

Sept. 10, 1968

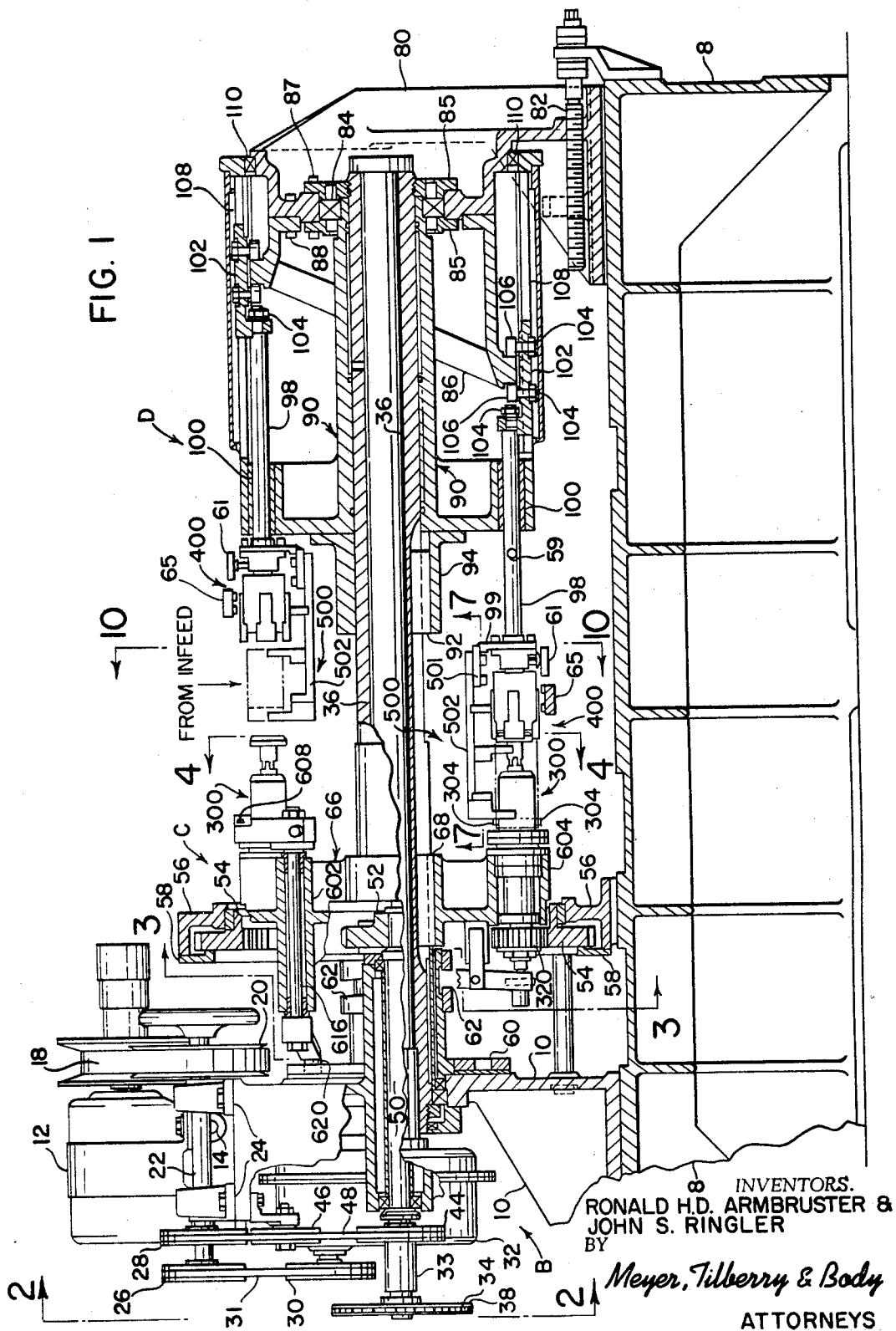
R. H. D. ARMBRUSTER ET AL

3,400,620

METHOD AND APPARATUS FOR TRIMMING EXTRUDED CAN BODIES

Filed Aug. 22, 1966

6 Sheets-Sheet 1



Sept. 10, 1968

R. H. D. ARMBRUSTER ET AL

3,400,620

METHOD AND APPARATUS FOR TRIMMING EXTRUDED CAN BODIES

Filed Aug. 22, 1966

6 Sheets-Sheet 2

FIG. 2

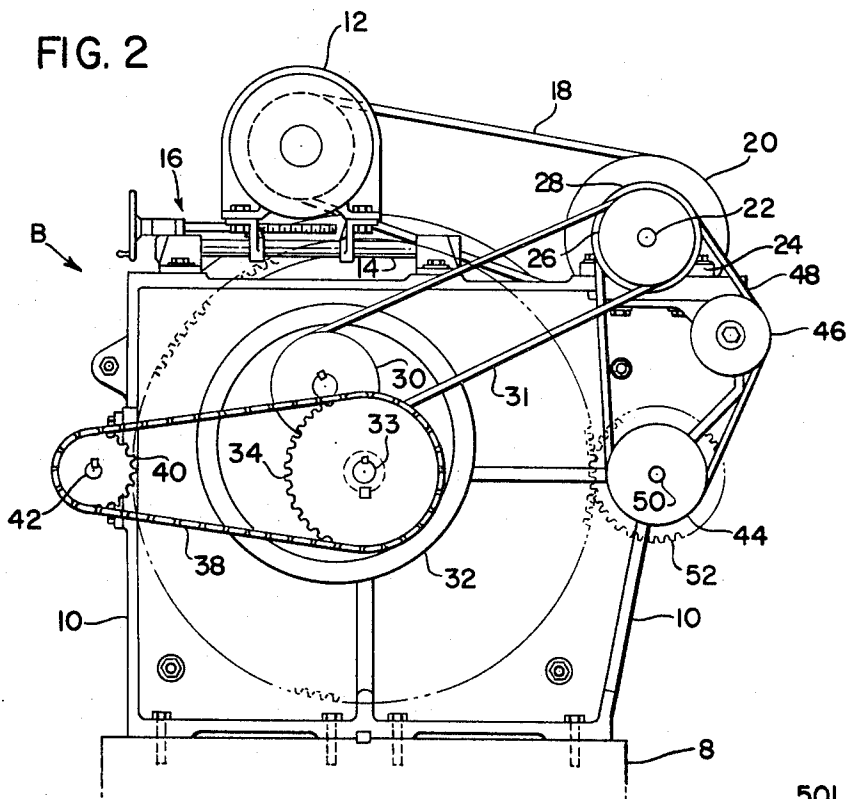
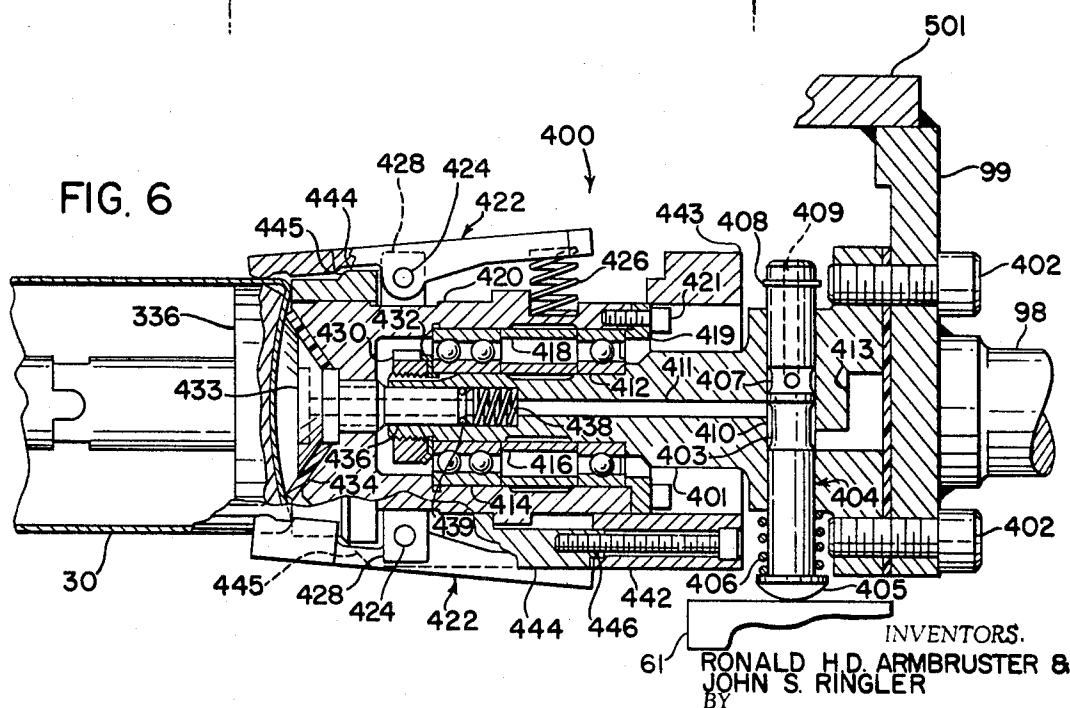


