May 26, 1925. 1,539,288

H. S. CAMERON ET AL

PIPE CUTTER

Filed Oct. 31, 1922 3 Sheets-Sheet 1

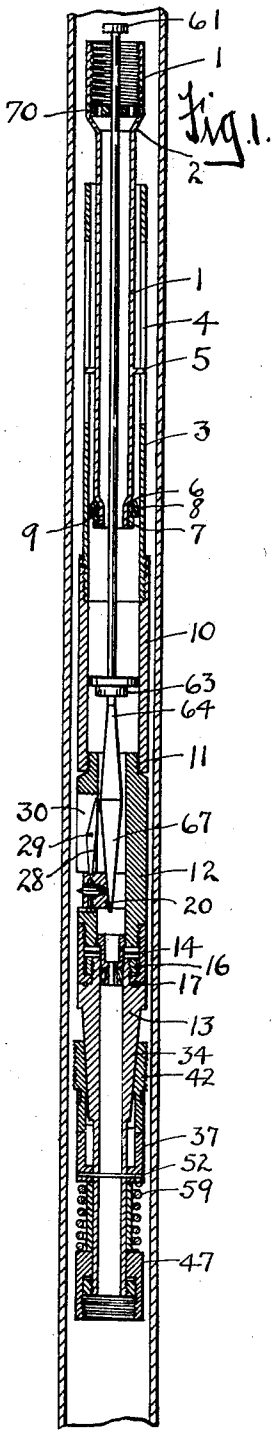


Fig. 1.

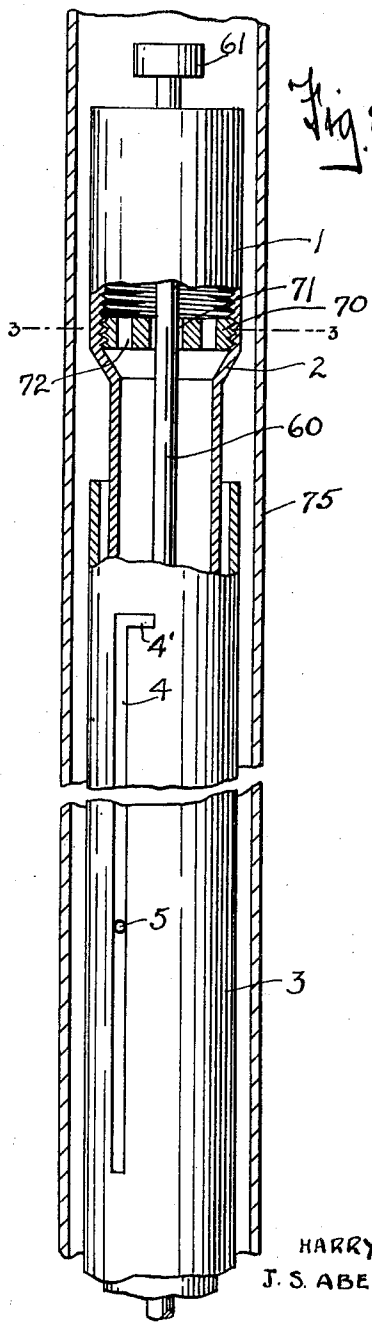


Fig. 2.

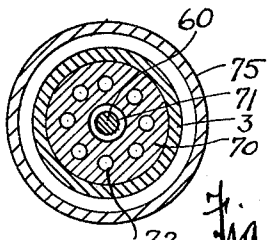


Fig. 3.

