United States Patent [19]

Cvacho et al.

[11] **3,756,103**

[45] **Sept. 4, 1973**

[54] **APPARATUS FOR AND METHOD OF TRIMMING CONTAINERS**

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[73] Assignee: **Reynolds Metals Company,** Richmond, Va.

[22] Filed: **Jan. 28, 1971**

[21] Appl. No.: **110,579**

Related U.S. Application Data

[63] Continuation of Ser. No. 745,447, July 17, 1968, abandoned.

[52] **U.S. Cl.** ..... **82/101 R,** 82/47 R, 82/85 R

[51] **Int. Cl.** **B23b 3/04,** B23b 1/00

[58] **Field of Search** 82/46, 47, 48, 59, 82/60, 85, 70.2, 101

[56] **References Cited**

UNITED STATES PATENTS

1,934,660	11/1933	Fairchild	82/101
2,298,366	10/1942	Gladfelter et al.	82/85
2,701,015	2/1955	Gottschalk	82/85
3,084,578	4/1963	Hartford	82/60
3,302,500	2/1967	Hackenberger	82/101 X
3,400,620	9/1968	Armbruster et al.	82/47
3,406,598	10/1968	Doucet	82/46
3,481,232	12/1969	Yann	82/46

FOREIGN PATENTS OR APPLICATIONS

971,496	9/1964	Great Britain

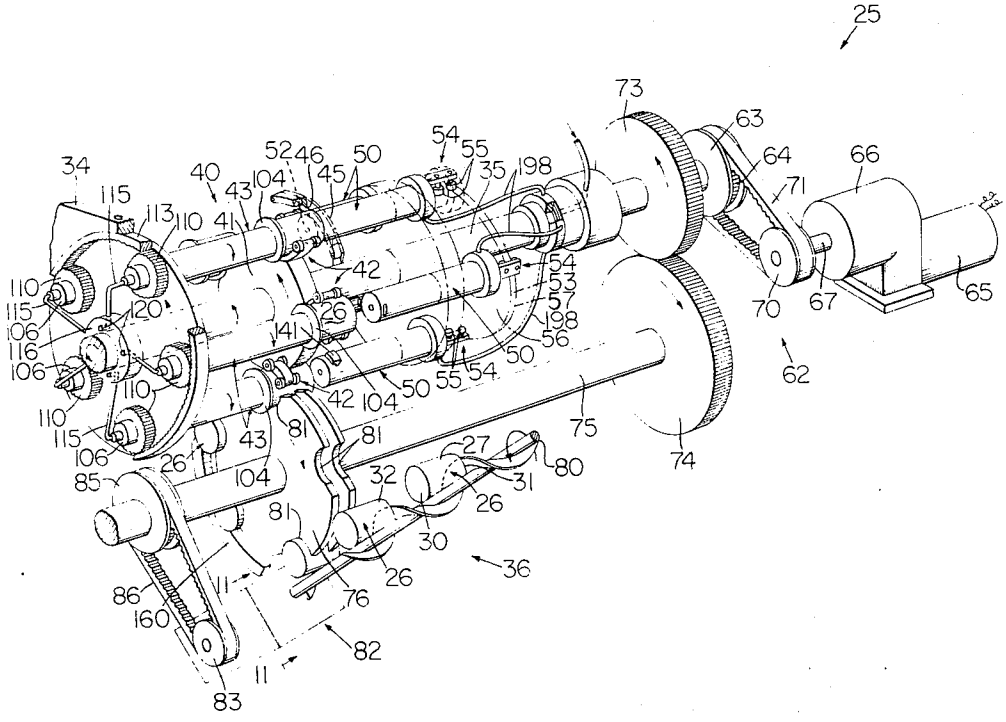
Primary Examiner—Harrison L. Hinson

Attorney—Glenn, Palmer, Lyne, Gibbs and Thompson

[57] **ABSTRACT**

An apparatus for and method of trimming cylindrical cans at high speed wherein each can is orbited and simultaneously rotated in a continuous nonindexing manner while being simultaneously held against a sickle blade.

