This invention relates to pipe cutting devices and more particularly to a device for severing pipe in place. This invention is directed to a pipe cutting device which includes a segmented tubular body carrying a rotatable cutter support, the body and support being articulated for disposition about a pipe to be severed. The body carries radially movable pipe-gripping means for securing the body to a pipe. The cutter support carries one or more assemblies which include knife means arranged to be advanced automatically in response to rotations of the cutter support. A self-contained power-drive is mounted on the body for rotating the cutter support.

In many instances, particularly in the servicing of oil and gas wells, it becomes necessary to sever the surface casing of the well while the casing is in place, without removing the wellhead fittings normally mounted on the upper end of the casing. Such an instance occurs when due to subsidence of the earth overlying producing formations, it becomes necessary to lengthen the surface casing in order to permit elevation of the wellhead and the inner pipe strings to again place the latter in tension. It is desirable to effect the lengthening of the surface casing without having to disassemble or remove the Christmas tree and other wellhead equipment.

Accordingly, it is primary object of the present invention to provide an improved form of cutting tool by which pipe may be severed at some point intermediate its ends where the pipe equipment attached to the pipe comprises a cutting device over an end of the pipe. An important object of this invention is to provide a rotary cutting device having a self-contained power unit for rotating the latter about a pipe, the device being constructed of completable articulated segments which may be opened to permit placing the device around the pipe in preparation for cutting the pipe. A further object is the provision of a rotary cutting device mountable about a pipe and provided with radially movable cutter knives adapted to be advanced toward the pipe in response to rotation of the cutterhead to increase the depth of the cut until the pipe is severed. Still another object is the provision of a compact, high-efficient power-driven rotary cutting tool for effectively severing a well casing in place in a well bore without removing the wellhead equipment. Other and more specific objects and advantages of this invention will become more readily apparent from the following detailed description when read in conjunction with the accompanying drawing which illustrates a useful embodiment in accordance with this invention.

In the drawing:

FIG. 1 is a perspective elevational view of the assembled pipe cutting device in accordance with this invention;

FIG. 2 is a vertical sectional view taken generally along line 2—2 of FIG. 1;

FIG. 3 is a transverse sectional view taken generally along line 3—3 of FIG. 2;

FIG. 4 is an exploded perspective view of the pipe cutting device; and

FIG. 5 is a fragmentary view generally similar to FIG. 3 showing a modified form of cutter knife.

Referring to the drawing, the cutting device comprises a generally tubular body 10 constructed of two comple-

mentary semi-circular segments 10a and 10b provided with a hinge 11 connecting the segments along one side, the mating edges of the segments opposite the hinge means being provided with keels 12 and 13. The inner edge of the segments 10a and 10b is provided with slots 13—13 in the ends thereof to receive a locking bolt 14 by which the body may be locked in place about a pipe P (FIG. 4). The lower portion of body 10 is provided on its inner wall with a plurality of recesses 15 (FIG. 2) in which are mounted pipe-gripping slips 16 which are radially movable relative to the central axis of the body by means of adjusting screws 17 threaded into the back of the slips and extending through the wall of the body 10. Recesses 15 and slips 16 are of complementary, non-round shape, so that radial movement of the slips may be effected by rotation of the screws 17.

Mounted on the upper end of the body 10 is a generally semi-circular segment 18 rigidly secured to the body 10, as by welding 19. An annular recess 20 is cut into the exterior of the body 10 beneath the lower end of bearing ring 18 and is adapted to receive a radially extending annular flange 21 which is fixedly secured in recess 20 by the welding beads 19a, 19b, and 19d. The upper end portion of bearing ring 18 is provided on its exterior with an outwardly extending lip 22 defining an annular groove 23 in the exterior of the bearing ring. Mounted on the upper end of bearing ring 18 is an annular support plate 24 having a depending flange 25 (FIG. 2) terminating in an inwardly turned lip 25a adapted to fit snugly in groove 23 of the bearing ring and defining a groove 25b adapted to snugly receive lip 22 of the bearing plate. With this arrangement, support plate 24 will be rotatably mounted on the bearing ring 18 at a point spaced above flange 21. A ring gear 26, split diametrically, is mounted beneath support plate 24 surrounding flange 21, and is secured to support plate 24 by means of a plurality of studs 27 which extend downwardly through support plate 24 and are screwed into ring gear 26. It will be understood that bearing ring 18 will be split diametrically to align with the split in body 10, and that support plate 24 and ring gear 26 will be splined diametrically, the splits in the ring gear and support plate 24 likewise being aligned with each other. A powered motor 30, such as a conventional hydraulic motor, is mounted on a bracket 31, rigidly secured to flange 21, and extending laterally therefrom. Shaft 32 of motor 30 projects upwardly through bracket 21 and carries a pinion 33 which meshes with ring gear 26. With this arrangement, it will be seen that by operation of motor 30, ring gear 26 and its supporting plate 24 will be rotated about the pipe when the structure is in place, as will appear subsequently.