HARRY S. CAMERON AND
J. S. ABERCROMBIE, Inventors

By Jesse R. Stone

their Attorney

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H. S. CAMERON ET AL

PIPE CUTTER

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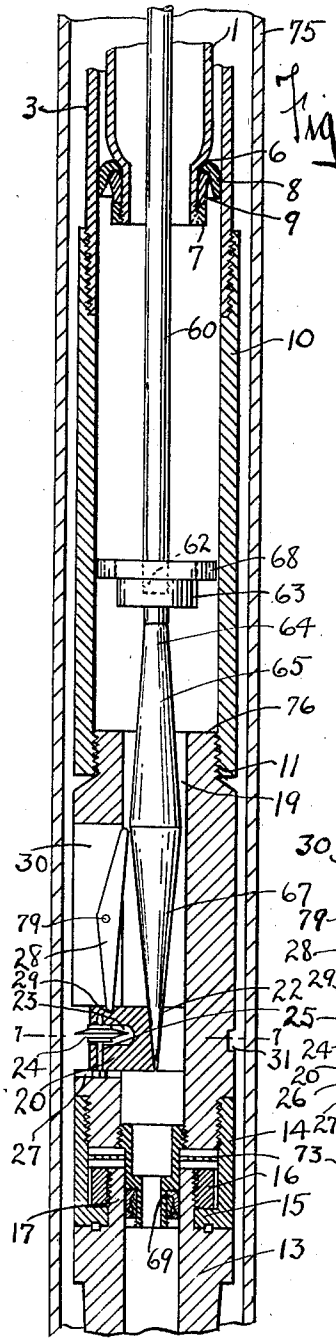


Fig 4.

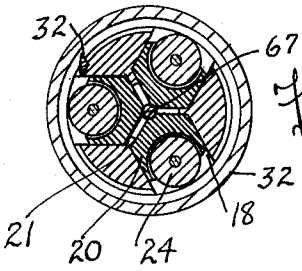


Fig 7.

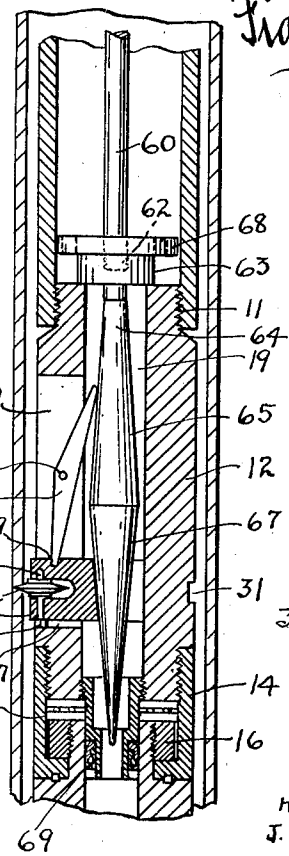


Fig 5.

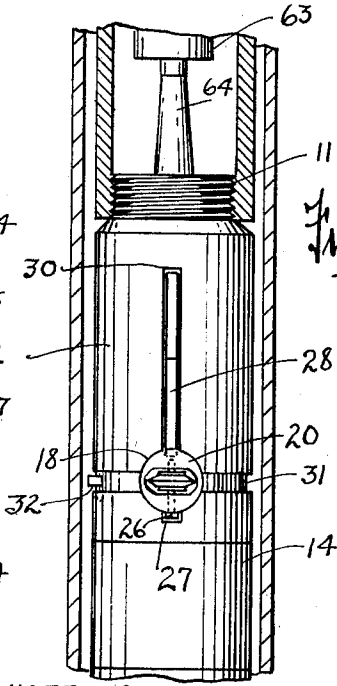


Fig 6.

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PIPE CUTTER

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Fig. 8.