24 Claims, 20 Drawing Figures



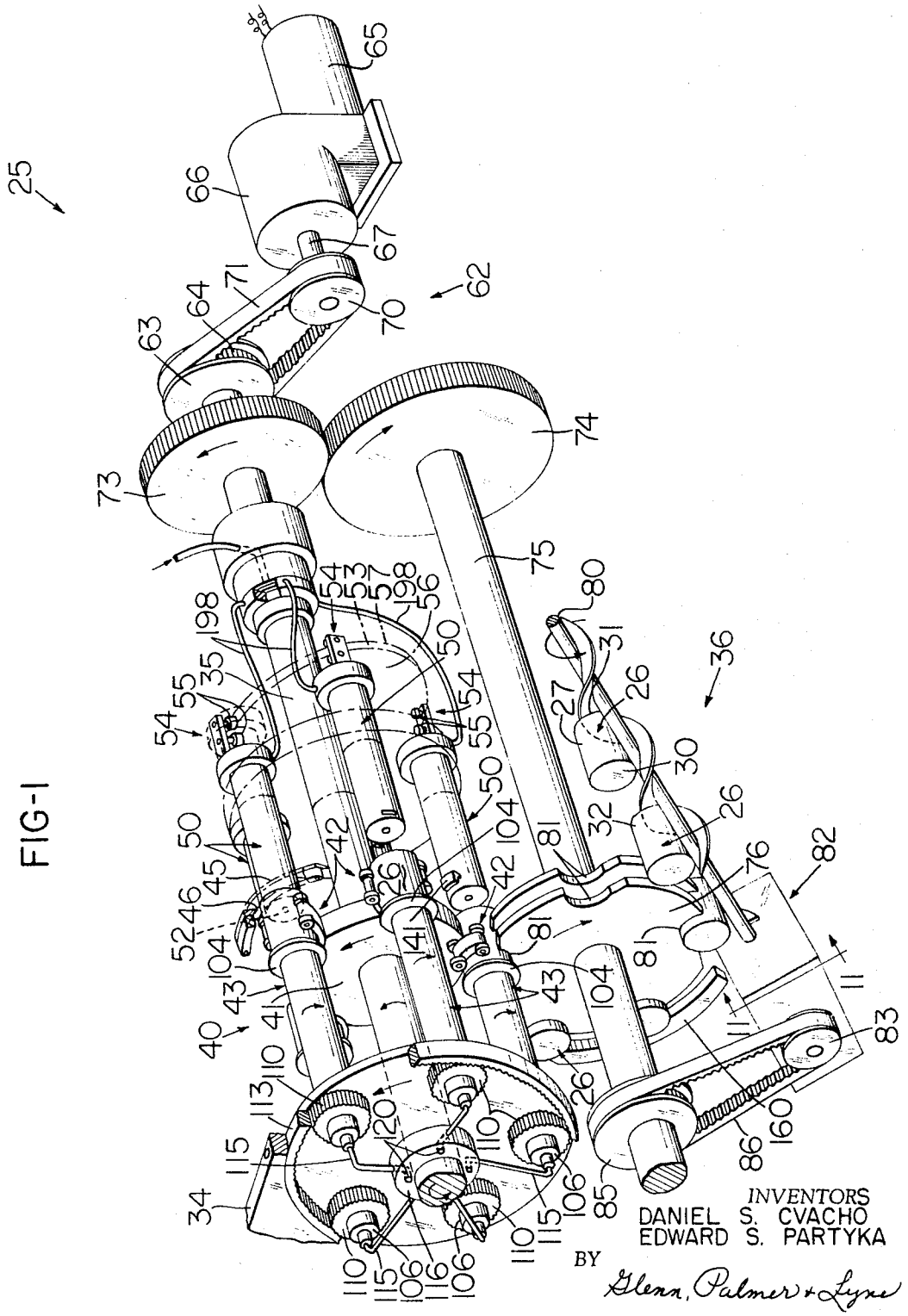


FIG-1

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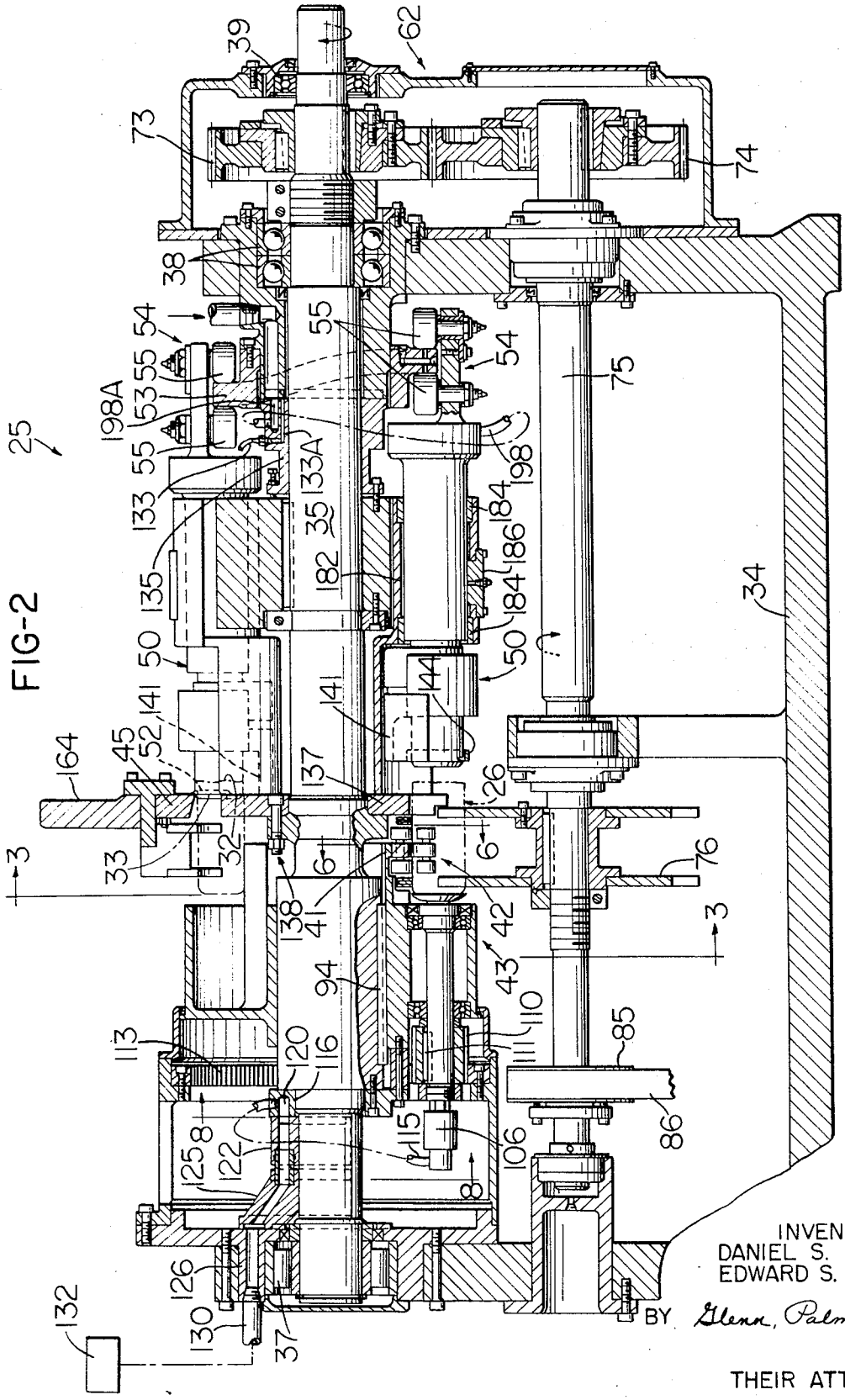


FIG-2

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FIG-3

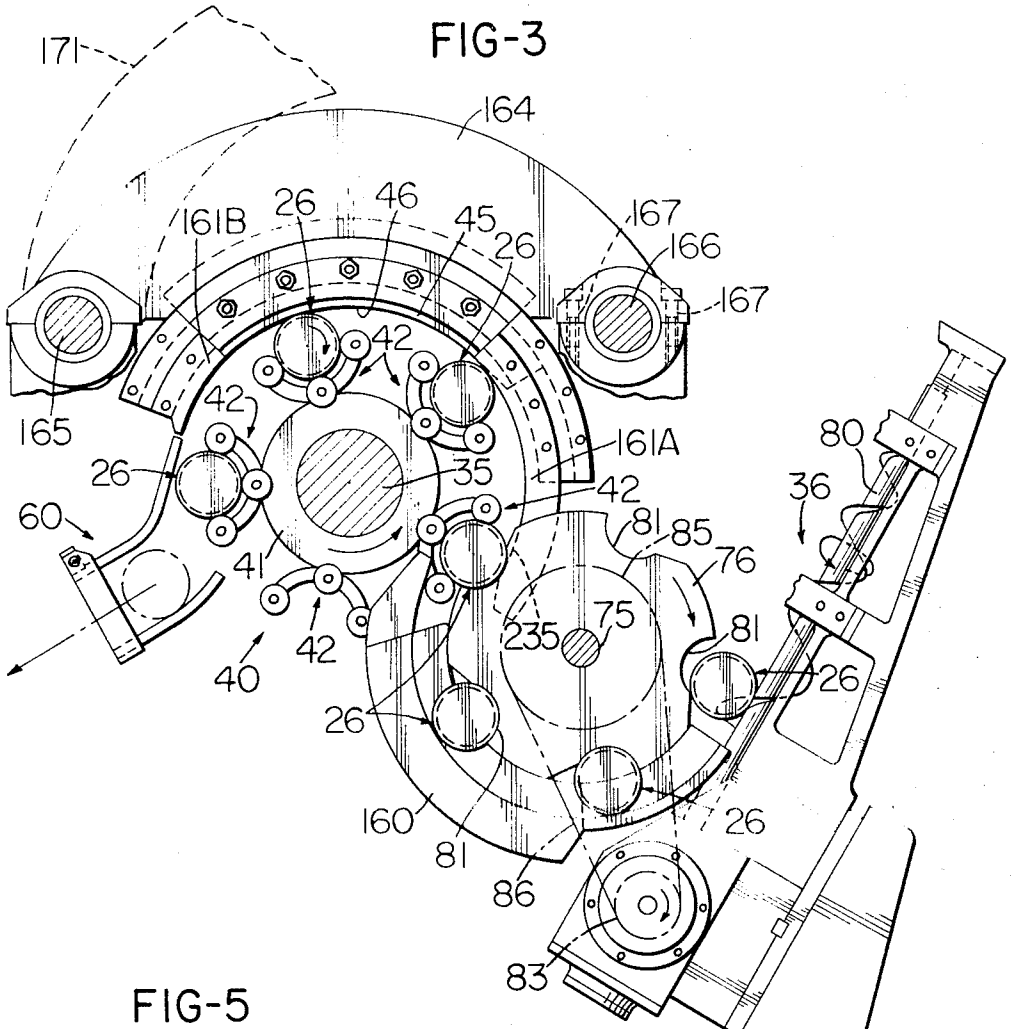
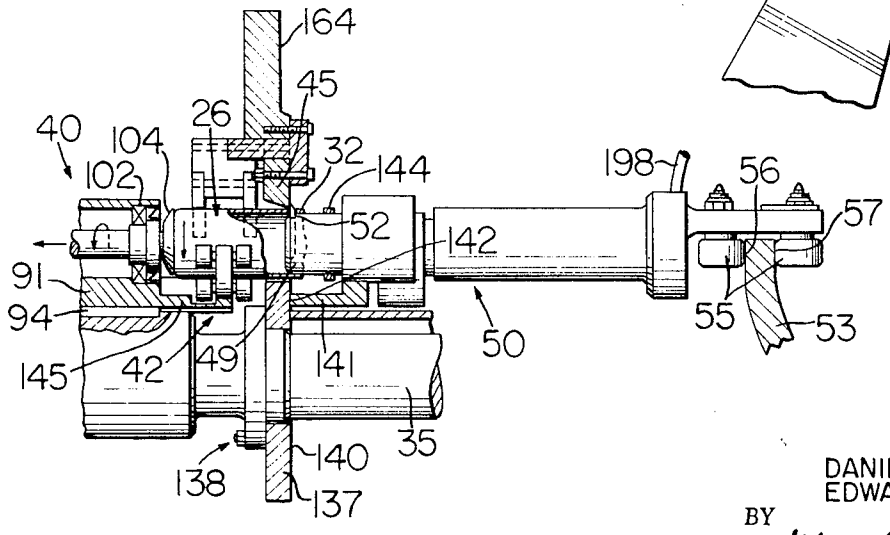


FIG-5



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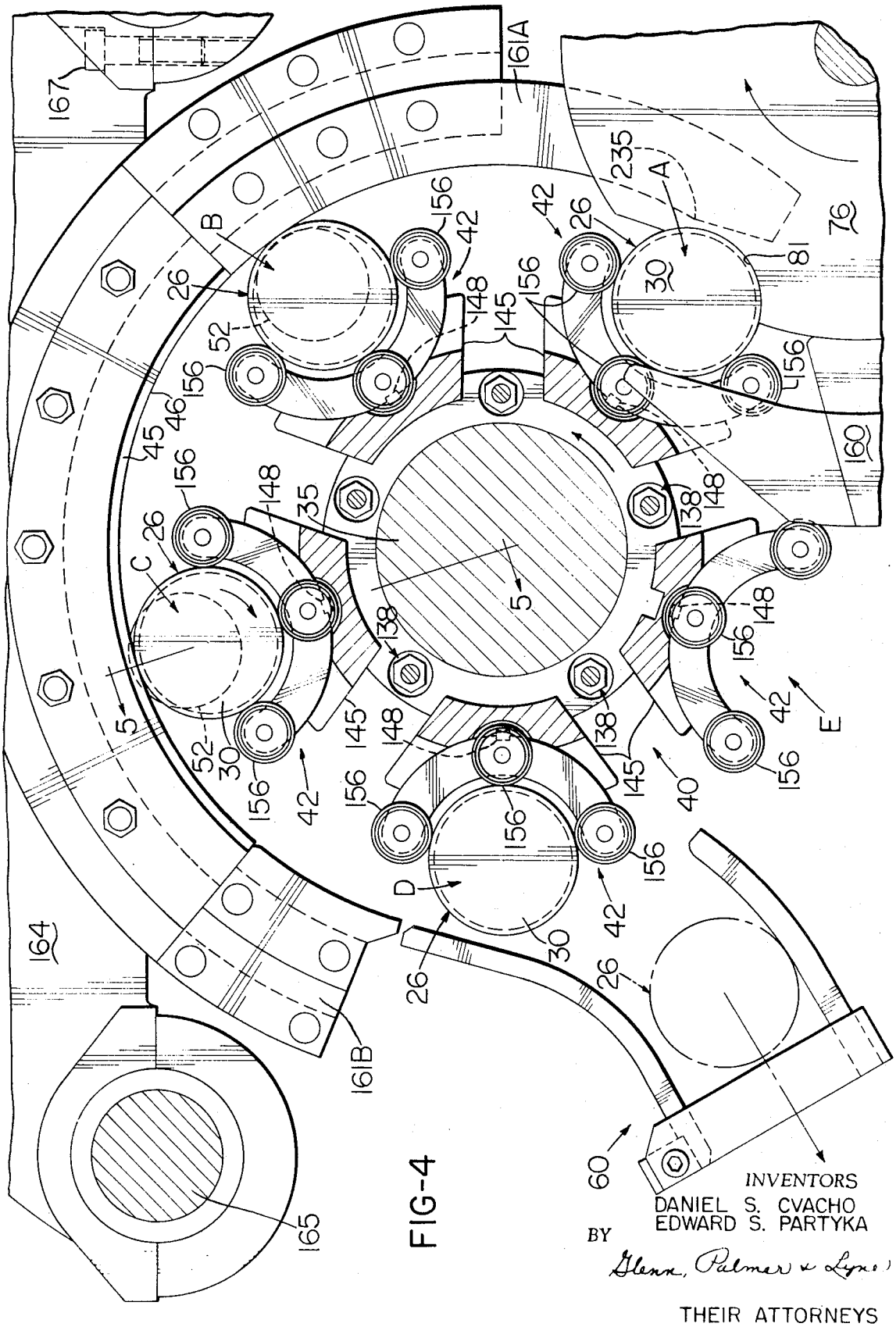