FIG. 6



INVENTORS.
RONALD H. D. ARMBRUSTER &
JOHN S. RINGLER
BY

Meyer, Tilberry & Boddy
ATTORNEYS

Sept. 10, 1968

R. H. D. ARMBRUSTER ET AL

3,400,620

METHOD AND APPARATUS FOR TRIMMING EXTRUDED CAN BODIES

Filed Aug. 22, 1966

6 Sheets-Sheet 3

FIG. 3

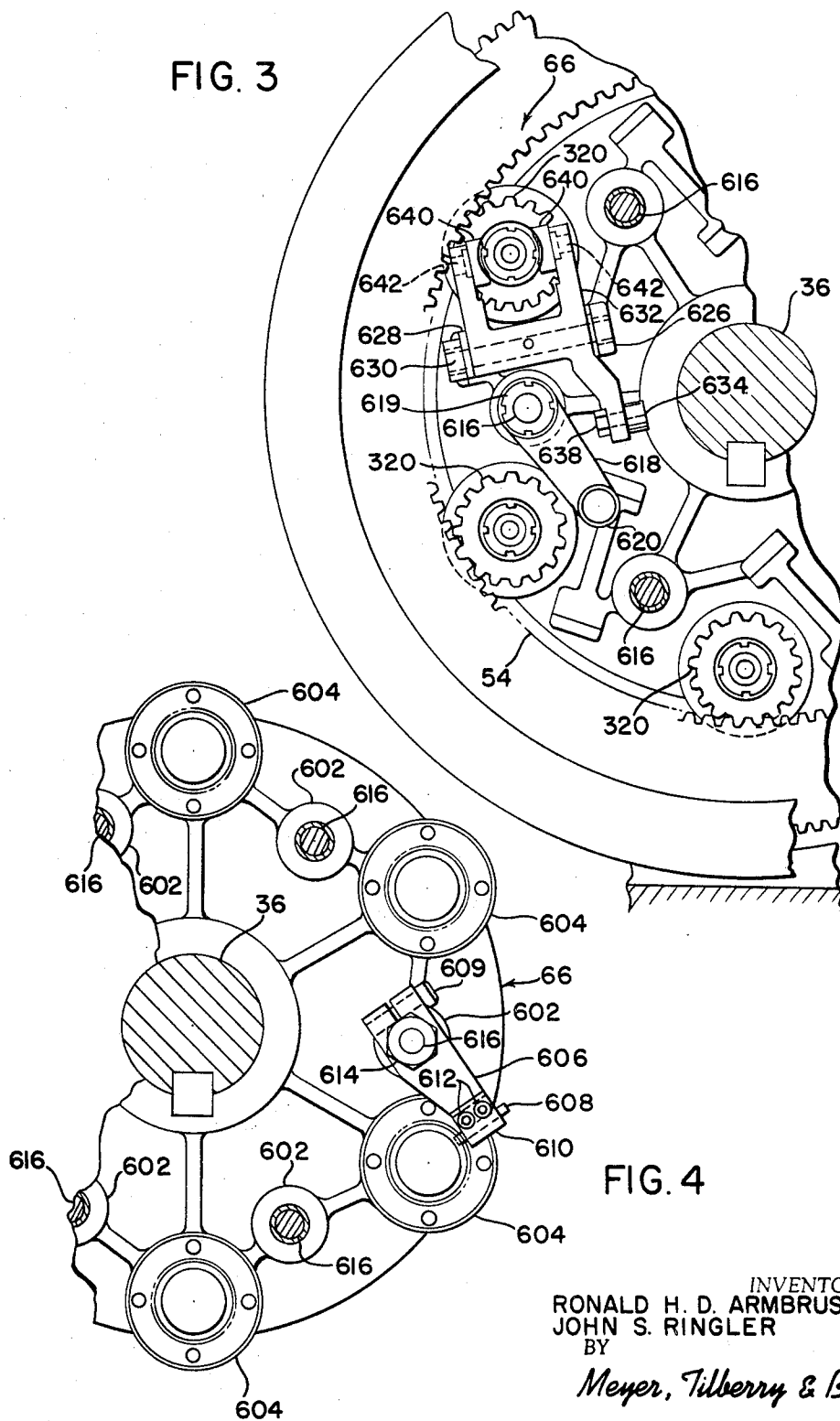


FIG. 4

INVENTORS.
RONALD H. D. ARMBRUSTER &
JOHN S. RINGLER

BY
Meyer, Tilberry & Body
ATTORNEYS

Sept. 10, 1968

R. H. D. ARMBRUSTER ET AL

3,400,620

METHOD AND APPARATUS FOR TRIMMING EXTRUDED CAN BODIES

Filed Aug. 22, 1966

6 Sheets-Sheet 5

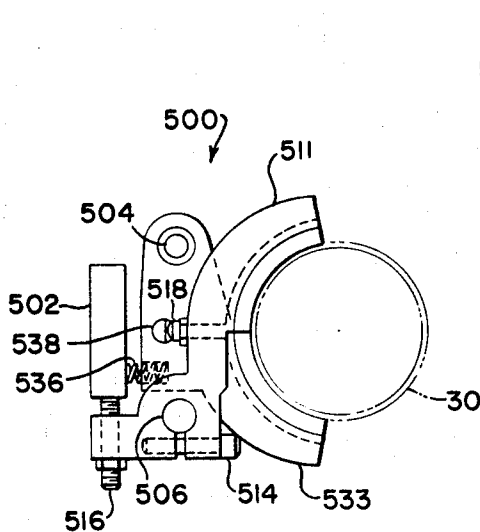
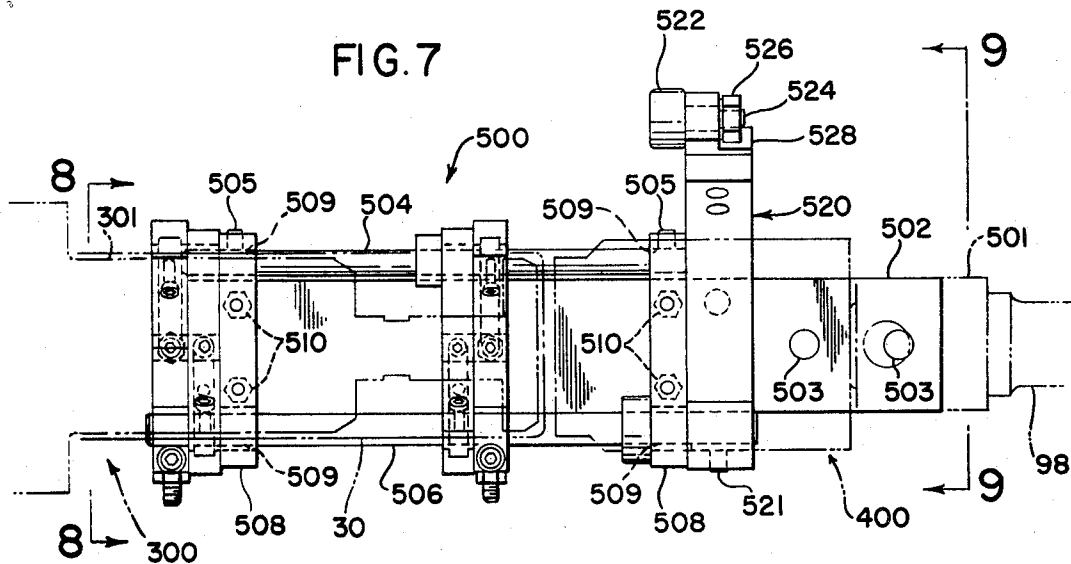


FIG. 8

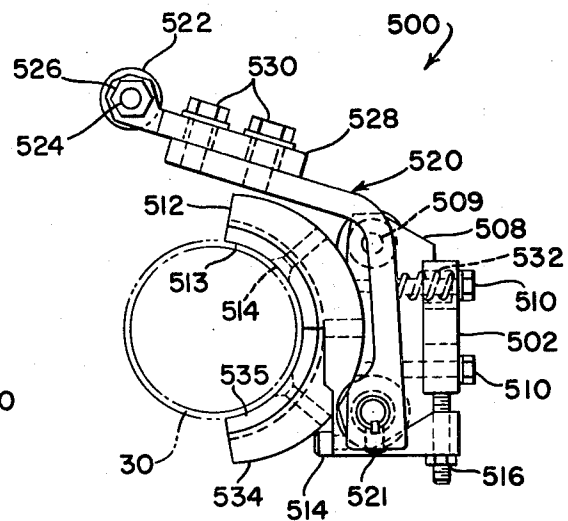


FIG. 9

INVENTORS.
RONALD H. D. ARMBRUSTER &
JOHN S. RINGLER

BY
Meyer, Tilberry & Body

ATTORNEYS

R. H. D. ARMBRUSTER ET AL

METHOD AND APPARATUS FOR TRIMMING EXTRUDED CAN BODIES

6 Sheets-Sheet 6



Meyer, Tilberry & Body

ATTORNEYS

1

3,400,620

METHOD AND APPARATUS FOR TRIMMING EXTRUDED CAN BODIES

Ronald H. D. Armbruster, Battle Creek, and John S. Ringler, Hastings, Mich., assignors to The E. W. Bliss Company, Canton, Ohio, a corporation of Delaware
Filed Aug. 22, 1966, Ser. No. 573,903
20 Claims. (Cl. 82-47)

The present invention is directed to the art of can making and more particularly to an improved machine for trimming the ends of extruded can bodies.

The present invention is particularly applicable for trimming the ends of extruded aluminum cans, and it will be described with particular reference thereto; however, it will be appreciated that the invention could be used to trim the end of any relatively thin walled tubular member.

As used in this application, "tubular member" refers to any hollow, elongated element having a generally circular cross-section.

In the can making art, it has become comparatively common practice to make can bodies by impact extrusion and deep drawing processes. By use of these processes, a generally circular flat metal plate or sheet is first passed through an impact extrusion or deep drawing press where it is formed into a relatively shallow cup. The cup is then passed through an ironing press which elongates the side walls and reduces them to the proper wall thickness to produce a can of required size. However, because of the nature of these forming processes, it is not possible to produce a can having the exact height required or having the upper edge of the side wall exactly square. Thus, it is necessary to trim the can to the required height.

