Feb. 2, 1937. D. H. REED 2,069,593

OUTSIDE PIPE CUTTER

Filed July 26, 1934 3 Sheets-Sheet 1

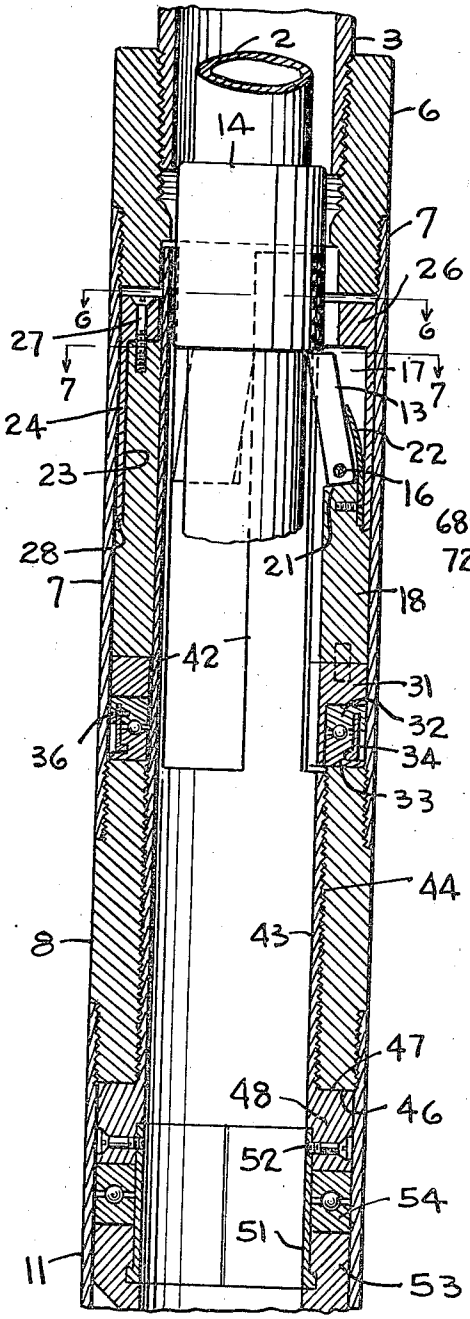


Fig. 1.

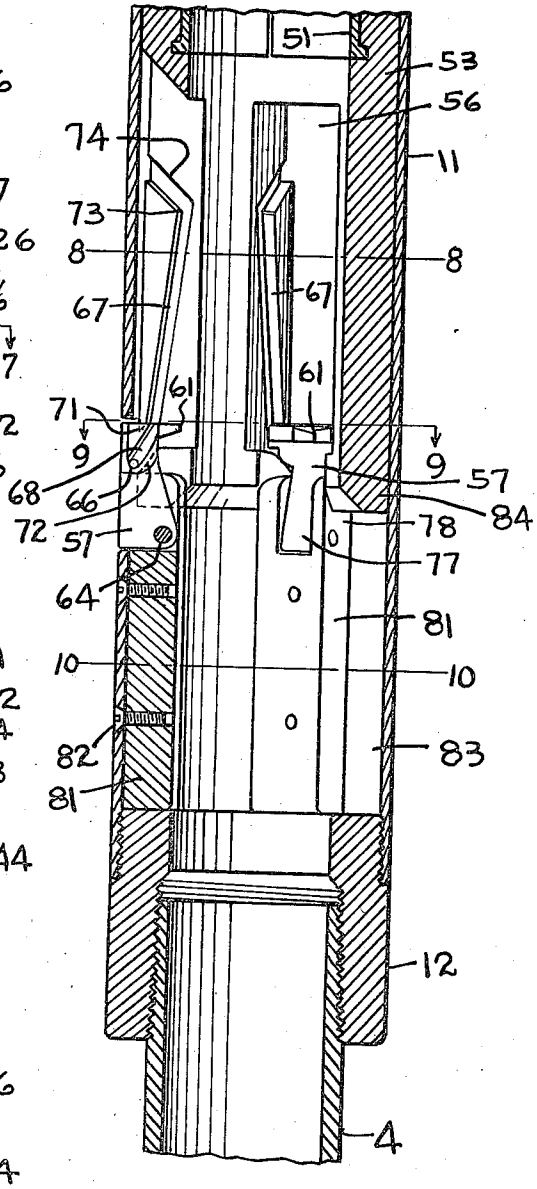


Fig. 2.