Two cutterheads, each designated generally by the numeral 35, are mounted at diametrically opposite points on top of support plate 24. Each of the cutterheads 35 includes a base plate 36 adapted to be secured to the top surface of plate 24 by some of the bolts 27 which pass through slots 37 provided to open out through the opposite side edges of the base plate 36. Generally, the base plates will be mounted to span the split between the ends of the segments of the support plate and the ring gear, so that upon removal of one of the bolts 27, from one end of each of the base plates, the support plate and ring gear may be opened to swing apart with the spreading of the segments of body 10. When the segments are reclosed a stud 27 may then be re-inserted through the open slot 37 in order to bolt the base plate to the other segment of the support plate and the ring gear. A pair of parallel, spaced apart rails 38 are positioned on top of base plate 26 to provide a guideway for the cutter feed head 39 for guiding the latter radially of the device.

As best seen in FIGS. 2 and 3, the cutter feed head 39 has a knife 40 of conventional design, slidably mounted in
its forward end to project into the bore of the cutting device for engagement with pipe P. Knife 40 is shown mounted in knife holder 40a of generally rectangular cross-section, which is slidable mounted in a correspondingly shaped opening 406 in the forward end of feed head 39. Cutter head 39 is provided with a transverse slot 41 behind knife 40 in which is pivotally mounted a cam lever 42 pivotally supported at about its center on a pivot pin 43 extending vertically between the top and bottom walls of the cutter head feed. The cam lever 42 is provided near its opposite ends with elliptical openings 44 wherein the limit pins 45 in slot 41 between the upper and lower walls thereof. Adjacent one side of cutter feed head 39 is an elongate slot 46 which opens to the outer or rear face of head 39. A clamping stud 47 extends downwardly through slot 46 and screws to base plate 36. The stud 47 and slot 46 cooperate to provide means for adjusting the radial position of cutter feed head 39 on the support plate, whereby the entire cutter head carrying knife 40 may be adjusted to accommodate the cutters to pipes of different diameters. Stud 47 carries a nut 48 which engages the top of head 39 and serves to clamp the cutter feed head 39 to support plates 36 and 46.

Cutter feed head 39 is provided with a cylindrical opening 50 parallel to slot 46 opening outwardly to the rearward face of head 39 at one end and to recess 41 at the other end. A feed screw 51 is rotatably mounted in opening 50 and carries a flange 52 engageable with an internal shoulder 53 in opening 50 to limit inward movement of screw 51 in opening 50. The inner end of the feed screw has threadedly mounted thereon a thrust sleeve 54, the inner end of which is adapted to bear against the adjacent end of cam lever 42. It will be understood that sleeve 54 will be suitably splined or keyed to a stationary part of the cutter head to constrain it to longitudinal movement in response to rotation of the feed screw. With this arrangement, it will be seen that as feed screw 51 is rotated in one direction, sleeve 54 will be urged outwardly of opening 50 against the adjacent end of the cam lever which will be caused to pivot about pin 43, causing sloping cam face 42a to slidably thrust against the inner end of knife holder 40a to thereby urge knife 40 radially toward the pipe in proportion to the amount of rotation applied to feed screw 51. The outboard end of screw 51 carries a toothed ratchet wheel 55 secured on the outer end of the feed screw by means of a nut 56. Ratchet wheel 55 has peripheral teeth 57 which are adapted to cooperate with a stationary finger 58 mounted on a side of body 10 in the path of rotation of the peripheral of ratchet wheel 55; the latter is carried around the pipe by rotation of the ring gear 26 and support plate 24. The arrangement is such that each time ratchet wheel 55 strikes the end of finger 58 during each rotation, the ratchet wheel will be turned through an angle corresponding to the pitch of one tooth, thereby correspondingly turning feed screw 51. By providing two of the knife feed structures at diametrically opposite points on the support plate, two knives 40 may be employed to track one another and increase the speed of severing of the pipe to which the device is applied. If desired, one of the two knives 40 may be shaped to sever the pipe while the second of the two may be shaped to bevel the edges of the cut as it tracks the cutter knife.