Many different types of machines have been used to trim the extruded and drawn can bodies to the required height; however, all these machines have one or more of the following shortcomings: (a) ragged edges on the trimmed cans; (b) inconsistent length of the trimmed cans; (c) difficult and inconsistent disposal of the trim scrap; (d) slivers on the trimmed edges; and (e) abrasion damage to the side walls of the trimmed cans.

The present invention overcomes the above disadvantages and provides a trimming machine which consistently trims the extruded cans to the required height and produces a trimmed edge that is extremely smooth and free from slivers or other defects. Further, because of the unique sequence of cutting steps performed, scrap disposal is greatly simplified.

In accordance with the present invention, a method of trimming a tubular member to a desired length is provided which comprises: making two generally diametrically opposed cuts extending through the walls of the member from the scrap end to an imaginary line constituting the desired end thereof, and subsequently cutting circumferentially around the member at the desired end line.

In accordance with another aspect of the present invention, a machine for trimming tubular members to a desired length is provided which includes a rotating work-supporting mandrel and cutters adapted to cut through two diametrically opposed portions of the tubular member positioned on the mandrel. The cuts extend from an imaginary line constituting the desired end of the member to the scrap end thereof. An additional cutter is provided which moves against the rotating mandrel and cuts circumferentially around the tubular member at the desired end line.

As a result of having made the diametrically opposed cuts through the scrap end portion of the can, when the circumferential cut is made the scrap falls free of the mandrel and does not have to be slid therefrom. This simplifies scrap removal and avoids the necessity of pro-

2

viding mechanisms to remove the scrap from the mandrel. Additionally, because the circumferential cut is made while the entire can wall is supported by the mandrel, the resulting cut end is not bent over as sometimes happens when thin walled tubular members are cut off without an internal support.

An object of the present invention is to provide a method of trimming tubular members to length which facilitates removal of the scrap portion.

A further object of the present invention is the provision of an apparatus for trimming tubular members to length which produces an extremely smooth cut.

Another object of the present invention is the provision of a machine for trimming can bodies that is capable of holding the can height to extremely close tolerances.

Still another object of the present invention is the provision of a machine that is capable of trimming can bodies to a desired length at a very high rate.

These and other objects and advantages will become apparent from the following description used to illustrate a preferred embodiment of the invention as read in connection with the accompanying drawings in which:

FIGURE 1 is a cross-sectional elevation of the preferred embodiment of the present invention;

FIGURE 2 is an end elevation of the left end of FIGURE 1;

FIGURE 3 is a sectional view taken on line 3-3 of FIGURE 1 and showing the left end of the head stock;

FIGURE 4 is a sectional view taken on line 4-4 of FIGURE 1 and showing the right end of the head stock;

FIGURE 5 is a detailed cross-sectional view of one of the rotatable spindles carried by the head stock;

FIGURE 6 is a detail view, partially in section, of one of the work holding and positioning spindles carried on the tail stock;

FIGURE 7 is a plan view of one of the cull assemblies carried by the tail stock;

FIGURE 8 is a view taken from the left end of FIGURE 7;

FIGURE 9 is a view taken from the right end of FIGURE 7; and

FIGURE 10 is an elevational view of the feed and discharge assembly of the present invention as viewed from the right end of FIGURE 1.

Referring now to the drawings wherein the showings are for the purpose of illustrating the preferred embodiment of the invention only and not for the purpose of limiting same, FIGURE 1 shows the overall arrangement of the trimming machine A of the present invention and comprises drive assembly B, rotatable head stock assembly C, and tail stock assembly D. Positioned on the opposite side of the machine and not shown in FIGURE 1 is feed and discharge assembly E.

Generally, the trimming machine comprises a main horizontal drive shaft 36 which is rotatably driven by drive assembly B. Positioned on the shaft and adapted to rotate therewith are a head stock 66 and a tail stock 90. Carried on head stock 66 are six equally spaced head-stock spindle assemblies 300. These assemblies are adapted to receive the can to be trimmed and hold it during the rotation of head stock 66. Each of the spindle assemblies 300 also rotates about its own axis independent of the rotation of head stock 66. Also carried by head stock 66 are a pair of scrap knives 304 and a trim knife 608 (shown in FIGURE 4). One set of these knives is positioned relative each of the rotating spindle assemblies 300 so as to trim the can carried on that spindle.

Carried on the rotatable tail stock 90 are six tail stock spindle assemblies 400 and cull assemblies 500. Each of these tail stock spindle and cull assemblies is carried on the ends of rods 98 that are axially aligned with the head

stock spindle assemblies 300 and are reciprocated relative to tail stock 90 by a cam 86.

As the main drive shaft 36 is rotated, the head stock assembly C and the tail stock assembly D rotate therewith. As each tail stock spindle assembly rotates to approximately the 2 o'clock position (see FIGURE 10), a can from the can feeding assembly E is deposited in the arms of the cull assembly. At this time the rods 98 are withdrawn away from the head stock spindle assemblies. The tail stock spindle is then actuated forward by the cam and a vacuum and spring finger mechanism move with the can. As the tail stock continues to rotate it feeds it onto the corresponding head stock spindle, and at this time the spring fingers grip the can. Now scrap knives 304, carried in the head stock spindle, sever two longitudinally extending, diagonally positioned, cuts through the top scrap end of the can. Continued rotation causes trim knife 608 to be actuated inwardly by a cam and sever circumferentially around the rotating can removing the scrap end. As the spindle turns back to approximately its 5 o'clock position, as viewed from the right hand end of FIGURE 1, the can is withdrawn from the head spindle by the vacuum and spring finger mechanism carried in the tail spindle. The can is then discharged by the feed and discharge assembly E.

Each of the main assemblies of the machine will now be described in detail.

