Casing Cutting and Pulling Tool

Inventor
Bruce Barkis.
UNITED STATES PATENT OFFICE

BRUCE BARKES, OF HERMOSA BEACH, CALIFORNIA

CASING CUTTING AND PULLING TOOL

Application filed November 3, 1926. Serial No. 145,925.

This invention has generally to do with pipe cutters or perforators; and as will be readily gathered from the following description, the invention may be utilized for cutting or perforating pipe in any situation.

The preferred embodiment of the invention, however, without thereby limiting the invention, is herein described as a form of pipe cutting or pulling device adapted particularly for working on pipe in the well.

As applied more particularly to cutting well pipe and the like, it is a general object of the invention to provide a device that is both efficient and reliable in its action, and also to provide a device that may be used not only for cutting through or cutting off a pipe, but also that may be used for pulling the pipe if so desired.

Other objects of the invention will best appear throughout the following detailed description, together with the corresponding accomplishments and advantageous features.

For the purpose of the following detailed description of a preferred and specific form embodying the invention, I refer to the accompanying drawings, in which:

Fig. 1 is a longitudinal vertical section showing an improved tool;
Fig. 2 is a horizontal section on line 2—2 of Fig. 1;
Fig. 3 is a view similar to Fig. 1, but showing the operating parts in another operating position;
Fig. 4 is a cross-section on line 4—4 of Fig. 3; and
Fig. 5 is a similar horizontal section showing a modified structure.

In the drawings a barrel is shown at B equipped at its upper end with a threaded box 10 adapted to receive a hub 11 through which the tool may be connected to the lower end of the drill pipe or tubing or the like. The drill pipe shown at 12 may be taken to typify any hollow pipe by which the tool is suspended and rotated through which fluid under pressure may be introduced to the working parts of the tool.

Barrel B is preferably made of a size to fit the interior of a casing or pipe through which the tool is inserted and on which the tool is to operate. In practice the exterior diameter of barrel B will be enough less than the interior diameter of the pipe or casing C to allow the barrel to easily pass down through the pipe. Inside barrel B is a plunger 8, the upper end of which may be fashioned as a piston 13 equipped at its upper end with a cup leather 14. Any suitable arrangement may be used on the piston to make a fluid tight joint between the piston and the wall of barrel B, but a cup leather such as shown at 14, held down by a ring 15, constitutes a practical means for that purpose.

A valve controlled passage leads through piston 16, as shown at 16 and 17, the lower part of the passage in the piston being divided to form two passages 17a in order to straddle the upper end of mandrel 18 which depends from the lower face of the piston. Within passage 16 there is a valve seat 16a on which a half valve 20 is adapted to seat downwardly, a retaining ring 21 preventing the ball from lifting out of position. The ball and its seat form an upwardly opening valve controlling the passage through the piston, for purposes to be hereinafter described.

Plunger 9 also includes a downwardly pointing conical mandrel or wedge 18 which depends centrally from piston 16 and at its upper end this conical mandrel has a reduced portion 18a presenting an upwardly facing shoulder 18b. In the annular recess 18c thus formed above shoulder 18b a split collar 19 may be inserted if desired, the collar being held in place by bolts or screws 19a.

At the lower end of barrel B there is an inwardly extending head flange 25 through the central opening 26 of which the mandrel 18 may move downwardly. Communicating with the interior of the barrel just above head flange 25 is a passage 27, and there is also a port 28 through the wall of the barrel at such a distance above head flange 25 that this port 28 will be uncovered by the piston when the piston has reached its lowermost position resting upon head flange 25, as is shown in Fig. 3.

Below head flange 25 the barrel has a depending annular flange 29 within which the cutter carriers 30 are mounted. In the form
shown in Figs. 1 to 4 these cutter carriers are illustrated as three in number, although they may be of any suitable number, and each carrier is pivotally mounted on a pivot pin 31. These pivot pins are set at their ends in head flange 25 and in a head 32, head 32 being held to barrel B by suitable bolts or cap screws 33. Head 32 has a reduced portion 32a which extends upwardly inside flange 29 and the cutter carriers 30 are moveable confined between the upper face of head 32 and the lower face of flange 25.