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Filed July 26, 1934 3 Sheets-Sheet 2

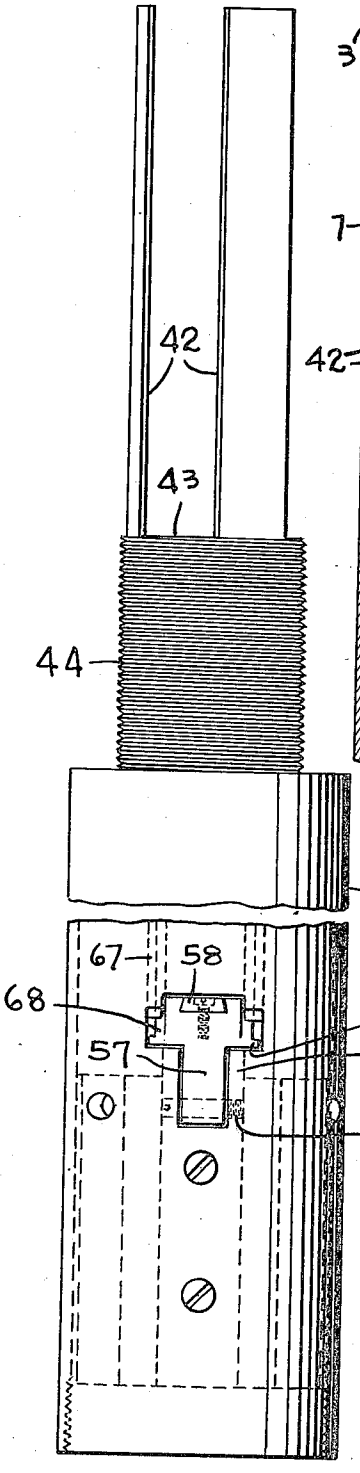


Fig. 3.

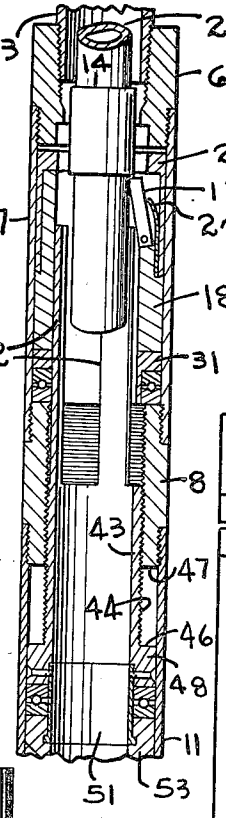


Fig. 11.

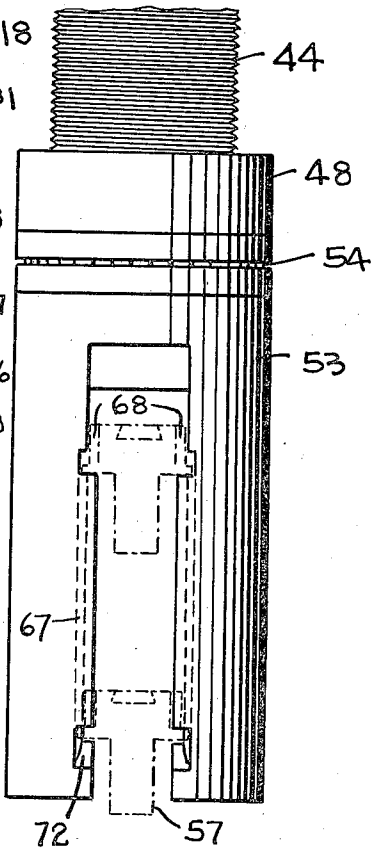


Fig. 4.