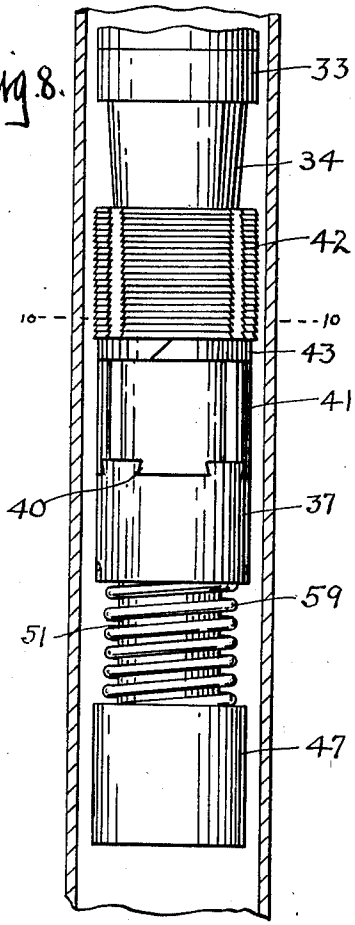
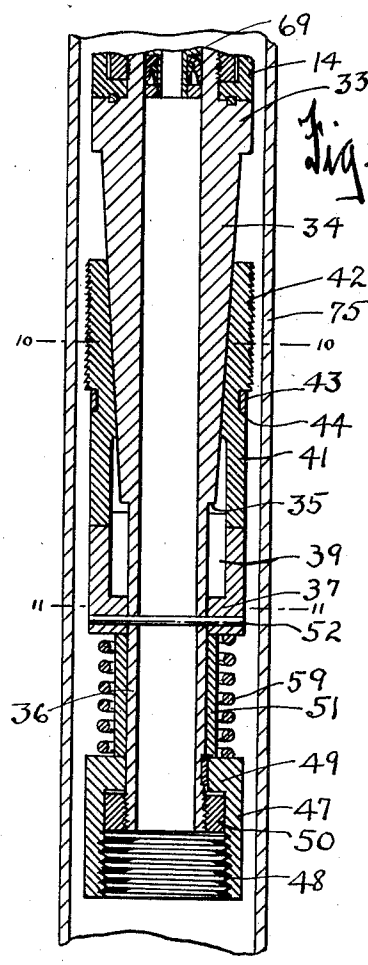


Fig. 9.



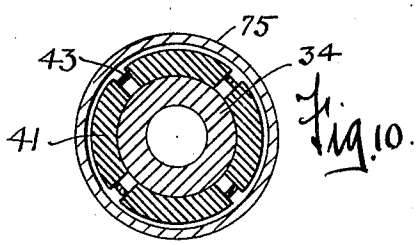


Fig. 10.

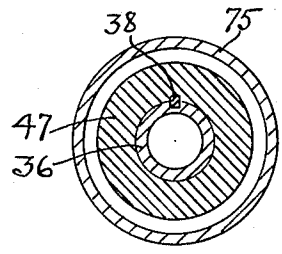


Fig. 11.

HARRY S. CAMERON, Inventors
AND T. S. ABERCROMBIE.

By Jesse R. Stone

their Attorney

Patented May 26, 1925. 1,539,288

UNITED STATES PATENT OFFICE.

HARRY S. CAMERON AND JAMES S. ABERCROMBIE, OF HOUSTON, TEXAS.

PIPE CUTTER.

Application filed October 31, 1922. Serial No. 598,130.

To all whom it may concern:

Be it known that we, HARRY S. CAMERON and JAMES S. ABERCROMBIE, citizens of the United States, residing at Houston, Harris County, Texas, have invented a certain new and useful Improvement in Pipe Cutters, of which the following is a full, clear, and exact description, such as will enable others skilled in the art to which it appertains to make and use the same.

Our invention relates to pipe or casing cutters of the type used in cutting pipe in deep wells, in the operations of drilling or pumping.

An object of the invention is to form a cutter which may be introduced into the casing or other pipe in a well and to then be fixed at the point or points desired and operated to sever the casing.

A further object is to provide means of positively anchoring the cutting device at the point desired in such manner that it may be withdrawn when the cutting operations are completed.

We also contemplate so constructing the device as to be able to advance the cutters to cutting position and to again withdraw them as desired and to support the cutter for rotation on said anchoring means.

A further object is to provide means to limit the weight resting on the cutter during operations and to also provide means to determine when the pipe is severed.