FIG-4

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FIG-6

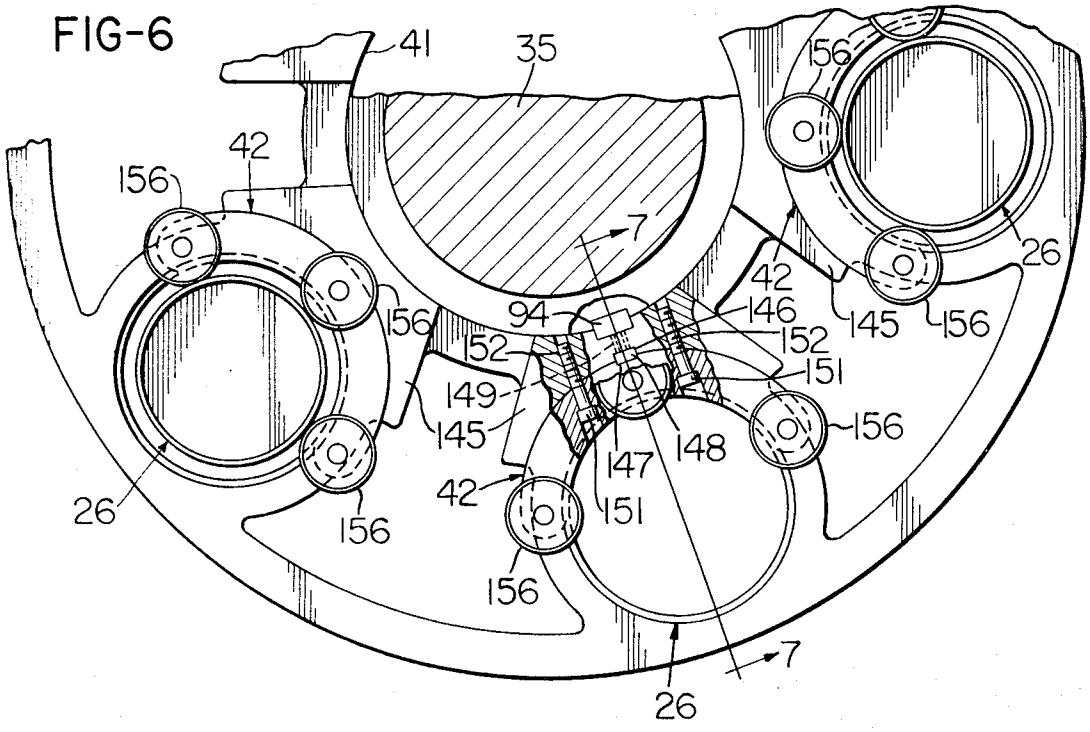
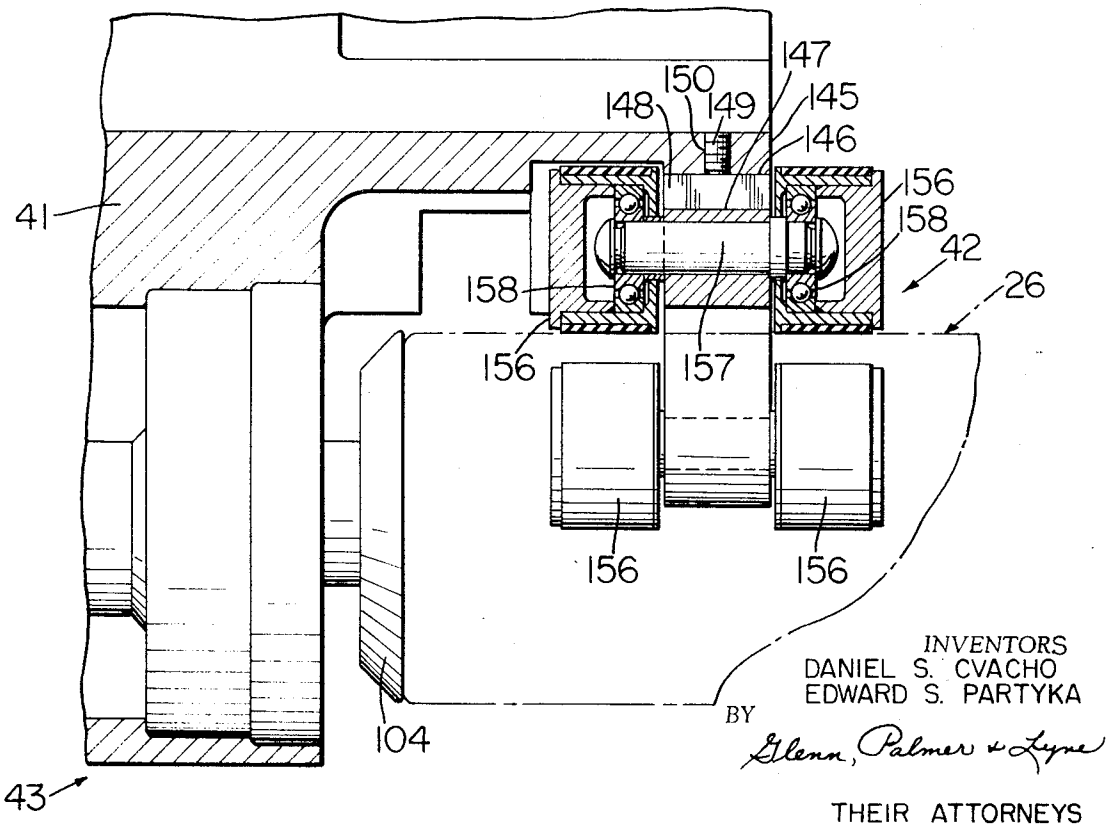


FIG-7



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FIG-8

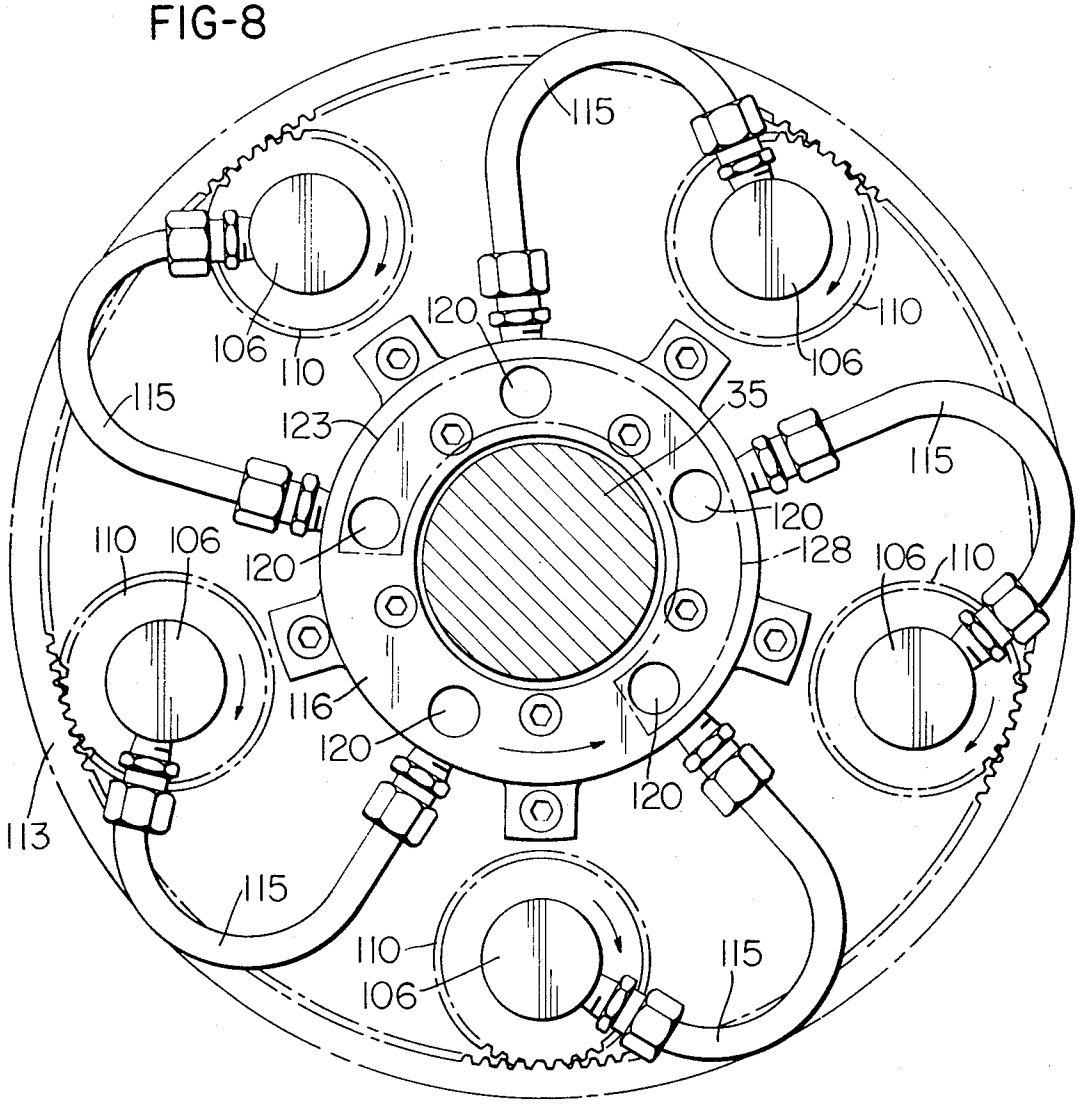
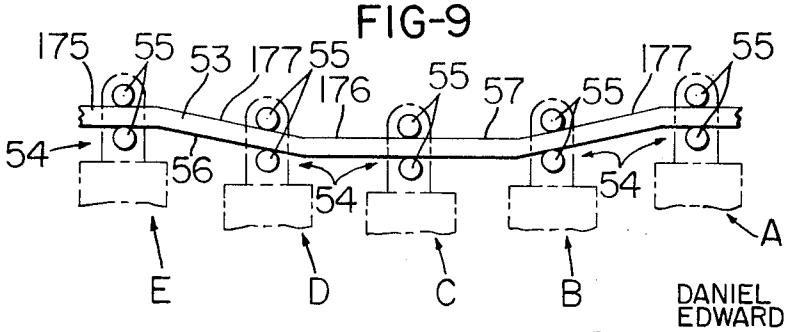