Any desired type of cutter may be mounted on the cutter carriers, and generally speaking the cutters may be either for pipe perforation or for pipe cutting. In the present drawings I have shown cutters for cutting of pipe, these cutters being shown at 35 and 36. And the cutters may be either in the form of a standard cutting tool, as at 35, or in the form of a cutting roller, as at 36, or a combination may be used as shown in Fig. 2. When the cutter carriers are in their contracted positions the cutters are just within the circle of the exterior of the barrel and a stop lug 37 on each carrier rests back against an adjacent carrier near its pivot point, as shown in Fig. 2. Lugs 37 also present shoulders against which the contracting springs 39 are arranged to press. Flange 29 has openings 29a opposite each cutter and through which the cutters are projected as shown in Fig. 4.

The lower small end of mandrel 18 extends below cutter carriers 30. Where it extends through the cutter carriers it engages with each of them on the surface 30a, these surfaces being preferably conoidal so as to give good bearings between the mandrel and the carriers. The small end of the wedge, when said wedge is in normal position of Fig. 1, thus establishes or predetermines the limit of inward or retractive movement of the cutters. It will be noted that collar 19 is of less diameter than that of the large end of the wedge and of greater diameter than the smaller end of the wedge and that, when it is applied to the mandrel, its peripheral face 19a defines the effective bottom of recess 18c. At the lower end of the mandrel below the carriers there is a spring seat 40 against which a compression spring 41 presses upwardly, this compression spring being preferably only strong enough to hold the mandrel and piston upwardly when there is no unbalanced pressure pressing the piston down. Spring 41 is enclosed within a tube 42, tube 42 being threaded at its upper end into head 32, tube 42 being closed at its end by a cap 43 which forms the seat for the spring. Spring seat 40 traveling in tube 42 also forms a guide for the lower end of the mandrel.

In using my improved device it is lowered into the pipe in the condition shown in Fig. 1, the drill pipe or tubing being lowered until the tool has reached the point where it is desired to operate on the pipe. If there is fluid standing in the well, as is usually the case, it is desirable to allow that fluid entry to the interior of the drill pipe or tubing because otherwise at any substantial depth the drill pipe or tubing would become so buoyant that the whole string would have to be forced down. As the device is lowered in the well the fluid in the well can pass inwardly through openings 27 and 28 into the barrel and thence upwardly through the piston passages, past valve 20 and up into the tubing or drill pipe, thus keeping the liquid level in the tubing or drill pipe at the height of the liquid level outside. Furthermore, this free passage of the liquid keeps pressures on piston 13 equalized at all times and prevents any heavy unequalized pressure on the lower face of the piston.

Having arrived at the point where it is desired to operate on the pipe or casing, a suitable pump pressure is then put upon the liquid within the drill pipe or tubing, in the manner well known to the art. Pressure is thus exerted upon the upper face of the piston and the piston is moved down, moving mandrel 18 downwardly and expanding or radially projecting the cutters against the inner face of the pipe. If it is desired merely to perforate through the pipe the device need not be rotated; but in the typical instance of completely cutting off a part of the pipe the whole device is rotated through the medium of the drill pipe or tube at the same time that the piston and mandrel are forced down by pressure. Keeping a suitable pressure upon the piston, and rotating the whole device, the cutters cut outwardly through the pipe C until they have cut clear through the pipe 105 and project on its exterior. This position of parts is shown in Figs. 3 and 4. When the cutters have reached their most expanded position and they have cut clear through the pipe—having reached their most expanded positions, the mandrel 18 is in a position just above that shown in Fig. 3, the upper end of the mandrel holding the cutter carriers outwardly as will be readily understood. As the piston reaches the position shown in Fig. 3 it uncovers port 28 so that pressure above the piston is relieved by port 28, and when the piston reaches its lowermost position, as shown in Fig. 3, then port 28 is fully uncovered. After the lower edge of the piston has passed port 28 the passage 27 allows escape of the liquid trapped at its upper end into head 32, tube 42 being closed at its end by a cap 43 which forms the seat for the spring. Spring seat 40 traveling in tube 42 also forms a guide for the lower end of the mandrel.