These and other objects and advantages will be better understood from the detailed description which follows.

Referring to the drawing herewith wherein like numerals of reference are applied to like parts in all the views—Fig. 1 is a central longitudinal section through a well casing showing our improved device inserted therein, some parts of said device being shown in elevation; Fig. 2 is an enlarged detail of the upper portion of the said invention, some parts being broken away for greater clearness; Fig. 3 is a transverse section on the plane 3—3 of Fig. 2; Fig. 4 is a longitudinal sectional view showing the cutter and the operating mandrel; Fig. 5 is a similar view showing the cutters extended; Fig. 6 is a side elevation of the cutter head; Fig. 7 is a transverse section on the plane 7—7 of Fig. 4; Fig. 8 is a side elevation of the anchor device; Fig. 9 is a central longitudinal section thereof; Fig. 10 is a transverse section on the plane 10—10 of Fig. 8 and Fig. 11 is a transverse section on the plane 11—11 of Fig. 9.

In drilling and pumping wells it sometimes occurs that the casing becomes fixed or frozen in the well and can not be removed when it is desired to do so. Also pipe may be dropped and bent in the well. In such cases it is sometimes possible to use a pipe-cutting means which may be inserted downwardly into the pipe or casing, and to sever the same at desired points throughout its length so that the said pipe may be removed in sections, thus cut off.

In the drawings, we have shown a type of cutter which may be used for this purpose. It is designed to be attached to the lower end of a string of pipe or drill stem when in use. It has, for attachment to such string of pipe or drill stem, an upper threaded nipple 1. This nipple is reduced slightly in diameter at 2 and extended downwardly for some distance, and adapted to telescope within an outer sleeve 3. The sleeve 3 is provided on opposite sides thereof with longitudinal slots 4 in which radially extending pins 5 on the nipple 1 are adapted to slide. At the lower end of the nipple 1 within the sleeve 3, the diameter of the nipple is reduced at 6 and threaded at its lower end to receive a nut 7. Between this nut and the shoulder formed at 6 is seated a cup 8, extending downwardly and held in place by means of a spacing element 9 between the nut and said cup. This cup, as will be seen, is for the purpose of maintaining a sliding but fluid-tight connection between the two telescoping pipes 1 and 3.

At the lower end of the sleeve 3, the same is connected by means of a collar 10 with the threaded upper shank 11 of the cutter head 12. This head is rotatably connected with a supporting anchoring device 13 by means of a coupling 14 threaded to the lower end of the cutter head and having an inwardly-extending flange 15 engaging the lower face of a shoulder formed by an annular nut or ring 16 threaded upon the reduced upper end 17 of the anchoring device 13.

The cutter head 12 has formed therein a plurality of cylindrical openings 18 extending radially through the walls of the head 12. The said head is tubular, having a central passage 19 extending longitudinally

thereof, in the openings 18 of which, we have shown (see Fig. 7) three cylindrical blocks 20 adapted to slide in said openings. The said blocks are beveled on their inner surfaces at 21 to contact with each other as shown at Fig. 7, and have a beveled recess 22 on their upper inner faces to receive an expanding means. Each of the blocks 20 has a transverse opening or slot 23 therein, in each of which is adapted to be mounted a horizontal cutter 24. These cutters are mounted to rotate upon a pin or shaft 25 extending in a vertical direction through said openings and through said cutters. The said pin 25 has a lower head 26 protruding from the lower side of the block and adapted to fit within a keyway 27 so as to allow the sliding of the cutter block radially of the head, but also adapted to prevent rotation of the said block in its opening. Each of the blocks is held in contracted position within the said openings by means of a lever 28 secured pivotally within a slot 30 in the side of the head. The lower end of the lever fits within a recess 29 in the upper face of the block and the upper end lies against the side of the expanding mandrel. In contracted position, the outer edge of each of the cutters 24 will extend outwardly to a point about flush with the outer face of the head.