FIG-9



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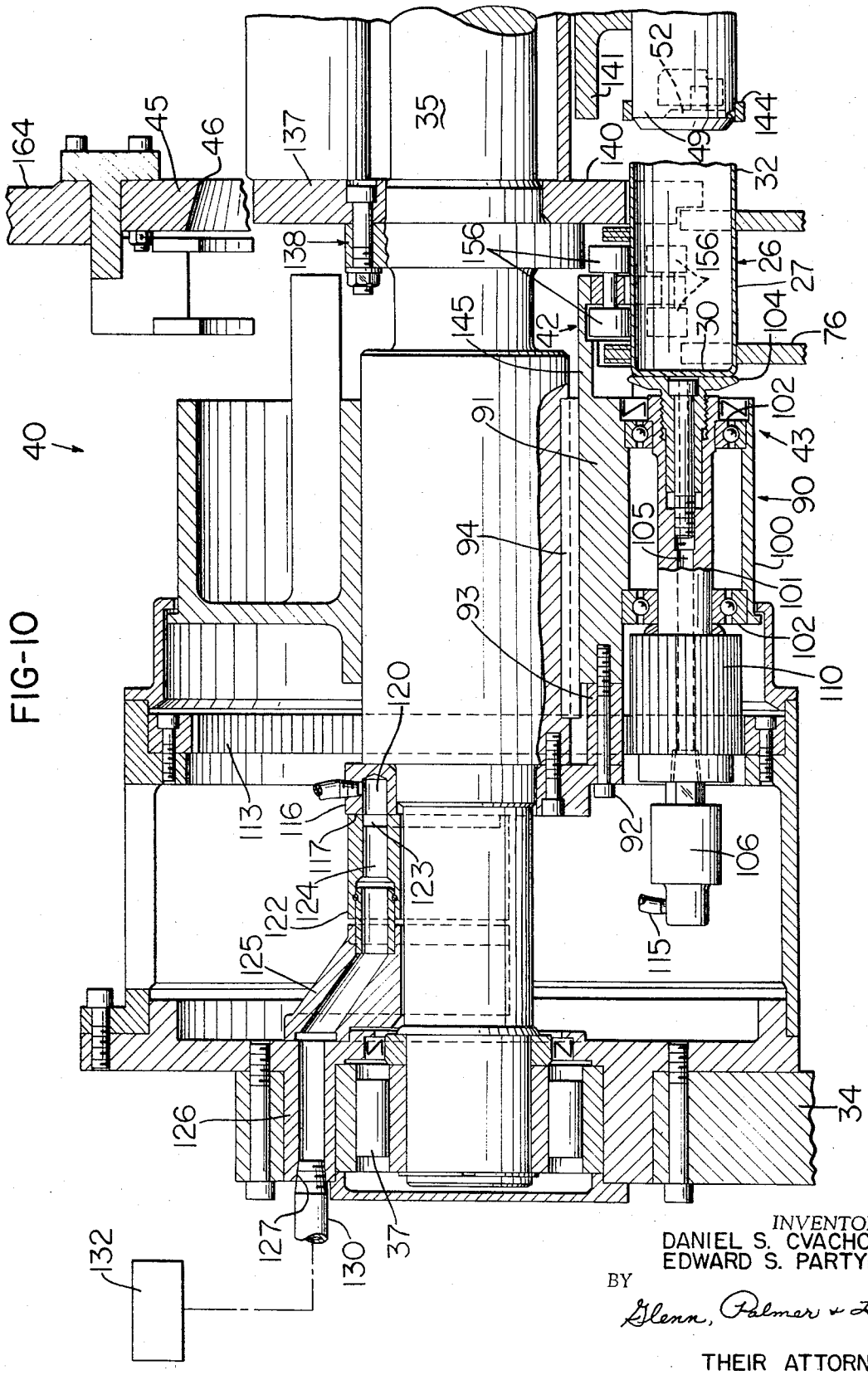


FIG-10

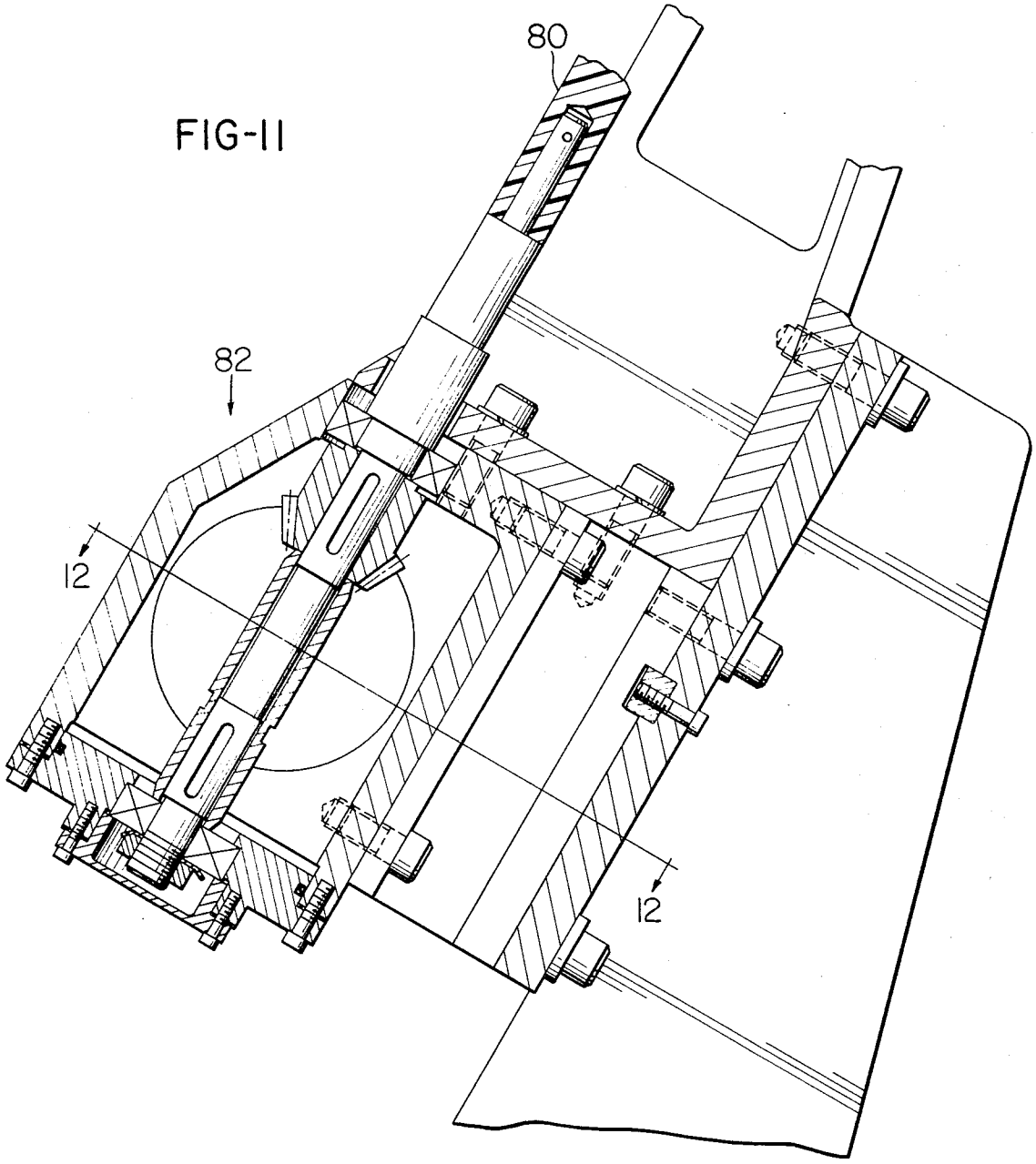
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FIG-11