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OUTSIDE PIPE CUTTER

Filed July 26, 1934 3 Sheets-Sheet 3

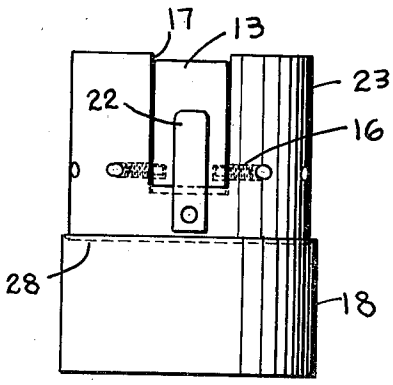


Fig. 5

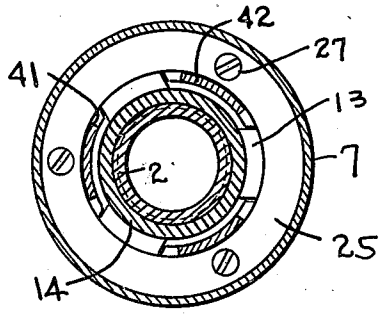


Fig. 6.

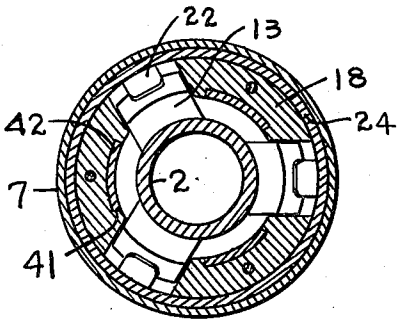


Fig. 7.

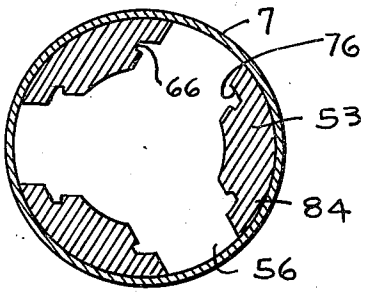


Fig. 8.

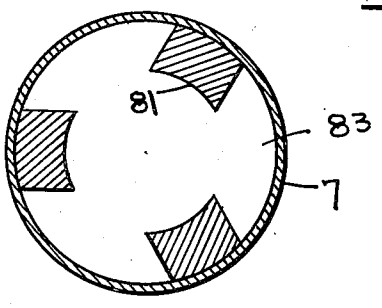


Fig. 10.

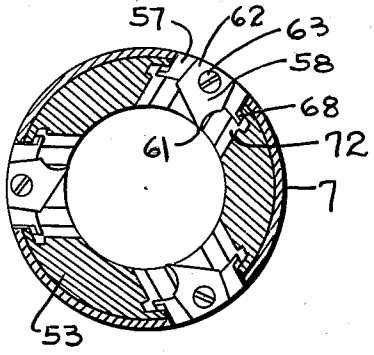


Fig. 9.

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UNITED STATES PATENT OFFICE

2,069,593

OUTSIDE PIPE CUTTER

Dempson H. Reed, Houston, Tex.

Application July 26, 1934, Serial No. 737,007

9 Claims. (Cl. 81—189)

The invention relates to pipe cutters for cutting pipe in wells and is more specifically a cutter of this character adapted to engage telescopically over the pipe to be cut and to cut the pipe from the outside.

In well drilling operations it often occurs that the drill stem or drive pipe will become broken or twisted off in the well so that a portion thereof remains in the well. Also, a well casing already set in position in the well may have to be removed. When this occurs the muddy flushing fluid which is present in the well may congeal or the walls of the well bore may cave into such an extent that the removal of the pipe remaining in the well cannot be accomplished.

The present tool is of the type which has been devised to remove such pipe or casing from the well by telescoping the tool over the outside of the junked pipe and severing from the uppermost end thereof a section thereof and then removing the severed section. It is usually necessary to repeat this operation in order to remove all of the pipe from the well and permit a continuation of the drilling operations, or to clear the well of casing.