As shown particularly in Fig. 6 we have formed a circumferential groove 31 in the side of the cutter head on the level with the cutters 24. This groove is to receive the rough ends of the cuttings or furrows formed in the casing by the rotating cutter. There is in this groove 31 at a point on the circumference of the head, a scraping cutter 32 which, as shown in Fig. 7, is inclined in the direction of rotation of the head, and adapted to scrape away the furrowed surface formed on the casing by means of the cutters.

Below the cutter head, as previously stated, is the anchoring means, 13. This anchoring device comprises an upper head 33, cylindrical in shape, below which the diameter is reduced and the head is formed into a downwardly tapered mandrel 34. This mandrel, about midway of its length, is reduced abruptly in diameter to form a shoulder 35 below which the remaining portion thereof is cylindrical, as shown at 36. Fitting on the outer surface of the cylindrical portion of the mandrel, is a sliding sleeve, 37. This sleeve is held non-rotatably on the said mandrel by means of a key, 38. The lower portion of the said sleeve is solid, but above the thickened lower end the said sleeve is spaced away from the mandrel at 39. The upper portion of the said sleeve is formed with a plurality of dove-tailed slots 40 into which the lower ends of expanding jaws or slips 41 are adapted to be slidably engaged. Said slips 41 are cylindrical on their upper portions and toothed at 42 to engage the inner surface of the pipe or casing. The inner faces of these slips are tapered to fit upon the said mandrel 34. The said slips or jaws 41 are held resiliently against the said tapered mandrel by means of an annular spring 43 shaped like a piston ring, split at one point and fitting within a groove 44 in the outer faces of the jaws or slips.

Below the sliding sleeve 37 is a lower collar 47. This collar is threaded internally at its lower end at 48 for attachment to the desired length of pipe, not shown. The upper end of the sleeve is extended inwardly to fit against the mandrel at 49, and said sleeve is held against removal from said mandrel by means of a nut or ring 50, threaded within the sleeve to the lower end of said mandrel. On the cylindrical surface 36 and between the sleeves 39 and 47 we provide a slidable sleeve 51 of such length as to fit between said sleeves when the slips or jaws are in inoperative position, as shown in Figs. 8 and 9. To hold the sleeve 37 and the jaws 41 in inoperative position while going into the hole we have employed a diametrical pin 52 extending through sleeve and the cylindrical portion of the mandrel 36. This pin is of brass or some metal of soft or brittle construction which can be broken or sheared off under the force of a blow.

The two sleeves 37 and 47 are acted upon by means of a spiral spring 59 fitted between the same and held under compression when the collar 37 is secured in the position shown in the drawing. When the collar 47 is forced upwardly by contact with the bottom of the well the upper end thereof will drive the sleeve 51 against the sleeve 37 so as to shear off the pin 52 and allow the spring 59 to act. This will serve to force said sleeve upwardly and the jaws attached thereto will be driven upwardly on the tapered mandrel 34 so that said jaws will be expanded firmly against the walls of the casing 75, thereby holding the anchoring means rigidly within the said casing.

To expand the cutters within the cutterhead there is provided within the passage inside the drill stem and other pipe, an expanding mandrel formed with an upper rod 60. This rod has an enlarged head 61 at the upper end and at the lower end is threaded at 62 within a head 63 upon the expanding mandrel 64. This mandrel is reduced in diameter below the head 63, and then gradually enlarged to a central point, 65. Below this portion 65 the mandrel is tapered at 67 downwardly to a point.

Formed in the upper portion of the nipple 1 is a disk or diaphragm 70. As shown particularly in Fig. 2 the disk is threaded on its

outer face to be secured within the upper head of the nipple, and is formed with a central opening 71 therein to allow the passage of the rod 60 on the mandrel. It is further provided with a plurality of perforations 72 to allow the free passage of water in the operation of the device. Fitting loosely on the rod 60 of the mandrel is a second disk or diaphragm 68, also loose within the collar 10. It is perforated to allow the passage of liquid and acts as a guide to prevent a wabbling of the mandrel.