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FIG-12

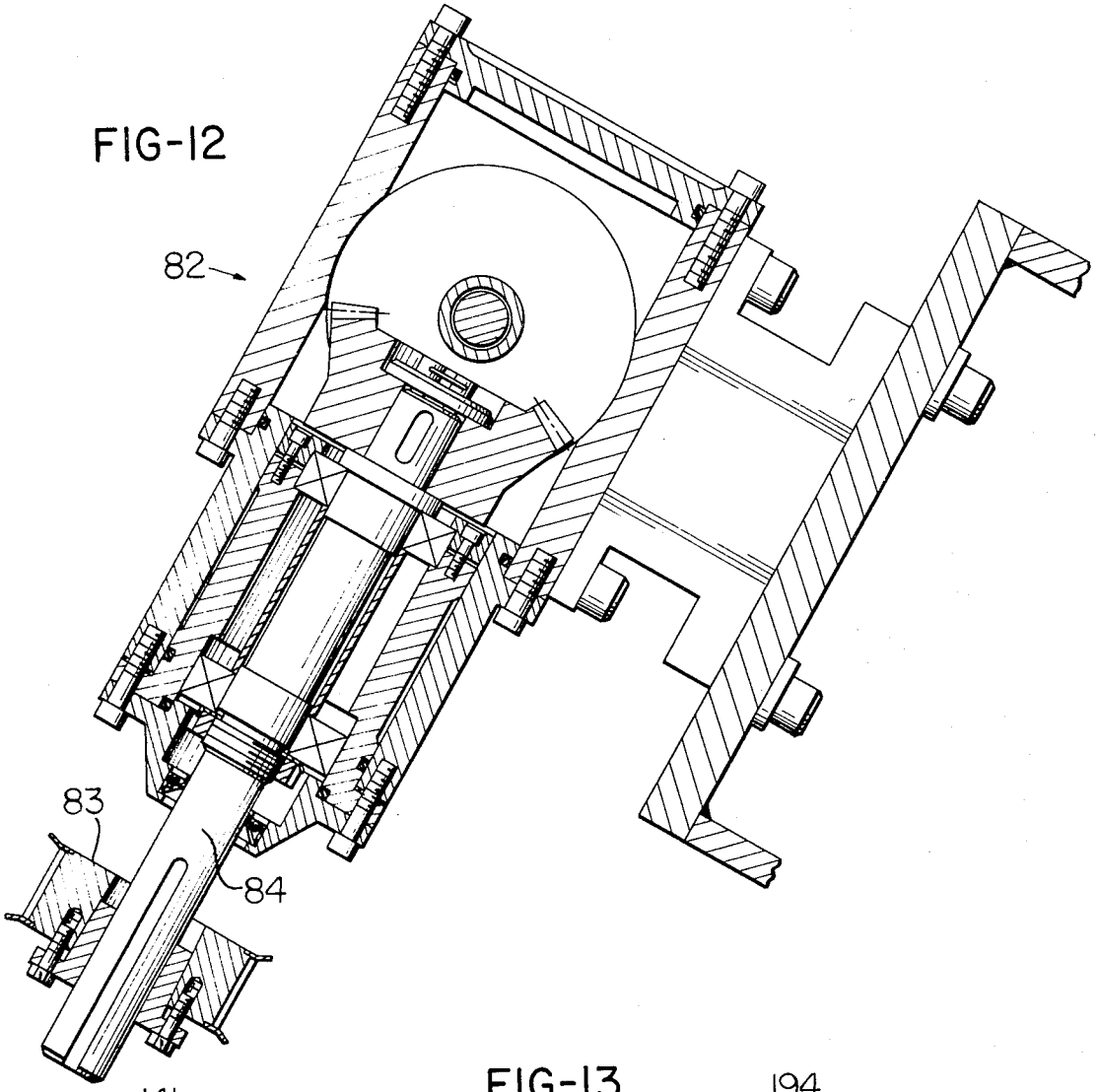
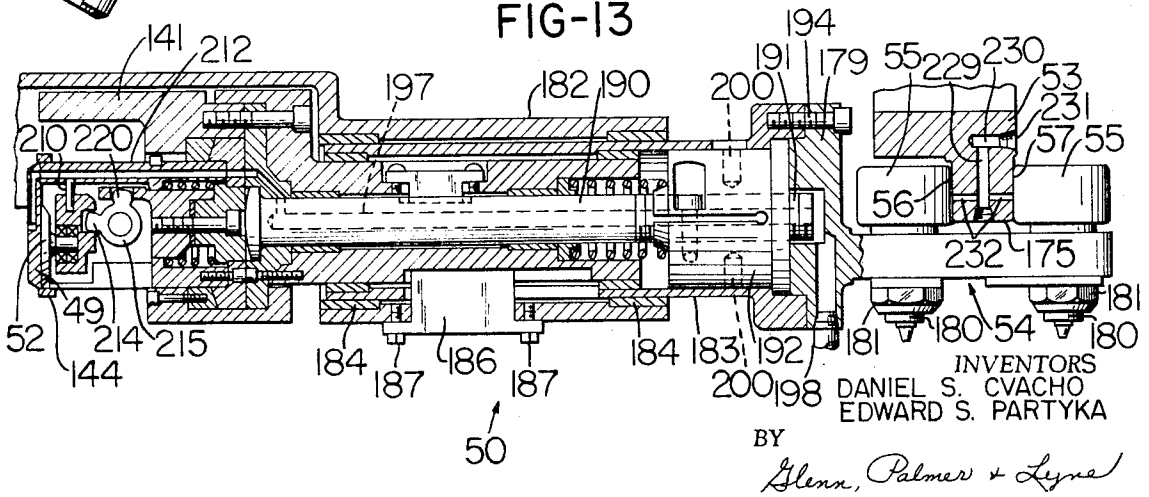
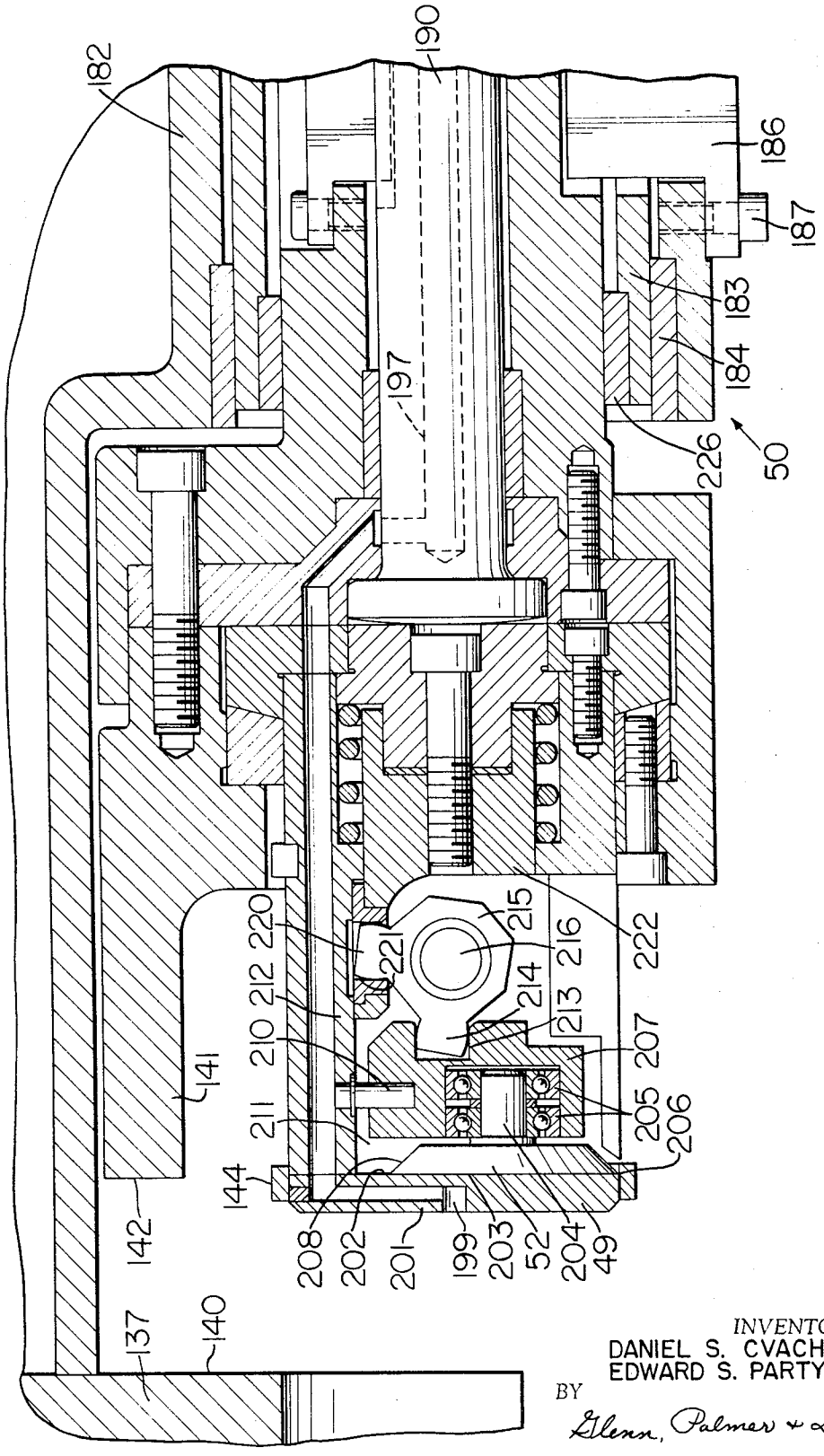