It frequently happens that when a string of pipe which is suspended in a well fails or breaks, a portion drops to the bottom of the well. As a result the dropped pipe is buckled and bent and is frequently "corkscrewed" in the well in such a manner that it is impossible to telescope more than a comparatively short length of pipe at each operation.

One of the objects of the invention is to provide an outside cutting tool which is adapted to telescope over a length of junked pipe by successively engaging and pulling the pipe to straighten it and free it from obstructions, and advancing downwardly around the pipe until obstruction is encountered, when the procedure is repeated.

Another object of the invention is to provide a pipe cutter wherein the cutting members are pivotally secured to a support at two spaced points whereby they are positively controlled.

Still another object of the invention is to provide a pipe cutter having cutters positively actuated to move into and out of engagement with a pipe.

It is also an object of the invention to provide an outside pipe cutter wherein the cutters may be withdrawn from the pipe if the cut cannot be completed.

It is another object of the invention to provide a pipe cutter wherein the cutters move transversely and are independent of the pull exerted on the pipe by the cutting string of pipe.

It is a further object of the invention to provide a pipe cutter having pipe engaging dogs which are circumferentially supported against radial displacement whereby a heavy pull may be made without damage.

A still further object is to provide grooved guides for the cutters so that the cutters are positively controlled and cannot gouge into the pipe and be broken.

Another object of the invention is to devise a pipe cutter which will have a positive cutting action dependent on the rotation of the body of the tool.

Another object is to provide cutter members having a fixed pivotal connection at one end and a radially movable pivotal connection at the other end whereby the cutters may engage a pipe.

These and other objects will be apparent when the following description is read in connection with the accompanying drawings.

Fig. 1 is a vertical sectional view showing the upper portion of the cutting tool and parts thereof in section and with the junked pipe in elevation.

Fig. 2 is a central vertical sectional view of the running portion of the cutting tool connected below the portion shown in Fig. 1.

Fig. 3 is an elevation of a section of the housing having parts removed to disclose the interior arrangement of other of the parts.

Fig. 4 is a side elevation of the operating mandrel and portion of the feed screw, one cutter block being shown in dotted lines in two positions.

Fig. 5 is a side elevation of the pipe engaging or overshot assembly with the supporting band removed showing the arrangement of the dogs and springs.

Figs. 6 to 10, inclusive, are transverse sectional views taken on the planes 6—6 to 10—10, respectively, of Figs. 1 and 2.

Fig. 11 is a vertical sectional view similar to Fig. 1 showing the relation of the parts during the cutting process.

In recovering junked pipe from wells by the use of a pipe cutter embodying the invention the tool is lowered over the "fish" until a kink in the pipe or other obstruction is encountered. At this point the tool is raised to engage under the nearest coupling on the "fish" above the overshot dogs and a strain is taken on the fish tending to free it from mud or the wall of the well, center the fish in the well and straighten out the buckles or kinks in the pipe. After this operation the tool is further advanced over the fish until another stoppage occurs when the procedure is repeated.

It will be seen that whereas a conventional tool could be lowered to the first obstruction, a tool embodying the features of this invention would be able to overcome a number of obstacles and telescope a much greater length of pipe before it is necessary to make a cut. Consequently the amount of pipe recovered at one operation is materially increased. The economic advantages are obvious.

The fish or piece of pipe to be cut is indicated generally at 2 in Figs. 1 and 11. The tool is attached to the lower end of a string of pipe 3, which is of such size as to pass over the couplings of the pipe to be recovered. The tool is lowered into the well and telescoped over the junked pipe. A guide shoe is employed for this purpose of which there are numerous types, and it is contemplated that such a shoe, not shown, will be attached to the lower end of the tool by means of the pipe 4 as seen in Fig. 2.