Drive assembly B

Referring to FIGURES 1 and 2, the drive assembly for the preferred embodiment of the trimming machine will first be described. Mounted at the left hand end of machine base 8 is a cast drive support frame 10. Carried on the top of frame 10 on a guideway formed by parallel rods 14 is electric motor 12. This motor is adjustable along guideway 14 by a threaded rod and hand wheel assembly 16. Mounted on the upper right corner of drive frame 10, as viewed in FIGURE 2, is a companion pulley 20 which is driven by a variable pitch pulley mounted on motor 12. The variable pitch pulley permits the speed of the machine to be varied. Pulley 20 is driven by motor 12 through belt 18; and it, in turn, drives pulleys 26 and 28 through shaft 22 carried in bearing blocks 24. Pulley 26 is drivingly connected to pulley 30 of drive housing 32 by belt 31. Extending from the right side of housing 32, as viewed in FIGURE 1, is the main drive shaft 36 which carries the rotatable head stock and tail stock assemblies. Extending from the left side of housing 32, as viewed in FIGURE 1, is shaft 33 on which is mounted sprocket 34. Sprocket 34 is connected by a chain 38 to a sprocket 40 that is keyed to shaft 42 which extends along the back of the machine and drives the can feed and discharge assembly E.

Connected with pulley 28 through belt 48 and idler pulley 46 is pulley 44. Pulley 44 is mounted on a shaft 50 which extends along the front side of the machine, as viewed in FIGURE 1, and is drivingly connected to a pinion gear 52. Pinion gear 52 drives ring gear 54 which is carried on ring gear guide bearings 56, and maintained thereon by retainer ring 58 which extends completely around the outer periphery of the ring gear and is bolted to guide 56. As can be seen, rotation of ring gear 54 causes gears 150, which are engaged with the toothed internal periphery of the ring gear, to be rotated, thus rotating the head spindle assemblies 300 independent of the rotation of head stock 66.

Head stock assembly C

Head stock assembly C comprises a generally circular head stock 66 that is connected for rotation by main drive shaft 36 by a key 68.

Rotatably mounted at equally spaced locations about the outer portion of head stock 66 are six head stock spindle assemblies designated generally as 300. Each of these spindle assemblies is shown in detail in FIGURE 5 and comprises a main central spindle 310 carried in head

stock 66 by bearings 311 and 312. Bearings 311 and 312 are spaced by a spacer member 314 and retained in the head stock by retainer ring 316 which is fastened to the head stock by screws 318. Mounted at the right hand end of spindle 310, by screws 302 and an adapter plate 317, is spindle nose portion 301. Spindle nose portion 301 is of a diameter to fit within the can 30 to be trimmed and carry it during the trimming operation. Positioned within spindle nose 301 are a pair of reciprocable scrap knives 304.

Extending from the right end of spindle nose 301 is rod 338 on which is mounted nose piece 336. Nose piece 336 is designed to assist in guiding can body 30 onto the rotating spindle nose 301 and to press against the bottom of the can 30 to maintain it snugly against the tail spindle assembly 400. Rod 338 and nose piece 336 are continually biased outwardly by a spring 342 which acts against sleeve 340 which in turn acts against the enlarged inner end portion of shaft 338. Sleeve 340 is slotted where it passes knives 304 so as not to interfere with their motion. Attached to the left end of spindle 310 by a key 322, lock washer 326, and lock nut 324 is a pinion gear 320. As previously noted, rotation of pinion gear 320 by ring gear 54 causes spindle 310 and spindle nose portion 301 to be rapidly rotated independent of the rotation of head stock 66.

As shown in the drawings, there are two scrap knives 304 adapted to be extended through opposite sides of the spindle nose. These knives act to cut a pair of diametrically positioned cuts through the wall of the can 30 from the scrap end 31 to the desired end line 32. Thus when the can is trimmed or cut circumferentially around at line 32 the two scrap portions fall free of the spindle nose 301. This eliminates the necessity of providing additional mechanisms to remove the scrap collar from the mandrel or spindle nose 301.

Although in the preferred embodiment of the invention two scrap knives are shown, it is apparent that one or several could equally well be used. For example, a single knife could be actuated to extend first out one side and then out the other. Alternately, it would be possible to use several knives actuated from mechanisms such as fluid pistons to extend outwardly from the nose or to extend inwardly to the nose from a carrier mounted externally of the nose. The exact number of cuts made through the scrap collar is not of great importance. However, it is important that the scrap collar be cut into at least two portions of not much more than 180° in extent. Otherwise, problems are had in removing the scrap from the spindle nose portion or mandrel.

In the preferred embodiment, the scrap knives 304 are actuated through a cam mechanism. As shown in FIGURE 5, an actuating rod 306 extends centrally through spindle 310. Rod 306 is mounted to be freely slidable within spindle 310. At the right end of rod 306, a pair of cam tracks 308 are formed on opposite sides or flats on rod 306. These cam tracks engage cam following portions in the sides of each of the knives 304. It can be seen that reciprocation of rod 306 will cause knives 304 to be extended through opposite sides of spindle nose 301. Thus, the knives 304 are placed in position for cutting the pair of diametrically opposed longitudinal cuts in the can as the can is forced into its position on the spindle nose by tail stock spindle assembly 400.

Connected to the left hand end of rod 306 is a sleeve 328 on which is mounted a bearing 330. Bearing 330 is retained on sleeve 328 by a lock washer 334 and lock nut 332. The outer surface of bearing 330 is engaged by yoke members 640 carried on actuating arm 632, shown in FIGURE 3. This provides means to actuate the scrap knives at the proper time during the cycle in a manner to be subsequently described.

Referring now to FIGURE 4 which shows a partial end view of head stock 66 as viewed from the right end of the head stock as seen in FIGURE 1, there are shown

a plurality of bosses 604 equally spaced about the circumference of the head stock. There are six of these bosses 604, and in each is carried a previously described head spindle assembly 300, as shown in FIGURE 1.

Positioned adjacent each of the bosses 604 is a smaller boss 602. Extending through each of the bosses 602 from one side of the head stock to the other is a shaft 616.

Mounted on the end of each shaft 616 by lock nut 614 is knife arm 606 (for the sake of clarity only one such arm is shown, however it should be realized one such arm would be mounted adjacent each head spindle assembly 300). This arm is attached by screw 609 which extends through the end of the arm 606 to clamp it firmly to shaft 616. Mounted on the other end of arm 606 is knife 608. Knife 608 is releasably retained in arm 606 by plate 610 and screws 612. Each of the arms 606 is mounted so that when it is rotated clockwise into the corresponding spindle nose mounted at location 604, the knife 608 mates with a circumferential recess 303 (see FIGURE 5) of the spindle nose. Thus it can be seen that when knife 608 is actuated against a can carried on rotating spindle nose 301, a circumferential incision will be made in it at the line above recess 303.