In using my improved device it is lowered into the pipe in the condition shown in Fig. 1, the drill pipe or tubing being lowered until the tool has reached the point where it is desired to operate on the pipe. If there is fluid standing in the well, as is usually the case, it is desirable to allow that fluid entry to the interior of the drill pipe or tubing because otherwise at any substantial depth the drill pipe or tubing would become so buoyant that the whole string would have to be forced down. As the device is lowered in the well the fluid in the well can pass inwardly through openings 27 and 28 into the barrel and thence upwardly through the piston passages, past valve 20 and up into the tubing or drill pipe, thus keeping the liquid level in the tubing or drill pipe at the height of the liquid level outside. Furthermore, this free passage of the liquid keeps pressures on piston 13 equalized at all times and prevents any heavy unequalized pressure on the lower face of the piston.

Having arrived at the point where it is desired to operate on the pipe or casing, a suitable pump pressure is then put upon the liquid within the drill pipe or tubing, in the manner well known to the art. Pressure is thus exerted upon the upper face of the piston and the piston is moved down, moving mandrel 18 downwardly and expanding or radially projecting the cutters against the inner face of the pipe. If it is desired merely to perforate through the pipe the device need not be rotated; but in the typical instance of completely cutting off a part of the pipe the whole device is rotated through the medium of the drill pipe or tube at the same time that the piston and mandrel are forced down by pressure. Keeping a suitable pressure upon the piston, and rotating the whole device, the cutters cut outwardly through the pipe C until they have cut clear through the pipe 105 and project on its exterior. This position of parts is shown in Figs. 3 and 4. When the cutters have reached their most expanded position and they have cut clear through the pipe—having reached their most expanded positions, the mandrel 18 is in a position just above that shown in Fig. 3, the upper end of the mandrel holding the cutter carriers outwardly as will be readily understood. As the piston reaches the position shown in Fig. 3 it uncovers port 28 so that pressure above the piston is relieved by port 28, and when the piston reaches its lowermost position, as shown in Fig. 3, then port 28 is fully uncovered. After the lower edge of the piston has passed port 28 the passage 27 allows escape of the liquid trapped at its upper end into head 32, tube 42 being closed at its end by a cap 43 which forms the seat for the spring. Spring seat 40 traveling in tube 42 also forms a guide for the lower end of the mandrel.
enough to relieve all pressure from above the piston, so that continuance of the pump pressure above the piston will force the piston on downwardly to its lowermost position as shown in Fig. 3. In this position the shoulder 182 of mandrel 18 has passed cutter carriers 30 and the cutter carriers have sprung inwardly over shoulder 185. If the removable collar 19 is in place as shown in Fig. 3, the cutter carriers spring inwardly only a short distance, bringing up against collar 19. Since collar 19 is of greater diameter than the small end of the wedge, it serves to hold the cutters from the movement inwardly to their positions of full retraction. In this position of the parts the cutters still project through the pipe and the cutter carriers lock mandrel 18 down by their engagement with shoulder 185. Consequently, the whole device is locked in the position shown in Fig. 3, with the cutters extending outwardly under the piece of pipe that has been cut from the pipe below, and the upper piece may then be pulled by hoisting the tool through the medium of the drill pipe or tubing.

If it is not desired to hoist the severed piece of pipe with the tool itself, split collar 19 is removed from the position shown in the drawings, so that when the mandrel has reached its lowermost position and the cutter carriers spring in over shoulder 185, the carriers and their cutters are then contracted to the same contracted position as shown in Figs. 1 and 2, the reduced portion 18a of mandrel 18 being substantially of the same diameter as the lower small end of the mandrel which normally lies between the cutter carriers when the cutters are contracted. With the cutter carriers so contracted about 18a, the tool can then be lifted out of the well without pulling the severed piece of pipe.

There is an advantage in contracting the cutters with the mandrel at its lowermost position. The cutters of course could be contracted by moving the conical mandrel upwardly, to put the parts back in the relative positions shown in Fig. 1. But such an operation depends upon the action of spring 41 and cannot be infallibly depended upon.

The tool may be somewhat stuck with mud so that spring 41 cannot move mandrel 18 upwardly; but no matter how difficult the tool may operate due to the presence of mud, etc., a liquid pressure can be brought to bear upon the face of the piston to make it move down to its lowermost position without fail.