The overshot or pipe gripping member includes a coupling 6 at its upper end adapted to screw onto the pipe or drill stem 3 and into the housing member 7, which is in turn secured at its lower end to the fitting 8. The lower housing member 11 of the cutter member is attached to the fitting 8 and at its lower end receives the coupling 12. The coupling 12 connects the housing member 11 and the pipe 4.

Within the upper housing 7 is the overshot assembly and driving mechanism. The overshot consists of a number of pipe-engaging dogs 13 whose upper faces are adapted to engage under the coupling 14 of the junk pipe or fish 2 whereby it may be tensioned by raising the operating pipe 3. These dogs 13 are of very massive construction and are adapted to apply a heavy pull to the fish. When the dogs engage the collar on a pipe they will center it within the tool. As shown in the drawings, three equally spaced dogs are preferred. These dogs are housed in a ring 18 and are pivoted near their lower ends by the threaded pins 16 which anchor the dogs in the slots 17 of the ring 18, as best seen in Fig. 5. The dogs are laterally supported by the walls 17 of the slots and are adapted to seat firmly on the bottom 21 of the slot. The bottom 21 of the slot is inclined inwardly and downwardly to provide a base perpendicular to the line of thrust of the dog 13. Springs 22 press on the dogs to cause them to engage the pipe and close in below a coupling 14 on the fish after passing said coupling.

The reduced portion 23 of the ring 18 is adapted to receive the reenforcing sleeve or cuff 24 of a ring 26, which is mounted between the ring 18 and the coupling 6 and is secured to the upstanding lugs between the slots in the ring 18 by the cap screws 27. The shoulder 28 at the lower end of the sleeve 24 is inclined downwardly and inwardly to form a tapered joint between the ring 18 and the sleeve 24, thus tending to prevent the relative spreading of said sleeve.

The ring 18 is supported by the bearing cap 31 containing the ball thrust bearing comprised of upper and lower bearing races 32 and 33, respectively. The two races are retained in operative relation by the split flanged ring 34 which engages the annular groove in the lower race 33 and is fastened to the upper race by the screws 36.

The weight of the salvaged pipe is transmitted through the dogs 13, ring 18, bearing cap 31, upper race 32 and balls to the lower race and fitting 8, and the dogs 13 and associated parts are held against rotation by the contact with the salvaged pipe.

The sleeve 24 prevents spreading of the upstanding lugs of the ring 18, which otherwise would expand due to the radial forces of the pipe engaging dogs, and drag on the tool housing, thus interfering with the operation of the device. The support for the dogs 13 is thus reenforced and supported by the sleeve 24 and greatly strengthened.

The ring 18 has depressions or grooves 41 formed longitudinally on its inner periphery, these grooves being adapted to form a splined connection with interfitting driving fingers 42 upstanding on the actuating tube 43, so that the tube 43 may slide axially with respect to the ring 18, but is splined against relative rotation. The exterior of the actuating tube 43 is threaded at 44 and engages corresponding threads in the fitting 8. The threads 44 are lefthand and accordingly, since the tube 43 and ring 18 are splined together, are held against rotation by the engagement between the dogs 13 and the frozen pipe 2; when the drill stem or pipe 3 is rotated in a righthand direction the tube 43 moves downwardly separating the shoulders 46 and 47 of the flange 48 on the tube 43 and fitting 8, respectively, as is best seen in Fig. 11.

A mandrel 53 is connected to the lower end of the flange 48 of the tube 43 by the split ring 51 which is fastened to the flange 48 with the screws 52 and a radial flange thereon engages the annular groove in the mandrel 53 whereby the mandrel is free to rotate. A ball thrust bearing 54 is positioned between the two parts to facilitate relative rotation.

This downward movement of the mandrel 53 resulting from the rotation of the pipe or drill stem moves the pipe cutters into operative position, feeds them into the pipe to be cut, and, if the cut cannot be accomplished, moves them back into the wall of the tool. The mechanism by which this is accomplished will now be noted.