As noted before, shaft 616 extends completely through the head stock and out the opposite side. As shown in FIGURE 3, which is an end view of the head stock as seen from the left end of FIGURE 1, a trim knife actuation arm 618 is connected to the opposite end of shaft 616 by a lock nut 619. Carried at the end of arm 618 is a cam follower 620. Cam follower 620 is adapted to engage cam track 60 mounted on the drive frame 10 and extending circumferentially around main drive shaft 36 as shown in FIGURE 1. Cam track 60 is designed so that trim knife 610 is caused to rotate into spindle nose 301 at the proper point in the rotation of the head stock 66. It should be remembered that although only one trim knife actuating arm 618 is shown in FIGURE 3, there would be six such arms, one positioned on each shaft 616.

Also shown in FIGURE 3 is a scrap knife actuating lever 632. This lever is pivotally mounted on shaft 630 which extends between support extension 626 and bracket 628. Support extension 626 is made integrally with head stock 66 while bracket 628 is connected thereto by screws 629. Carried on the single lower arm of trim actuation lever 632 is a cam follower 634 connected thereto by a nut 638. Mounted on the two oppositely extending arms of trim actuation lever 632 are a pair of yoke members 640. These members are pivotally connected to the arms by pins 642 and are adapted to engage and hold bearing 330 shown in FIGURE 5. Thus rod 306 is caused to reciprocate and actuate scrap knives 304. In order to assure that rod 306 is actuated at the proper time during the cycle, cam follower 634 is guided in stationary cam track 62 which extends circumferentially about main drive shaft 36 as shown in FIGURE 1. Although only one actuating lever 632 is shown in FIGURE 3, it should be remembered that there are five more such levers mounted at equally spaced locations about head stock 66.

Tail stock assembly D

Referring to FIGURE 1, the tail stock assembly D will now be described. As shown by section lines 1—1 in FIGURE 10, the upper half of the tail stock assembly D shown in FIGURE 1 has been rotated from approximately the 2 o'clock position as viewed from the right end of the machine. This has been done to clearly show the position of tail stock spindle assemblies 400 when they receive a can from the can feeding mechanism.

Tail stock assembly D comprises a main tail stock support member 80 which is carried on the right hand end of base 8. Support 80 is mounted to be slidably adjustable on the base 8 by a threaded adjusting screw 82. Positioned centrally of tail stock support 80 is a bearing 84 held in position by bearing retainers 85 and bolts 87. Rotatably carried within bearing 84 is main shaft 36 and

rotatable tail stock 90. Rotatable tail stock 90 is joined to rotate with main shaft 36 by a key 92 which extends between main shaft 36 and collar 94 which is joined to rotatable tail stock 90. The right hand end of tail stock 90 is mounted on a bearing 110 carried by tail stock support 80.

Positioned around the outer rim of tail stock 90 are six sleeve bearings 100. Each of these bearings is mounted so that its center is aligned with the center of a corresponding head spindle assembly 300. Carried within each of the sleeve bearings 100 is a tail spindle actuating rod 98.

Means are provided to reciprocate rods 98 at the proper time during the cycle and comprise a cam follower carrier 102 which is connected to the threaded end of rods 98 by a nut 104. Each of the cam follower carriers 102 is adapted to slide in slideways 108 provided in tailstock 90. Extending inwardly from cam follower carrier 102 are a pair of cam followers 106 connected to the cam follower carrier by nuts 104. A drum cam 86 which is connected to tail stock support 80 by bolts 88 extends completely around shaft 36, serves to give the proper motion to rods 98 by causing cam follower carriers 102 to be reciprocated in tracks 108.

Referring to FIGURE 6, the tail stock spindle assemblies will now be described in detail. One of these assemblies is mounted at the end of each rod 98. Since each of the spindle assemblies are identical, only one will be described. Each of the assemblies comprises a centrally extending stub shaft member 401 attached to spindle mounting plate 99 by four bolts 402.

A vacuum line 411 and valve chamber 410 are formed centrally of the stub shaft. Vacuum is communicated to inlet 13 from any convenient source. Slidably mounted in the valve chamber 410 is a spool valve 404 which serves to control the vacuum to the end of the stub shaft. This valve is continually biased downwardly by a spring 406 and is retained in the stub shaft by an upper snap ring 408. Extending circumferentially around the center portion of the valve are two relieved portions 403 and 407. When the valve is in the position shown in FIGURE 6, vacuum is communicated from the right end of the stub shaft around the relieved portion 403 to the nose portion of the stub shaft. However, when valve member 404 has moved to its lower position with snap ring 408 in contact with the upper surface of stub shaft 401, vacuum is cut off to the end portion of the stub shaft and vacuum line 411 is communicated with the atmosphere through relieved portion 407 and opening 409. The means to control the motion of the valve 404 comprises a cam 61, shown in FIGURE 1, which extends circumferentially around main shaft 36 and acts against cam surface 405 of valve 404.

Mounted on the left end of stub shaft 401 are bearings 412 and 414. These bearings are spaced by inner spacer 416 and outer spacer 418 and are held on stub shaft 401 by a lock nut 430 and lock washer 432. Carried on the outer surface of the bearings and adapted to freely rotate relative the stub shaft 401 is finger carrier 420. Finger carrier 420 is retained on the bearings on stub shaft 401 by bearing retainer ring 419 and screws 421. Mounted on the left hand end of finger carrier 420 are four fingers 422. Only two fingers 422 have been shown; however, it should be realized that there are four such fingers spaced at 90° locations about finger carrier 420. These fingers are pivotally carried by a pin 424 extending between two supports 428 which extend from the outer surface of finger carrier 420. The right end of each finger 422 is continually biased upwardly by a spring 426 which causes the finger to pivot about pin 424.

Positioned around the outer surface of finger carrier 420 and longitudinally slidable relative thereto are a front cam ring 444 and a rear cam ring 442 connected by screws 446. Front cam ring 444 has a cam surface 445 which, when the cam ring is reciprocated outwardly, acts

against the under surface of fingers 422 to force them out of gripping engagement with the can. The means for actuating the cam rings 444 and 442 at the proper time during the cycle comprises a stop 59 carried on the tail stock adjacent each rod 98 (shown in FIGURE 1). As the tail spindle assembly is reciprocated rearwardly, circumferentially extending portion 443 of rear cam ring 442 contacts stop 59. Further rearward reciprocation causes the cam rings to be moved outwardly on the finger carrier 420 and move fingers 422 to their can disengaged position. Conversely, when the tail spindle is moving a can onto the head spindle, the bottom of the can contacts the front portion of cam ring 444 and moves it back to permit the spring fingers to grip the can.