In the use of our improved cutter, it is usual to calculate at about what elevation the casing or pipe is to be severed. We contemplate that ordinarily the pipe will be severed at a point spaced upwardly from the bottom of the well a short distance and for that reason have shown a comparatively short sleeve 47 at the lower end of the device. It is obvious however, that this sleeve may be lengthened to any desired length by attaching at 48 the required amount of pipe or drill stem. With the sleeve or collar 47 of the length shown in the drawing the device will be lowered with the anchoring means in locked or inoperative position, as shown in Figs. 8 and 9 particularly. When the collar 47 strikes the bottom of the well it will slide upwardly along the cylindrical portion 36 of the mandrel and through the sleeves 51 and 37, shear the pin 52 as previously described. The spring 59 will then act to lock the jaws or slips 41 against the casing. In this position the further lowering of the drill stem and string of pipe above the anchoring device will allow the cutter head 12 to rest upon the upper end of the head 33 of the anchoring means. In order to allow the head 12 of the cutter to rotate upon the anchoring device, I preferably fit an antifriction ball race 73 between the bearing surfaces, which is protected from water and mud by a stuffing box 69. The head then rests upon this surface and sustains the weight only of the coupling 10 and pipe 3. This weight will not be sufficient to interfere with the free action of the cutters 24 upon the side of the casing. The weight of the nipple 1 and the string of pipe above the same will be supported from the surface of the ground and will not be allowed to rest upon the cutting device. The cutting head may be rotated however, from the surface because of the radial pins 5 fitting within the slots 4 of the pipe 3. When the device is being lowered into cutting position the upper head 61 of the expanding mandrel will be supported upon the disk 70. When the cutter head is set in position, however, the further lowering of the pipe will cause the whole weight of the expanding mandrel to rest upon the beveled upper surface of the cutter blocks 20. The device will then be ready for rotation, and as the cutter head 12 is rotated, the weight of the expanding mandrel will force the cutters radially outward against the casing and hold them firmly in cutting position. The rotation of the pipe will cause the cutters to work their way through the outer casing 75.

While the cutter is being rotated, water will be pumped downwardly through the string of pipe, the cutting device and the anchoring device, and this water will find its way upwardly around the outside of the device to the surface. When the expanding mandrel has forced its way downwardly as the cutters expand until the pipe is severed, the mandrel will be in such position that the head 63 thereof will contact with the upper shoulder 76 of the cutter head and will entirely close the passage 19 therethrough. The cup 8 at the lower end of the nipple 1 will prevent the escape of water upwardly. The said water will then find no outlet and the pumps will automatically be stopped, thus furnishing an indication to the operator that the pipe has been severed and the job completed.

When the operator has received indication from the pumps that the pipe has been severed, the string of pipe will be raised, thus carrying the nipple 1 upwardly in the pipe 3 until the pin 5 contacts with the upper end of the slot 4. Before this point is reached the disk 70 will strike against the upper head 61 of the mandrel and will raise it out of operative position with reference to the cutters. It will be noted that as the cutters are expanded the upper end of the lever 28 will rest on the upwardly tapering surface of the mandrel 65. When the mandrel is withdrawn this surface will by contact with the lever force the upper end outwardly and the lower end, together with the cutter block, inwardly, thus retracting the cutters positively.

The continued upward movement of the pipe will raise the cutter head from its seat upon the anchoring device and will raise the mandrel upwardly in the said anchoring jaws. It will be noted from the drawing that the teeth formed upon the surface 42 of the locking jaws or slips 41 are inclined downwardly. It will therefore be possible when the device is pulled upwardly to force the locking jaws downwardly on the mandrel until a second point is reached above the first cut, and a downward movement thereafter will automatically cause the jaws to grip the pipe and lock the anchoring means again in position. This may obviously be done at any height in the well and by beginning at the bottom of the well and proceeding upwardly the pipe or casing may be severed at desired intervals until the whole casing has been cut up into such lengths that they may be later withdrawn from the well piece by piece.