The mandrel 53 is tubular and has a plurality of axial slots or openings 56 in the walls thereof, as is best seen in Figs. 8 and 9. These slots are adapted to receive and actuate the cutter blocks indicated generally at 57, on which are mounted the tool steel pipe cutters 58, each of which has a cutting edge 61 and a tapered dovetail portion 62 which is socketed in a corresponding opening in the top of the cutter block 57 and held in place by the screw 63. The lower end of the block is pivoted on the through pins 64.

The bottom end 77 of each of the cutter blocks is pivoted within forks 78 carried by the upper ends of the bars 81. These bars are secured upon the inner face of the housing 11. They bear directly on the coupling 12 and are held in place by the screws 82. Their relative positions are shown in Fig. 10. The bars 81 are spaced to form a series of axial ways 83 which are adapted to receive the lower ends 84 of the mandrel, thus permanently aligning the parts for positive operation.

There are two opposite outwardly extending projections or pins 66 on each of the cutter blocks 57, which are adapted to slide in mating grooves 67 in the side walls of the cutter openings 56 of the mandrel 53.

When the block is in its retracted position, as best seen in Fig. 2, the pins 66 have not yet entered the grooves 67, but the block is positively held by the engagement of inclined ribs 68 formed on the side of the block and inclined upwardly from said pins. Said ribs are positioned between the inclined surfaces 71 and 72 of the mandrel,

which form a groove communicating with the lower end of the groove **67**. As the mandrel moves downwardly relative to the cutter blocks the inclined ribs **68** move between the inclined faces and guide the pins **66** into the lower end of the slots **67**, in a position such as is indicated by the lower portion of Fig. 4.

The grooves **67** are upwardly and inwardly inclined whereby the cutters **58** are carried into engagement with the pipe and are fed inwardly as the rotation and cutting progresses. From a point indicated at **73** the groove is inclined upwardly and outwardly at an angle of approximately 45° and this inclined portion **74** engaging projections **67** and pins **66** act to withdraw the cutters to a second retracted position.

It will be seen that the cutter blocks are pivoted at both ends and that their movement is positive at all times. Should crystallized pipes be encountered and the cutters be damaged to such an extent that the cut is not accomplished the continued rotation of the tool will return the cutters to their original position, as shown by the upper dotted position in Fig. 4.

The face **76** of the groove, as seen in Fig. 8, is adapted to contact the pin **66** and the lower end of the inclined rib **68**, thus giving a wide bearing surface and applying the load to the rib rather than the small pin. This results in a very rigid construction.

In operation, the pipe cutting tool is attached to the lower end of a string of pipe and stabbed over the junked pipe as far as possible. When no further progress can be made the operating pipe is raised until the dogs engage under a coupling upon the junked pipe and a heavy pull of as much as several hundred thousand pounds is made. This pull frees the junked pipe from the wall of the well, straightens out any kinks present and loosens any material which may have settled around the fish.

The cutting tool may now be lowered still further over the loosened pipe until another stoppage occurs. This process is repeated until the desired length of junked pipe has been encompassed, whereupon the cut is made.

To make a cut, the tool is raised until the overshot dogs engage beneath a collar on the junked pipe and tension then is maintained to hold the inside parts of the tool against rotation. Turning the operating pipe engages the cutters and they feed inwardly as the rotation progresses. As soon as the pipe is cut, the salvaged portion turns with the tool and the cutting operation stops. The fish is suspended in the overshot and may be raised with the cutters locked in the position obtaining when the cut was completed. It is to be noted that the cutters maintain the same horizontal level as the cut is made and that the mandrel is moved downwardly relative thereto by the unscrewing of the mandrel along the threaded area **44**.

In the event that the cut is not completed which may be due to crystallized pipe or failure of the cutting edges, continued rotation will move the mandrel to its extended position and the projections on the cutter members will retract them and lock them in the upper dotted position shown in Fig. 4 where they are safe from damage if an attempt is made to pull loose from the junked pipe.

