hooks can be mounted on pipe flange **57** and the entire apparatus suspended by a cable suspended above the hole. The water **55** is then turned on and the handle **53** rotated in a manner to cause extender means **22** and **23** to move closer together. Since the threads are of opposite hand, rotating rod **10** in one direction will cause extender means to move together and rotation of the rod in the opposite direction will cause the extender means to move away from each other. The handle **53** will be rotated sufficiently to cause cutting end **30** to engage the wall **17** of bore hole **16**. Once the point engages the wall, handle **54** is rotated sufficiently to cause housing **10** to move through 360°. Continuous pressure of the cutting end **30** against the bore hole will be accomplished by applying continuous pressure to handle **53** while handle **54** is being rotated through 360°. Continuous pressure by handle **53** will eventually cause extender means **22** and **23** to urge the cutting end **30** fully into the formation. As it does so, however, the sides of arms **25** and **26** (see FIG. 2) will begin to engage at a point **80** in the wall of the bore hole cutting away this area and forming a biconical slot. During the cutting operation, jets **62** and **63** will be flushing away the cut particles moving them uphole and away from the cutting operation. It is obvious, of course, that additional jets can be used whenever they are needed. Once the notch is fully cut, rotation of handle **54** can be stopped and rotation of handle **53** will commence in the opposite direction, causing rod **20** to rotate in the opposite direction, moving extender means **22** and **23** away from each other. Arms **25** and **26** will retract back into the inside of housing **10**. The entire assembly can then be lifted out of the hole and the fracturing procedure commenced. Another method for extending and retracting the arms **25** and **26** can be an electrical motor **82** (see FIG. 4). A pair of wires **83** and **84** are connected serially through a switch **85** and a battery

86. Switch 85 is a reversing switch so that operation of the switch will cause the motor to rotate in one direction and operation of the switch in the opposite direction will cause the motor to rotate in the opposite direction. In operation, switch 85 would be closed until the motor ceased operating, indicating the cutting end 30 was engaging the bore hole wall. Handle 54 would then of course be rotated and the motor periodically operated, maintaining the end 30 continuously in contact with the bore hold wall. Once the slot was cut, the switch would be reversed and the apparatus retracted and lifted from the bore hole in the usual manner. Obviously, a clutch could be employed so that the switch need not be operated in an intermittent manner. It is also obvious that other apparatus can be employed to retract cutting end 30.

The notching tool, as above described, will cut a deep notch symmetrically located about a vertical axis. The tool will also form a notch having a sharp periphery. The symmetrically formed notch will provide equal application of fracturing pressures at every point along the periphery of the notch. The sharp edge periphery will form a high stress location, resulting in a fracture radiating out from the high stress location in every direction. It should also be noted that the walls of the notch meeting the sharp edged periphery have the same angle with respect to the horizontal plane passing through the periphery. A uniform angle will result in the fracturing stresses falling on the horizontal plane and not at some other undesirable direction. In addition to the above, the threaded rod 13 has an extremely desirable effect on the movement of the point 30 into the formation; for example, at the initial point of penetration, the point will be moving fairly rapidly into the formation for each rotation of the rod; however, as point 30 enters its maximum extend into the formation, it will be moving at a fairly slow rate in comparison to the initial rate of movement into the formation. The differential rates of movement of the point 30 per rotation of the rod is desirable since it affords much better control of the notching process. The particular shape of the arms 25 and 26 also provide for an extremely deep, narrow notch, yet the rods will maintain sufficient strength to cut the notch in most formations and will also permit complete retraction of the notching mechanism into the housing. In the preferred embodiment of this invention, point 30 has an angle of approximately 30°, or when fully extended, 15° on each side of the horizontal plane. This is illustrated in FIG. 2.

It is of course obvious that this device will work best when used in plastic soils, such as clay mixed with sand. However, the tool should work equally well in harder and consolidated formations by proper design of the cutting edge. One device built in accordance with the teachings of this invention produced a notch approximately six times the tool diameter.

What we claim is:

1. A notching tool for the wall of a bore hole comprising:
   a. a tubular housing having an elongated longitudinal slot therethrough;
   b. first and second spaced extender means;
   c. a threaded rod means one-half of which is threaded in the opposite direction from the remaining half, each set of threads having screwed thereon one of said spaced extender means,
   d. means connected to one end of said threaded rod for turning said rod about its axis;
   e. first and second symmetrically formed notching members pivotally attached at one end to each other and at the other end to said first and second spaced extender means to uniformly urge said first and second symmetrically formed notching members out of said slot; and
   f. notching means attaching at one end to the pivotal end of said first notching member, the remaining end having a sharp periphery with a cutting angle of approximately 30°.

2. A device as described in claim 1 wherein said rotating means comprises an electrical motor.

3. A device as described in claim 1 wherein said rotating means comprises an elongated rod coupled to said threaded rod at one end and to handle at the other end, the length of said elongated rod being sufficient to extend out of said bore hole.