To positively withhold the pressure of the mandrel 67 upon the cutters while going into the hole we form the slots 4 in the pipe 3 with an offset channel 4′ at the upper end. Thus the pins 5 may be raised to the upper ends of the slots 4 and then rotated to fit within the part 4′. If the device is stopped by an obstruction, pressure may be exerted thereon without lowering the mandrel to expand the cutters. When the desired point in the hole is reached the pins 5 may be rotated to move downwardy in the slots 4 as described.

The advantages of this type of device will be apparent to one skilled in the art. The locking means will work automatically and positively to secure the device when the cutting operation is going on. The rotation of the cutter with the expanding mandrel resting thereon will cause the cutters to be driven gradually through the casing to sever it, and when the job is completed the indicator formed by the pumps will show the operator when the same has been accomplished. No further description of the operation of this device is necessary.

Having thus described our invention, what we claim as new and desire to protect by Letters Patent is:

1. In a pipe cutter for use in deep wells, a string of pipe, an anchoring means thereon, a pin to hold said anchoring means in inoperative position, means to release said pin when the string contacts with the bottom of the well, a cutter head secured to the upper end of said anchoring means and rotatable relative thereto, said string, anchoring means, and cutter head having a passage therethrough for liquid, cutters mounted on blocks slidable radially in said head, means to force said cutters outwardly operable by means of said string of pipe, said cutter head being rotatable through said string of pipe, and means to close the passage of fluid through said head when said cutters have been advanced sufficiently to sever the pipe operated upon.

2. In a pipe cutter for use in deep wells, an operating pipe, an anchoring means thereon, means operable at a predetermined position in the well to fix said anchor, a cutter head having a rotatable bearing on said anchoring means, radially movable cutters in said head, means loosely mounted in said operating pipe to advance said cutters when said operating pipe is lowered relative to said head, said operating pipe also serving to rotate said head.

3. In a pipe cutter for use in deep wells, an operating pipe, a cutter head rotatable therewith, an anchoring means secured rotatably to said head, means to fix said anchor in the casing at the desired point, a telescopic connection in said operating pipe, means slidable relative to said pipe and said head to advance said cutters, and means cooperating therewith to withdraw said cutters when said pipe is elevated.

4. In a pipe cutter for use in deep wells, a supporting means, an anchoring means thereon comprising a downwardly tapering mandrel, a cylindrical extension thereon, a collar slidable on said extension, toothed slips on said mandrel detachably connected with said sleeve, means to lock said sleeve and slips in inoperative position, means to release said locking means, means to force said sleeve and slips upwardly on said mandrel, a cutter above said mandrel, and means to rotate said cutter on said anchoring means.

5. In a pipe cutter for use in deep wells, a supporting means, an anchoring means thereon, comprising a tapered mandrel, toothed slips fitting on said mandrel and slidable thereon, means to hold said slips in inoperative position on said mandrel, means to release said last-named means, means to thereafter force said slips into operative position, a cutter above said anchoring means, and means to rotate said cutter.

6. In a pipe cutter for severing casing and the like in deep wells, adapted to be operatively supported through a string of pipe, the combination of means on said string adapted to anchor said string to said casing, a cutter head supported by and rotatable on said anchoring means through connection with the string of pipe above, said connection allowing vertical play of said string relative to said head, cutters on said head slidable radially therein, means holding said cutters in retracted position, a downwardly tapered expanding mandrel controlled through said string of pipe to advance said cutters in the manner described.