In a tool embodying the invention it will be seen that it is adapted to center the pipe, free it from compacted material, or straighten it by one or more heavy pulls, so that the tool may be lowered thereover; that the pipe cutter blocks are pivoted at both ends in such a manner that their movement is constrained and positive; that the cutters are locked in place before the cut is started and again when the cut is completed, and that in case of an unsuccessful attempt to cut, the cutters may be retracted and locked in a protected position.

What is claimed as new is:

1. An outside pipe cutting tool including in combination a string of pipe, dogs mounted thereon and adapted to engage under a pipe collar upon the pipe to be cut, a mandrel responsive to the rotation of said tool to move vertically, cutters having sliding engagement with said mandrel and means on said mandrel engaging said cutters to move the said cutters into and out of contact with said pipe to be cut in response to the vertical movement of said mandrel in one direction.

2. An outside pipe cutter including in combination a string of pipe, cutters thereon to engage a pipe. a mandrel adapted to be moved vertically relative to said cutters, means on said mandrel to positively engage said cutters and by continuous translation in one direction to move the same into cutting position and then to retracted position and to hold said cutters in retracted position both before and after said cutters are operated to cut the pipe.

3. An outside pipe cutter including a string of pipe, in combination with dogs thereon adapted to engage a pipe to lift the same, cutters below said dogs to engage the pipe, a vertically movable mandrel having positive engagement with the sides of said cutters and adapted to actuate said cutters whereby said cutters are held positively and moved by the movement of said mandrel to and from cutting position and are held in retracted position when said mandrel is fully extended.

4. An outside pipe cutter including a string of pipe in combination with cutters mounted thereon to engage the pipe to be cut, lateral projections on said cutters, a mandrel on said string vertically movable by the rotation of said string to actuate said cutters, and means on said mandrel engaging said projections to move said cutters inwardly and then outwardly responsive to the relative downward movement of the mandrel.

5. In an outside pipe cutter, a string of pipe, a set of cutters thereon, a mandrel operatively connected with said cutters to move vertically relative thereto and advance and retract said cutters, a relatively rotatable member above said mandrel upon which said mandrel is screwed, a support on said member, dogs mounted in recesses in said support and adapted to engage the pipe to be cut, and means including a sleeve surrounding said support to reinforce said support and firmly support said dogs.

6. In an outside pipe cutter a string of pipe, a cutter thereon, a mandrel on said string adapted to be moved vertically relative to said cutter, projections on said cutter engaging grooves in said mandrel whereby said cutter may be controlled and moved inwardly and then outwardly when said mandrel is moved relatively downwardly, a relatively movable member upon which said mandrel is screwed, a support on said member and means to engage the pipe to be cut and to hold said member and support from vertical movement while said string is rotated to screw said mandrel vertically.

7. In an outside pipe cutter a string of pipe, a cutter thereon, a mandrel on said string adapted

to be moved vertically relative to said cutter, projections on said cutter engaging grooves in said mandrel whereby said cutter may be controlled, said grooves being inclined so that said cutter is moved first inwardly to cutting position and then outwardly to retracted position as said mandrel is moved relatively downwardly, a relatively movable member upon which said mandrel is screwed, and means associated with said member to engage the pipe to be cut and to hold said member against vertical movement while said string is rotated to screw said mandrel vertically.

8. An outside pipe cutting tool including a string of pipe, pipe engaging dogs supported thereon, cutters on said string to sever a pipe, a mandrel responsive to the rotation of said string when said dogs have engaged an inner pipe to move vertically, slots in said mandrel adapted to cooperate with said cutters, grooves inclined inwardly and then outwardly in said slots, and means on said cutters to engage said grooves whereby the longitudinal movement of said mandrel relative to said cutters advances and withdraws said cutters toward and from the pipe to be cut.

9. An outside pipe cutter including a string of pipe, pipe engaging dogs supported thereon, cutters below said dogs to sever a pipe, a vertically movable mandrel, means connecting said cutters and said mandrel whereby the lateral movement of said cutters toward and away from the pipe to advance and again retract the same is constantly controlled by continuous rotation of said pipe cutter in one direction.

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