At the end of finger carrier 420 is mounted a suction cup 434. This suction cup extends completely around the outer end of finger carrier 420 and is retained in position by a large screw 433 which has a vacuum opening extending centrally therethrough and communicating with vacuum line 411. Mounted in the end of stub shaft 401 and continually biased against the end of screw 433 by a spring 438 and a washer 439 is sealing sleeve 436.

Also carried by actuating rods 98 and supported from tail stock spindle support plates 99 by a plate 501 which extends horizontally therefrom is a cull assembly 600. The cull assembly is cantilevered from plate 501 by a main support member 502 which is attached to plate 501 by a pair of screws 503.

Mounted at spaced locations along cantilever arm 502 are two rod supporting members 508. These supporting members are attached to support member 502 by screws 510. Fixedly mounted in the upper openings 509 in support plates 508 by set screws 505 is a rod 504. Mounted in the lower openings 509 of the support plates 508 is a lower rod 506. This rod is mounted to be freely rotatable in the support plates 508.

Carried by the upper rod 504 are a pair of cull arms 533 and 534. These arms extend downwardly from upper rod 504 to a lower can-engaging portion which has a can-engaging surface 535 of approximately 85° mounted thereon. Both of the arms 533 and 534 are freely rotatable on rod 509.

Carried by lower rod 506 are a pair of similar cull arms 511 and 512. These arms are fixedly connected to lower rod 506 by screws 514 which cause the arms to clampingly engage rod 506. Arms 511 and 512 likewise have a can-engaging surface of approximately 85° formed by two members 513 attached to the arm by screws 514. As best shown in FIGURE 8, the position of arms 511 and 512 is adjusted by a screw 516 which extends through the left arm portion of the arms and contacts cantilever support arm 502. Positively connected at the right hand end of rod 506 by set screw 521 is actuating arm 520. This arm includes an outer arm portion 528 which is adjustably joined to arm 520 by screws 530. Carried at the end of outer arm portion 528 is a cam follower 522 connected thereto by a bolt 524 and nut 526. Thus, it can be seen that movement of arm 520 causes the rotation of shaft 506 and corresponding movement of cull arms 511 and 512. Movement of cull arms 511 and 512 is also transmitted to lower cull arms 533 and 534. As shown in FIGURE 8, extending from the back of each of cull arms 511 and 512 is an adjustable stud 518. This stud contacts a pin 538 which extends from the side of each of the cull arms 533 and 534. This counterclockwise movement of cull arms 511 and 512 by rod 506 causes a corresponding counterclockwise movement of cull arms 533 and 534 about upper rod 504.

Cull arms 533 and 534 are continually biased to the position shown in FIGURE 8 by springs 536 which extend between the back of each cull arm and cantilever support arm 502. Upper cull arms 511 and 512 are likewise biased to the position shown in FIGURE 8 by a spring 532 which extends between actuating arm 520 and

cantilever support arm 502, as best shown in FIGURE 9.

The means for actuating cull actuating arm 520 at the proper time during the cycle comprises a cam track 65. (Shown in FIGURE 1.) Cam track 65 extends circumferentially around the main shaft 36 and receives the cam follower 522.

As shown in FIGURE 10, the cull assemblies 500 are mounted on rods 98 so that the can receiving surfaces 513 and 535 carried on the cull arms 511, 512, 533, and 534 are always facing outwardly. This actual position of the cull assemblies is thus rotated slightly from the position shown in FIGURE 1. The FIGURE 1 showing is merely to give an understanding of the overall relationship of the cull assemblies to the rest of the machine.

Feed and discharge assembly E

Referring now to FIGURE 10, the feed and discharge assembly E will be described. FIGURE 10 shows the feed and discharge assembly as it appears when viewed from the right hand end of FIGURE 1 looking toward the drive end of the machine. The assembly comprises a main frame 200 which is adapted to be adjusted longitudinally of the machine by being mounted in guideways 202 on the base 8 of the machine. A threaded opening 204 is provided in the lower portion of the frame and a threaded rod, not shown, extends through this opening to permit adjustment of the frame.

Mounted on the upper end of frame 200 from shaft 208 which is mounted in bearings, not shown, and supported from the frame 200 is upper feed star wheel 206. Positioned immediately below star wheel 206 is lower discharge star wheel 210 which is likewise mounted on a shaft 212 supported by brackets, not shown, which extend from frame 202. Upper and lower star wheels 206 and 210 are driven by sprockets 214 and 216 by a chain 222 which connects them with main drive sprocket 218. Drive sprocket 218 is driven by shaft 42 which extends along the back side of the machine from sprocket 40 shown in FIGURE 2. Sprocket 218 is keyed to shaft 42 so that it rotates therewith but is permitted to have some longitudinal movement along the shaft when the feed assembly is adjusted longitudinally of the trimming machine. Also shown is an idler sprocket 220 which is carried on bracket 221. Bracket 221 is adjustable relative main frame 200 through the use of slotted openings 223 and bolts 224, thus permitting chain 222 to be tightened. Shown extending upwardly and to the right of frame 200 is screw conveyor 226. Screw conveyor 226 is driven from drive shaft 42 by gearing not shown.

This conveyor, in combination with upper guide 228, delivers the cans to be trimmed, one at a time, with their longitudinal axis horizontal to upper star wheel 206. Upper star wheel 206, in combination with lower curved guide 229, then transfers each can onto a cull assembly 500 of tail stock assembly 400. Rotation of the head stock assembly in a counterclockwise direction then takes the can and performs the above described trimming operations on it and returns it to approximately a 4 o'clock position at which time tail spindle assembly 400 withdraws it from the head spindle and in combination with cull assembly 600 deposits it in an opening of lower star wheel 210. Star wheel 210 rotates in a clockwise direction and in combination with curved guide 231 carries the can to discharge guideway 230. It should be remembered that both upper and lower star wheels 206 and 210 and screw conveyor 226 are continuously driven in timed relation with main spindle 36.

Operation

The overall operation of one complete cycle of trimming machine A will now be described. Referring to FIGURE 10, it can be seen that screw conveyor 226 feeds the cans horizontally one at a time to upper star wheel 206. Upper star wheel 206 in combination with the curved guide 229 carry the can to approximately the

2 o'clock position as shown on FIGURE 10. At this position the can is received by the cull assembly 500 which is carried by the tail stock assembly. As cull assembly 500 approaches the 2 o'clock position, the culls are closed to the position shown in FIGURE 7 and receive the can on surfaces 513 and 535. Simultaneously, the tail stock actuating rods 98 are moved forward under the influence of barrel cam 86. Now the can, guided on the inside by the cull and on the outside by curved guide 235, is guided onto the rotating head spindle nose 301. The culls are then opened removing them from contact with the can so that the can's exterior is not marred during its rotation. As the can is finally positioned on the head spindle nose 301, the spring fingers close on the can to assist in its removal at the end of the trimming operation.