7. In a pipe cutter for severing casing and the like in deep wells, adapted to be operatively supported through a string of pipe, the combination of means on said string adapted to anchor said string to said casing, a cutter head supported by and rotatable on said anchoring means through connection with the string of pipe above, said connection allowing vertical play of said string relative to said head, cutters on said head slidable radially therein, levers adapted to move said cutters into retracted position, a tapered expanding mandrel controlled through said string of pipe to advance said cutters in the manner described, said head and anchoring means having a water passage therethrough, and means on said mandrel to close said passage when said cutters have advanced sufficiently to sever said casing.

8. A pipe cutter for severing casing and the like in deep wells, comprising a string of pipe adapted to be lowered into said cas-

ing, means on said string adapted to anchor said string to said casing, a cutter head above and rotatable on said anchoring means, an elongated sleeve secured to said cutter head, a telescopic but non-rotatable connection between said sleeve and the string of pipe above whereby the weight on said cutter head may be limited, cutters on said head, means to hold said cutters in retracted position away from said casing, and means to advance said cutters against said casing when desired to cut the said casing.

9. A pipe cutter for severing casing and the like in deep wells, comprising a string of pipe adapted to be lowered into said casing, means on said string adapted to anchor said string to said casing, a cutter head above and rotatable on said anchoring means, an elongated sleeve secured to said cutter head, a telescopic but non-rotatable connection between said sleeve and the string of pipe above whereby the weight on said cutter head may be limited, cutters on said head, means to hold said cutters in retracted position away from said casing, and means to advance said cutters against said casing when desired to cut the said casing.

10. A pipe cutter for severing casing and the like in deep wells, comprising a string of pipe adapted to be lowered into said casing, means on said string adapted to anchor said string to said casing, a cutter head above and rotatable on said anchoring means, an elongated sleeve secured to said cutter head, a telescopic but non-rotatable connection between said sleeve and the string of pipe above whereby the weight on said cutter head may be limited, cutters on said head, means to hold said cutters in retracted position away from said casing, means to advance said cutters against said casing when desired to cut the said casing, and means to prevent passage of fluid through said string when said casing has been severed.

11. A pipe cutter for severing casing in deep wells, comprising a string of pipe adapted to be lowered into said casing, means operable when a suitable point is reached to anchor said string, a cutter head above said anchoring means having a rotatable bearing thereon, cutters on said head, positive means to hold said cutters in a normally retracted position, gravity operated means to advance said cutters when desired, and means separate from said advancing means to rotate said head.

12. A pipe cutter for severing casing and the like in deep wells, comprising a string of pipe adapted to be lowered into the said casing, means in said string adapted to anchor said string to said casing, a cutter head above and rotatable on said anchoring means, an elongated sleeve secured to said cutter head, said sleeve having a slot therein, a nipple on the lower end of the string of pipe above said sleeve, said nipple telescoping within said sleeve and having a radial pin fitting in said slot, cutters on said head, and means to advance said cutters radially, said head being rotatable through said string of pipe.

13. A pipe cutter for severing casing and the like in deep wells, comprising an anchoring means adapted to be fixed in said casing, a cutter head supported thereon and rotatable relative thereto, a plurality of rolling cutters slidable radially relative to said head, gravity-operated means to advance said cutters, means to withdraw said cutters actuated by the withdrawal of said advancing means, said head being grooved adjacent said cutters, an additional scraping cutter in said groove, and means to rotate said head.

14. In a device of the character described, a cutter head, cutter blocks slidable radially therein, there being vertical slots in said head above said cutters, levers pivoted in said slots, one end of each said lever engaging in a recess in the adjacent cutter blocks, a mandrel slidable vertically in said head, and an expanding head thereon to move said blocks outwardly, said expanding head having an upper tapered surface to engage the upper ends of said levers to withdraw said cutter blocks when said mandrel is elevated.

In testimony whereof we hereunto affix our signatures this the 27th day of October, A. D. 1922.

J. S. ABERCROMBIE.
H. S. CAMERON.