FIG-13



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FIG-14



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FIG-15

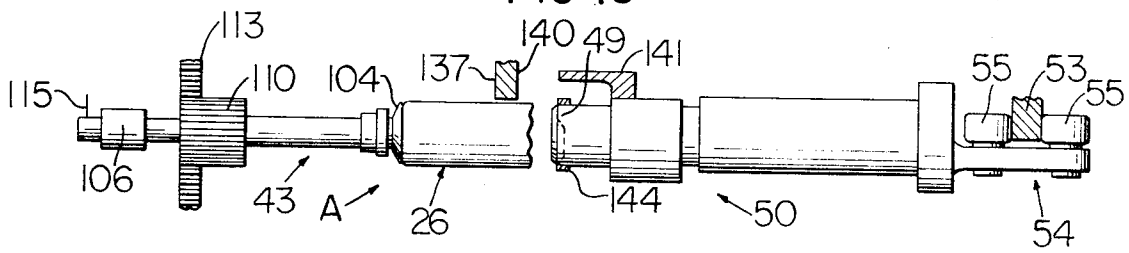


FIG-16

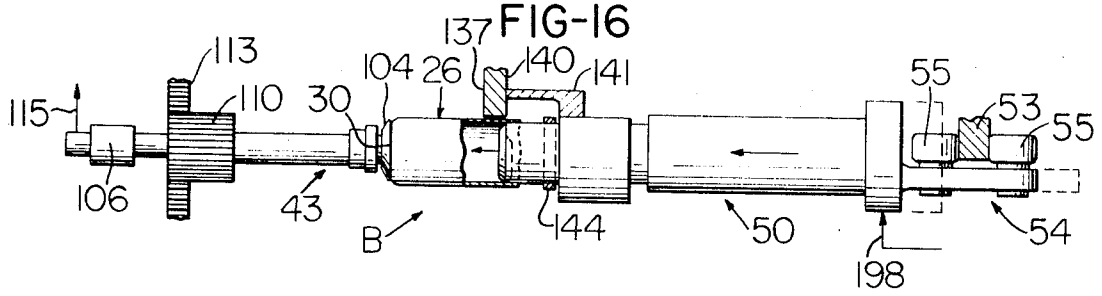


FIG-17

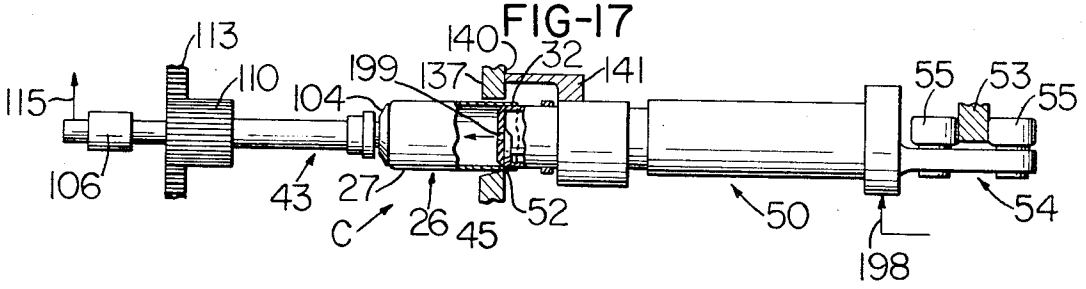


FIG-18

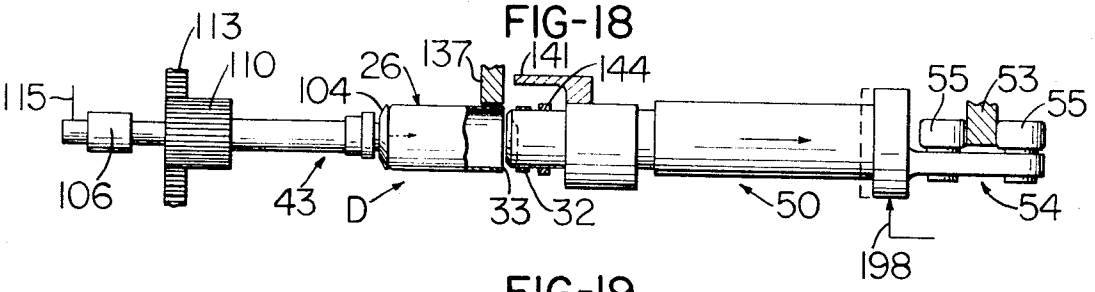


FIG-19

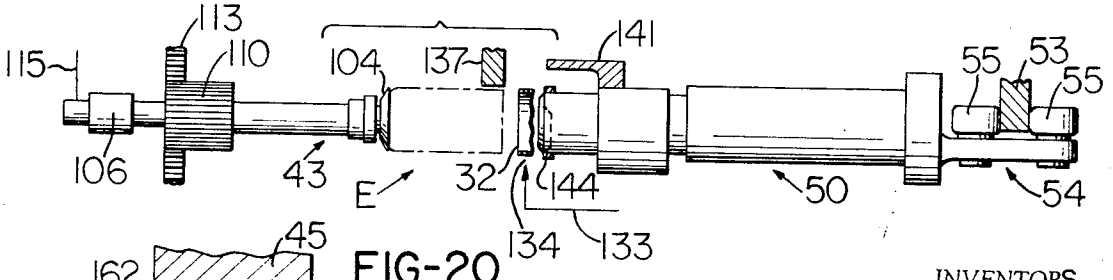
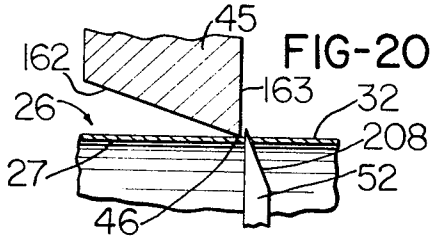


FIG-20



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APPARATUS FOR AND METHOD OF TRIMMING CONTAINERS

This application is a continuation of application Ser. No. 745,447 filed July 17, 1968, now abandoned.

BACKGROUND OF THE INVENTION

During the manufacture of tubular containers, particularly single piece cans having a cylindrical side wall with an integral bottom wall and an open end, it has been found that a top closure for each can may be more effectively provided by trimming an annulus from the open end of the cylindrical side wall so that such open end terminates in one plane. However, previously proposed apparatus and methods utilized to achieve such trimming are complicated, handle comparatively few cans for a given time increment, and are comparatively expensive to operate and maintain whereby the cost of trimming cans using present apparatus and methods is excessive.

SUMMARY

This invention provides an improved apparatus for and method of trimming cylindrical containers at high speed and minimum cost, yet the resulting trimmed container has a trimmed edge of optimum quality which assures easier and more effective sealing of an end closure in position thereagainst.

Other details, uses, and advantages of this invention will become apparent as the following description of the exemplary embodiment thereof presented in the accompanying drawings proceeds.

BRIEF DESCRIPTION OF THE DRAWINGS

The accompanying drawings show an exemplary embodiment of this invention, in which

FIG. 1 is a perspective view, with parts in section and parts broken away, illustrating the apparatus and method of this invention;

FIG. 2 is an enlarged cross-sectional View with parts broken away particularly illustrating (by dotted lines) one of a plurality of cans held in position by the apparatus of FIG. 1 prior to movement of such can post the arcuate cutting edge of a sickle blade which cooperates with a male knife to be inserted within such can to trim an annulus from the open end of such can;

FIG. 3 is a view taken on the line 3—3 of FIG. 2;

FIG. 4 is an enlarged view of the upper end portion of the illustration of FIG. 3 particularly showing the manner of moving cans past the arcuate cutting edge of the sickle blade and discharging the trimmed cans from the apparatus;

FIG. 5 is a view taken on the line 5—5 of FIG. 4;

FIG. 6 is an enlarged view with parts in section and parts broken away taken essentially on the line 6—6 of FIG. 2;

FIG. 7 is a view on the line 7—7 of FIG. 6;

FIG. 8 is a greatly enlarged view taken on the line 8—8 of FIG. 2;

FIG. 9 is a view with parts broken away particularly illustrating the contour of a cam plate which is effective in moving and holding a telescoping assembly within an associated can during the time interval that each can is in engagement with the arucate cutting edge of the sickle blade;

FIG. 10 is an enlarged view with parts in section and parts broken away particularly illustrating a typical holding device comprising the apparatus of FIG. 1 and utilized to hold each can to enable orbiting and rotating movement thereof;

FIG. 11 is an enlarged view with parts in section and parts broken away taken essentially on line 11—11 of FIG. 1 and particularly illustrating the drive for the infeed screw conveyor of the apparatus of FIG. 1;

FIG. 12 is a cross-sectional view taken on the line 12—12 of FIG. 11;

FIG. 13 is a cross-sectional view particularly illustrating a typical telescoping assembly of the apparatus of this invention;

FIG. 14 is an enlarged view with parts in section and parts broken away particularly showing the forward end portion of the assembly of FIG. 13 and the relative positions of a stop for such assembly and its cooperating control surface;

FIGS. 15–19 present a series of progressive steps illustrating the positions of a typical can as it is moved against the arcuate cutting edge of the sickle blade, has an annulus trimmed from its open end, and is discharged from the apparatus; and

FIG. 20 is a greatly enlarged fragmentary view particularly illustrating the manner in which the arcuate cutting edge of the sickle blade cooperates with the male knife inserted within a particular can to provide a high quality shear cut and trim an annulus from such can.