Prior to the can being moved onto the spindle, scrap knives 304 have been actuated to their extended position by cam 62 acting against cam follower 634 carried on scrap knife actuating lever 632, shown in FIGURE 3. Since scrap knives 304 are extended from the body of spindle nose 301, movement of the can onto the spindle nose by tail stock spindle assemblies 400 causes the scrap knives to cut diagonally opposed slits into the scrap end of the can. As head spindle 66 continues to rotate, scrap knives 304 are retracted part way into spindle nose 301, leaving a small length extended which assists in causing the can to continue to rotate with the spindle nose. Continued rotation of head stock 66 causes trim knife 608 to be actuated inwardly against the can which is rotating on spindle nose 301. As previously described, trim knife 608 is controlled in its movements by cam 60 which acts against cam follower 620 carried on trim knife actuation arm 618, as best shown in FIGURE 3. Trim knife 608 presses against nose spindle 301 and enters recessed slot 303, shown in FIGURE 5. This causes the can to be circumferentially trimmed about a line above recess 303. The continued rotation of the head stock and tail stock assemblies causes tail spindle actuating rods 98, under the influence of cam 86, to be moved back, pulling the tail stock assembly, and the can carried thereby, away from the head stock spindles. At this time the cull is again closed. As the can held in the tail stock spindle assembly and cull reaches approximately the 4 o'clock position in FIGURE 10, the cam track 61 actuates spool valve 404 to the position where vacuum is cut off to the suction cup 434 and the interior of the suction cup is communicated with the atmosphere through outlet 409 of spool valve 404. Simultaneously, outer cam ring 444 is moved forwardly because of contact with stop 59 releasing the fingers 422 from the can. The can is then received by lower star wheel 210 and carried to discharge guide 230 where it is discharged from the machine.

It should be remembered that the above-described cycle of operation is taking place simultaneously on all six spindles. Thus it can be seen that the machine is capable of trimming a very large number of cans at a high rate of speed governed only by the allowable speed of rotation of the head stock and tail stock assemblies.

The invention has been described in great detail sufficient to enable one skilled in the art of can making to duplicate the invention. Obviously modifications and alterations of the preferred embodiment described will occur to others upon the reading and understanding of this specification. It is our intention to include all such modifications and alterations as part of my invention insofar as they come within the scope of the appended claims.

Having thus described our invention, we claim:

1. A method of cutting a tubular member about an imaginary circumferentially extending line to separate said member into scrap portions and a usable body portion, one end of said member being a scrap end and the other end being a usable body end, said method comprising

the steps of: making at least two cuts between the scrap end and the imaginary circumferentially extending line, and cutting circumferentially around said member at said imaginary circumferentially extending line.

2. The method of claim 1 wherein adjacent cuts on said scrap end are spaced no more than approximately 180°.

3. The method of claim 1 wherein there are only two of said cuts.

4. The method of claim 1 wherein said cuts extend generally axially of said member.

5. The method of claim 1 wherein said cuts are progressively made longitudinally of said member.

6. The method of claim 1 including the additional step of rotating said member about its longitudinal axis whereby the scrap portions are thrown outwardly.

7. Apparatus for cutting a tubular member about an imaginary circumferentially extending line to separate said member into scrap portions and a usable body portion, one end of said member being a scrap end and the other end being a usable body end, said apparatus comprising means to support said tubular member; first knife means mounted for movement with said support means and adapted to make at least two cuts extending between the scrap end and the imaginary circumferentially extending line of a tubular member supported by said support means; second knife means associated with said support means and adapted to cut circumferentially around the tubular member at said imaginary line, while said tubular member is supported by said support means.

8. The apparatus of claim 7 wherein said support means comprises a rotatable mandrel adapted to fit within said tubular member.

9. The apparatus of claim 8 including means for rotating said mandrel and said first knife means simultaneously.

10. The apparatus of claim 8 including means for feeding tubular members to be cut onto said mandrel.

11. The apparatus of claim 8 wherein said mandrel has a longitudinal centerline and means are provided for rotating said mandrel about said centerline.

12. The apparatus of claim 11 including means for feeding tubular members onto said mandrel.

13. The apparatus of claim 12 wherein said feeding means is mounted for reciprocation along a line that is co-linear with said longitudinal centerline.

14. The apparatus of claim 13 wherein said feeding means includes means for gripping said tubular member.

15. The apparatus of claim 13 wherein said feeding means has means for permitting said feeding means to rotate with said mandrel.

16. Apparatus for cutting tubular members comprising: a head stock member mounted for rotation about an axis; a plurality of mandrels carried by said head stock, each of said mandrels having a longitudinal centerline and adapted to support a tubular member to be cut; means to rotate each of said mandrels about its longitudinal centerline independent of the rotation of said head stock; cutting means associated with each of said mandrels and rotatable therewith, said cutting means adapted to produce a pair of diametrically opposed cuts through the walls of a tubular workpiece positioned on the corresponding mandrel; and additional cutting means associated with each said mandrel for cutting circumferentially around the wall of a tubular workpiece positioned on the corresponding mandrel.

17. The apparatus of claim 16 wherein said mandrels are mounted with their longitudinal centerlines extending generally parallel to the axis of rotation of said head stock.

18. The apparatus of claim 16 further including; a rotatable tail stock member spaced from said head stock member and rotatable about the axis of rotation thereof; a plurality of work holding means carried by said tail stock member and rotatable therewith, each of said work

11

holding means being aligned with a corresponding one of said mandrels; means to independently move each of said work holding means toward and away from the corresponding mandrel to thereby place on and remove from said corresponding mandrel a tubular workpiece.

19. The apparatus of claim 18 including means for simultaneously rotating said tail stock member and said head stock member.

20. The apparatus of claim 18 in which each of said

12

work holding means is mounted for rotation with the corresponding mandrel.

References Cited

UNITED STATES PATENTS

2,298,366	10/1942	Gladfelter	-----	82—101	X
2,702,597	2/1955	Wickwire	-----	82—54	

HARRISON L. HINSON, *Primary Examiner.*