The advantages of the tool lie largely in its positiveness of action. The cutters are positively forced out against the pipe, being solidly backed by the mandrel 18. The amount of pressure on the cutters can easily be regulated by control of the liquid pressure at the top of the well. When the cutters have cut through the casing, and as the piston goes to its lowermost position, pressure is relieved, giving a signal at the top of the well, and the cutters spring back towards their contracted position without any necessity of upward movement of the mandrel. If for any reason springs 38 should fail to move the cutters inwardly, further rotation of the tool will cause the cutters positively to move back—to swing back about their pivot points 31. When the cutters have cut through the casing they will frictionally engage the sides of the cut, and when the mandrel is in such a position that it no longer supports the cutters outwardly, further rotation (in a right hand direction in Fig. 2) will cause the cutters to swing back on their pivots. And usually rotation of the tool will not be stopped until after the mandrel has reached its lowermost position. So, if springs 38 for any reason should fail to throw the cutter carriers inwardly over shoulder 185, rotation of the tool after the mandrel has reached its lowermost position will do the same thing.

As I have stated before, and depending upon whether collar 19 is used or not, the cutters are positively finally thrown either to a position to extend under the severed piece of pipe or to a fully contracted position, and this action is positive and dependable. Using the outer locking position of the cutters it is an advantageous feature of my tool that pipe can be cut and pulled by the same series of operations. In either case, the mandrel and piston are locked in lower position, and in this position port 28 is uncovered above the piston to allow escape of fluid from the drill pipe or tubing as the tool is hoisted.

Fig. 5 shows a modified arrangement of the cutter carriers wherein the cutter carriers are radially movable instead of pivotally movable. Here the cutter carriers 30e slide radially between guide blocks 50. The cutters 35 and 36 may be the same as before described. The springs 38e for contracting the cutter carriers may be arranged as shown in Fig. 5, each spring acting upon two cutter carriers at its opposite ends. These sliding cutter carriers may be used, if desired, instead of the pivoted carriers.

I claim:

1. An expansible tool of the character described, comprising a body, cutter carriers mounted on the body and expansively movable outwardly with relation thereto, a wedge movable longitudinally of itself and transversely of the expansive movement of said cutters, said wedge having at its larger end a recessed portion into which said carriers may move inwardly, and a removable filler for said recess to limit inward movement of said carriers into the recess.

2. In an expansible tool of the character described, the combination of a transversely movable cutter carrier and a longitudinally movable wedge member engaging said cutter carrier and adapted to wedge it outwardly.
by virtue of its longitudinal movement, the wedge member having at its larger end a recessed portion into which the carrier may move inwardly, and a removable filler for said recessed portion to limit inward movement of said carrier.

3. An expansive tool of the character described, comprising a vertical barrel adapted at its upper end to be connected to a pipe, a vertically movable piston in said barrel, a conical wedge member depending from said piston with its smaller end lowermost, a plurality of expansive transversely movable cutter carriers mounted in the barrel in a plane near the normal position of the lower smaller end of the conical wedge, said wedge entering between the several cutter carriers and adapted upon downward movement to force said cutter carriers outwardly, and a recessed portion at the upper end of said wedge under the piston and into which the cutter carriers may move inwardly, the wedge having an upwardly facing shoulder immediately below said recessed portion and over which upwardly facing shoulder the cutter carriers move inwardly to lock said wedge in its lowermost position, and a removable collar fitting in said recessed portion to limit inward movement of said carriers.

4. An expansive tool of the character described, comprising a vertical barrel adapted at its upper end to be connected to a pipe, a vertically movable piston in said barrel, a conical wedge member depending from said piston with its smaller end lowermost, a plurality of expansive transversely movable cutter carriers mounted in the barrel in a plane near the normal position of the lower smaller end of the conical wedge, said wedge entering between the several cutter carriers and adapted upon downward movement to force said cutter carriers outwardly, and a recessed portion at the upper end of said wedge under the piston and into which the cutter carriers may move inwardly, the wedge having an upwardly facing shoulder immediately below said recessed portion and over which upwardly facing shoulder the cutter carriers move inwardly to lock said wedge in its lowermost position, and a removable collar adapted to partially fill said recessed portion so as to leave exposed the outer edge of said upwardly facing shoulder and to limit inward movement of said carriers.

5. An expansive tool of the character described, comprising a substantially cylindrical barrel adapted at its upper end to be connected to a pipe, a piston vertically movable in the barrel and adapted to be moved downwardly by fluid pressure applied from the pipe, a depending wedge mounted on the under side of the piston with its small end downwardly, a transversely movable cutter carrier mounted in the barrel and engageable by the wedge to be moved transversely out-