DESCRIPTION OF ILLUSTRATED EMBODIMENTS

Reference is now made to FIGS. 1 and 2 of the drawings wherein an exemplary apparatus or machine of this invention designated generally by the reference numeral 25 is illustrated. The machine 25 is particularly adapted for cutting circumferentially around a cylindrical member shown in this example of the invention as a substantially right circular cylindrical can 26 having a right circular cylindrical side wall 27, an integral bottom wall 30 and an open end indicated at 31 from which an annulus 32 is trimmed.

The machine 25 is particularly adapted to trim the annulus 32 from each can 26 in an efficient and high speed manner whereby canS are continuously processed by the machine 25 without interruption and without requiring indexing movements of the machine 25. For example, machines such as machine 25 are particularly effective in trimming cans in high volume production quantities exceeding 600 cans per minute while providing a trimmed edge, indicated at 33 in FIGS. 2 and 18, which is of high quality and is arranged substantially in one plane so as to enable quick and easy fastening of a top closure against the can 26 in a most effective manner.

The apparatus of machine 25 has a supporting structure or machine frame 34 which may be suitably fixed in position on a rigid floor, or the like, and has a central shaft 35 which is rotatab'y supported by the supporting structure 34 so as to enable unobstructed rotation of such shaft during operation of the machine 25. The shaft 35 is preferably rotatably supported by a plurality of spaced apart antifriction bearings 37, 38, and 39 carried by the machine frame 34.

The machine 25 has an infeed 36 for containers or cans 26 which places the cans 26 in a positive manner on a head assembly designated generally by the reference numeral 40. The head assembly 40 is comprised of a number of component parts which are effectively fixed to and carried by the central shaft 35 and as will

be apparent from the following description. The head assembly 40 has a main star wheel 41 which is fixed to the shaft 35 and has a plurality of cradles 42 arranged in equally spaced apart relation about the periphery of the main star wheel 41 and each cradle is adapted to support an associated can 26 for orbiting movement of the can upon rotating shaft 35 and star wheel 41 in a manner to be described subsequently.

The head assembly 40 also has a plurality of holding devices 43 fastened in position radially around the central shaft and corresponding in number to the number of cradles 42 provided on the star wheel 41. Each holding device 43 is axially aligned with an associated cradle 42 for orbiting movement therewith and is positioned so that with an associated can 26 supported on the associated cradle 42 the central axis of the can 26 coincides with the axis of the holding device 43. Each holding device 43 serves the dual purpose of holding an associated can 26 at a predeterm6ned axial position, i.e., axially along its associated cradle 42, as well as rotating the associated can 26 within its cradle 42 (as will be described in detail subsequently) during orbiting movement of such can 26 in a substantially circular path and such orbiting movement being provided by the rotation of central shaft 35 and hence star wheel 41.

The machine 25 has a sickle knife which will be referred to hereinafter as a sickle blade 45 which is fixed to the supporting structure 34 and the blade 45 has a sharp arcuate cutting edge 46 which is arranged to extend over a portion of a circular path traveled by each can 26 during its orbiting movement. The arcuate cutting edge 46 is positioned so that it will cut circumferentially around each can 26 upon engagement of a particular can thereagainst during orbiting and rotating movement of the can. Thus, it will be appreciated from the illustration of FIG. 1 of the drawings that each can 26 is fed into the machine by the infeed 36 and then orbited and simultaneously rotated by the head 40 so that the terminal end portion of its cylindrical surface 27 engages the arcuate cutting edge 46 of the sickle blade 45 to thereby cut circumferentially around such can 26 and trim an annulus 32 therefrom.

The machine 25 has a plurality of telescoping assemblies 50 and each telescoping assembly is supported by the central shaft 35 at a predetermined fixed radial position and in axially aligned relation with an associated holding device 43 and cradle 42. Each telescoping assembly 50 is normally held in spaced apart relation from the head assembly 40 and is telescoped within a can 26 carried by an associated cradle 42 to support the inside surface, i.e., the inside surface of cylindrical side wall 27, of such can 26 during engagement of the can against the arcuate cutting edge 46. Each telescoping assembly 50 is removed from within its associated can after trimming of an annulus 32 from the particular can 26.

Each telescoping assembly 50 has a radially extendible male knife 52 carried thereby adjacent its terminal outer end indicated at 49, see FIGS. 5, 13, and 14. Upon telescoping a particular assembly 50 within an associated can 26 the male knife 52 is extended radially outwardly toward the arcuate cutting edge 46 of the sickle blade 45 during engagement of the can 26 against such arcuate cutting edge and the male knife 52 not only provides a backup type of support for the cylindrical side wall 27 of the can 26 opposing the action of the arcuate cutting edge 46, but the knife 52 also provides a cutting action of its own. The male knife 52 and arcuate cutting edge 46 provide a high quality scissors type shear cut in trimming an annulus 32 from a particular can 26 and in a manner as will be described in more detail subsequently in this specification.

The machine 25 has a cam plate 53 suitably attached to the machine frame 34 rearwardly, as viewed in FIG. 1 of the telescoping assemblies 50 and the cam plate 53 is adapted to be engaged by cam roller assemblies 54, each comprised of a pair of cam rollers 55, carried adjacent the rear portion of each of the telescoping assemblies 50. The cam rollers 55 of each assembly 54 engage opposed annular surfaces 56 and 57 provided on the cam plate 53 and control the axial position of their assembly 54 during orbiting of such assembly by rotating the shaft 35 of machine 25.

From the above description, it will be appreciated that the cans 26 are fed by the infeed 36 into the head assembly 40 and onto an associated cradle 42. Each can is then grasped and held by a holding device 43 and held in axial alignment with an associated telescoping assembly 50. Upon rotating the central shaft 35 of the machine 25 each can 26 is simultaneously orbited and rotated into engagement with the arcuate cutting edge 46 of a sickle blade 45 and at a location immediately preceding the point that a particular can 26 engages the arcuate cutting edge 46 a telescoping assembly 50 is telescoped by cam plate 53 within the open end of such can. As the outer periphery of the particular can 26 is moved against the arcuate cutting edge 46 a male knife 52 carried within the associated telescoping assembly 50 is extended radially outwardly and cooperates with the arcuate cutting edge 46 to provide a shear cut about the periphery of the particular can 26 in a rapid manner while simultaneously rotating and orbiting the particular can 26. Once the can 26 is moved away from the arcuate cutting edge 46 the associated telescoping assembly 50 is removed from within the particular can 26 whereupon the can is then orbited away from the machine and the particular can is dropped into an associated discharge chute as illustrated at 60 in FIG. 4.

The drive system for the machine 25 is of optimum simplicity and is illustrated particularly in FIGS. 1, 11 and 12 and designated generally by the reference numeral 62. The drive system comprises a sheave 63 suitably fixed to one end of the shaft 35 and the sheave 63 has a plurality of equally spaced apart ridges or teeth 64 provided about the periphery thereof. A suitable drive motor shown as an electric drive motor 65 is provided and the drive motor is operatively connected to a speed reducer unit 66 which has a shaft 67 extending outwardly therefrom. The shaft 67 has another sheave 70 suitably fixed thereto and the sheave 70 has a plurality of teeth corresponding to the teeth 64 provided in the sheave 63 so as to enable a belt blet 71 to be operatively connected around the sheaves 63 and 70.

Upon energizing the motor 65 power is transmitted through the speed reducer 66 and belt 71 to the central shaft 35 to thereby rotate such shaft and the head assembly 40 with its main star wheel 41 and provide orbiting movement of the cradles 42 and holding devices 43. Rotation of central shaft 35 also starts simultaneous orbiting movement of the telescoping assemblies 50 while the cam plate 53 causes the assemblies 50 to be moved axially toward and away from the sickle blade

45 in a precisely controlled manner and as previously mentioned.

The motor 65 and speed reducer 66 are suitably fixed in position on an associated portion of the frame structure 34 and although the motor 65 may be of any suitable type in this example of the invention the motor 65 is illustrated as an electric drive motor which may be supplied with electrical power from any suitable source.

The drive system 62 also drives the infeed 36 as will now be explained. The central shaft 35 of the machine 25 has a gear 73 suitably fixed thereto which operatively engages a gear 74 which is fixed at the one end of a shaft 75 carried by another portion of the frame structure 34 and upon rotating the central shaft 35 the gears 73 and 74 and hence shaft 75 are also simultaneously rotated therewith.

The infeed 36 comprises an infeed star wheel 76, which is suitably fixed to the shaft 75 for rotation therewith, and a screw conveyor 80 which feeds the cans 26 downwardly therealong so that they are picked up by a plurality of can receiving cutouts 81 provided in the infeed star wheel 76. As seen in FIGS. 11 and 12, the infeed screw conveyor 80 is driven through a gear box 82 operatively connected to the shaft 75. The gear box 82 has a toothed sheave 83 suitably fixed to a rotatable shaft 84 extending outwardly therefrom. The shaft 75 has a cooperating toothed sheave 85 fixed thereto and a toothed belt 86 is operatively connected between the sheaves 83 and 85 so that upon rotating the shaft 75 the infeed star wheel 76 and infeed screw conveyor 80 are also simultaneously rotated. From the above description it will be seen that the drive system for the machine 25 is of utmost simplicity whereby rotation of the central shaft 35 provides precisely synchronized orbiting movement of the cans 26, holding assemblies 43, and telescoping assemblies 50. Further, inasmuch as the infeed star wheel 76 and infeed screw conveyor 80 are positively connected to the shaft 35, the processing of cans 26 by the trimming machine 25 is achieved in a positive high speed manner with minimum or little likelihood of jamming and at speeds in excess of 600 cans per minute.