FIG. 5 illustrates a suitable form of bevelling cutter knife, designated by the numeral 40C, the other parts of the cutter head and knife feed assembly being identical with those previously described. If desired, only a single cutter knife may be employed. Also, more than two knives may be used.

In operation, when it is desired to sever a pipe, such as the surface casing of a well, on which the casinghead and Christmas tree are in place without removing the latter, the cutter device herein described will be opened so that the structure, as a whole, may be placed about the pipe. To open the segments of the structure for placement about the pipe, one of the studs 27 will be removed from each of the base plates 36 to thereby permit the segments of support plate 24 and ring gear 26 to be opened, and thereupon body 10 may be opened about hinge 11. The thus opened structure, as seen in FIG. 4, will be placed about the pipe, bolts 14 will be secured to lugs 12 to lock the body segments about the pipe and the studs 27 will be replaced to clamp base plates 36 in position across the splits between the segments of the support plate and ring gear. Slips 16 will then be moved outwardly to tighten gripping engagement with the surface of pipe P and the structure will then be securely locked to the pipe.

With the cutter device in place, power will be supplied to the motor 30, whereby rotation of ring gear 26 and support plate 24, carrying cutter feed heads 35, will be caused to take place. As the ring gear and support plate rotate, feed screws 51 will be actuated by repeated engagement of ratchet wheels 55 with finger 58 to feed cutters 40 into the pipe. This operation will be continued until the pipe has been severed, whereupon by removing one of the studs 27 from each of the cutter heads and releasing bolts 14 from lugs 12, the cutting device may be opened and removed about the pipe.

It will be understood that numerous changes and modifications may be made in the details of the illustrative embodiment within the scope of the appended claims but without departing from the spirit of this invention.

What I claim and desire to secure by Letters Patent is:

1. A rotary cutting device for severing pipe, comprising, a segmented tubular body articulated for disposition around a pipe to be severed, pipe-gripping means mounted interiorly of the body for securely gripping the pipe, a segmented cutter support ring rotatably mounted on the body to rotate about the pipe, drive means mounted on the body in driving engagement with said support ring, at least one cutter assembly mounted on said support ring, said assembly including a base plate secured to the support ring, a cutter head mounted on the base plate for radial adjustment relative to the support ring, knife means mounted on the cutter head for radial movement thereon relative to the pipe, feed means including a feed screw rotatably mounted on the cutter head for moving knife means radially, stationary means mounted on the body cooperating with said feed screw means for rotating the same in response to rotations of said support means relative to said body, said feed means including a thrust sleeve connected to said feed screw for longitudinal movement by rotation of the feed screw, said thrust sleeve carried on the cutter head between said thrust sleeve and said knife means, said cam lever having a cam surface adjacent one end operable to urge said knife means radially outwardly of the cutter head in response to thrusting engagement of said thrust sleeve with the opposite end portion of the cam lever.

2. A rotary cutting device according to claim 1, wherein said drive means includes a powered motor and cooperating gears forming a drive connection between said motor and said support ring.

3. A rotary cutting device according to claim 1, wherein said pipe-gripping means includes a plurality of angularly spaced toothed slips and means for radially advancing and retracting said slips relative to the body.

4. A rotary cutting device according to claim 1 having two of said cutter assembly means in spacing relation on said support ring, and wherein the knife means of the respective assemblies track each other during rotation.

5. A rotary cutting device according to claim 4 wherein at least one of the knife means is shaped to sever pipe and another of said knife means is shaped to bevel the edges of the cut made by said one knife means.

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