As previously indicated each holding device 43 serves the dual purpose of holding an associated can 26 at a predetermined axial position as well as rotating such can therewith and within its associated cradle 42 during orbiting movement of the can 26 in a substantially circular path. The detailed description will now proceed with the simple manner in which each holding device 43 is rotated and particular reference is made to FIG. 10 of the drawings.

Each holding device 43 has a substantially cylindrical configuration as indicated at 90 and comprises an inner portion 91 fixed by a bolt 92 to a plate 93 comprising the head assembly 40. A locating key 94 is also provided and positions each holding device 43 at a predetermined radial position about the shaft 35. Each hOlding device 90 also has an outer protective portion 100 and a freely rotatable shaft 101 extends through each device 43 and is supported by a pair of axially spaced apart roller bearings 102.

The shaft 101 has a vacuum unit in the form of a vacuum cup 104 suitably fixed to one end thereof in a fluid tight manner and a passage 105 is provided through the shaft 101 and is placed in flow communication with a hose connector 106. The vacuum cup may be made of any suitable material, such as steel, for example. A rotatable gear 110 is suitably fixed to the opposite end of the rotatable shaft 101 as by a key 111 and upon rotating the rotatable gear 110 the shaft 101, together with the vacuum cup 104 at its terminal end is free to rotate in its supporting ball bearings 102.

The machine 25 has a gear in the form of a ring gear 113 which is fixed to the supporting or frame structure 34 adjacent the outer end of the head assembly 40. The ring gear 113 has a plurality of gear teeth provided in its inside periphery for engagement by cooperating gear teeth provided on the rotatable gears 110. Upon rotating the shaft 35 the holding devices 43 are orbited in a continuous circular orbit; however, the rotatable gears 110 have their gear teeth intermeshed with the teeth of the ring gear 113 whereby as the shaft 35 is rotated the holding devices 43 are orbited and simultaneously rotated by the rotatable gears 110. This arrangement provides a planetary gear system of utmost simplicity which provides positive rotary movement of each holding device 43 and hence each can 26 held thereby in a precise manner and the rotating movement provided is a nonslipping type of movement which will not vary between holding devices due to the positive engagement provided between the rotatable gears 110 and the ring gear 113.

As previously mentioned each holding device 43 has a vacuum cup 104 and each cup 104 is adapted to engage the bottom 30 of an associated can 26 and hold such can in a predetermined axial position upon applying a vacuum through the passage 105. The cups 104 are arranged so that their can-engaging surfaces rotate in a fixed vertical plane. Upon applying a vacuum through each passage 105 it will be appreciated that each can 26 is held with its bottom 30 in the above mentioned fixed vertical plane. Each annulus 32 is trimmed from an associated can so that the trimming action takes place in another fixed plane arranged parallel to the vertical plane in which the bottoms 30 are held, whereby the cans 26 are trimmed so they all have a predetermined precisely controlled height. Once an annulus 32 has been trimmed, the trimmed can 26 and its vacuum cup 104 are orbited so that an associated passage 105 to the cup 104 is open to atmosphere thereby releasing the trimmed can from its cup 104 and allowing it to be removed from its cradle 42 into the chute 60 leading away from the machine 25 and as will be described in more detail subsequently.

As seen particularly in FIGS. 8 and 10 of the drawings, each connector 106 arranged rearwardly of each holding device 43 has a conduit 115 extending therefrom which is in flow communication with a rotatable plate 116. The plate 116 has a vertical surface 117 through which a plurality of inlet passages 120 are provided and each inlet passage or inlet 120 is in flow communication with an associated conduit 115 and hence defines an inlet for an associated passage 105 within an associated device 43.

The machine 25 also has a member 122 suitably held in a fixed position by a portion of the frame structure 34 and the member 122 has an arcuate groove 123 provided therein. An uninterrupted passage 124 is also provided and extends through member 122, through an adjoining member 125, and through a portion 126 of the frame structure 34 whereby the passage 124 terminates, i.e., has an inlet, provided at the forward end of the machine 25. The frame portion 126 has an inter-

nally threaded portion 127 which defines the inlet to passage 124 and a vacuum line 130 is threadedly connected to the threaded portion 126. The vacuum line 130 is connected to a suitable vacuum source, such as a vacuum pump 132, and continuously applies a vacuum through the vacuum line 130.

The groove 123 in the fixed member 122 is provided so that it extends circumferentially around such member through a predetermined arc as indicated at 128 and it will be appreciated that as the central shaft 35 is rotated each inlet passage 120 is rotated so that it is held registered with the groove 123 and vacuum is continuously applied to the associated holding device 43 and its vacuum cup 104 over the entire length of the arc 128. It will be appreciated that the length of arc 128 corresponds to that arcuate increment traveled by a can 26 from a location immediately preceding the commencement of the trimming action to a location just prior to the location where such can is to be discharged into chute 60, whereby each can 26 is held tightly by its associated vacuum cup 104 throughout the entire trimming operation.

As each particular can 26 moves so that the inlet 120 to its associated passage 105 moves out of alignment with the groove 123 the vacuum is no longer present in passage 105 and normal atmospheric pressure is introduced into the passage 105 causing the associated can 26, now completely trimmed, to be supported in its cradle 42 independently of its vacuum cup 104. Continued orbiting movement of the trimmed can 26 brings it into alignment with the inlet to chute 60 and the can 26 drops by gravity or may be suitably stripped from its cradle 42 into chute 60 whereupon it is conveyed by chute 60 away from the machine 25.

As seen particularly in FIG. 5 of the drawings the central shaft 35 has an annular control ring 137 fixed thereto by a plurality of cooperating nut and bolt assemblies each designated by the general reference numeral 138. The ring 137 has a precisely finished control surface 140 arranged adjacent the inner end of the head assembly 40 and the control surface 140 is arranged generally opposite and in spaced apart relation from the terminal outer ends 49 of the telescoping assemblies 50 comprising the machine 25.

Each telescoping assembly 50 also has a stop which is shown as a substantially L-shaped stop 141 suitably fixed thereto. Each telescoping assembly 50 is moved axially along the machine 25, by the cam plate 53, toward an associated can 26 and generally toward the cutting edge 46 until the terminal end 142 of its stop 141 engages the control surface 140 and controls the amount that the particular assembly 50 is telescoped within an associated can 26.

In particular, each assembly 50 is controlled so that the male knife 52 provided at its terminal end is positioned in a plane arranged parallel to and substantially adjoining the plane of the arcuate cutting edge 46, see FIG. 20, to provide a shear cut circumferentially around the can 26 and assure that such cut has high quality and that the terminal open end of the trimmed can 26 is arranged, i.e., cut, substantially in one plane. In addition, it will be seen that the cooperating arrangement of the male knife 52 and the arcuate cutting edge 46 is such that the cutting edge of the male knife 52 does not actually engage the arcuate cutting edge 46 to thereby prevent excessive wear on the knife edges.

The machine 25 also has a plurality of stripper rings 144 each supported concentrically around an associated telescoping assembly 50 while allowing unobstructed telescoping movement of each assembly 50 within its associated stripper ring 144. The stripper rings 144 are carried at a fixed position with respect to the vertical plane of the arcuate cutting edge 46 and the stripper rings 144 are arranged so that they extend in a vertical plane substantially parallel to the plane of the arcuate cutting edge 46.

Upon trimming an annulus 32 from an associated can 26 it will be seen that such annulus is temporarily supported concentrically around the terminal end 49 of its associated telescoping assembly 50. However, the cam plate 53 cooperating with each set of cam rollers 55 moves a particular telescoping assembly 50 rearwardly away from the sickle blade 45. Because each stripper ring 144 is maintained at a fixed position, such rearward movement of its associated telescoping assembly 50 carries the trimmed annulus 32 therewith and inasmuch as the male knife 53 has been retracted radially inwardly the annulus 32 strikes the stripper ring 144 and is stripped from the telescoping assembly 50 and such stripped annulus 32 drops ino an associated refuse chute and is transferred away from the machine 25.

Each telescoping assembly 50 may have an air line 133, see FIGS. 2 and 19, associated therewith which is used to assure the trimmed annulus 32 is moved rapidly away from its associated assembly 50 into the refuse chute. Each air line 133 has its discharge end arranged so that it ejects a stream of high pressure air against a trimmed annulus 32 essentially as illustrated at 134 in FIG. 19. The inlet end of each line 133 is suitably fastened to an associated rotatable member 135 and in flow communication with an associated internal passage 133A in the member 135. The arrangement for providing air under pressure for trim blow off to the air line 133 provided with each assembly 50 may be similar to the arrangement used to provide a vacuum to the vacuum cup 104 of each device 43 and thus will not be described in detail.

Reference is now made to FIGS. 3, 6, and 7 of the drawings for a more detailed presentation of the cradles 42 fixed in position on the main star wheel 41. Each cradle 42 is supported in a yoke-like member or yoke 145 which is suitably fixed to the main star wheel 41. Each yoke 145 is suitably fixed to the main star wheel 41 at a precisely controlled radial position and each cradle 42 is also precisely supported within an associated yoke 145 in a manner now to be described.

Each yoke 145 has a slot 146 provided therein and each cradle 42 has a cooperating slot 147. Each cradle 42 is placed in position with its slot 147 arranged in alignment with an associated slot 146 and a key 148 is inserted in position within the slots 146 and 147 and held by a set screw 149 which is threaded through a cooperating threaded opening 150 provided in the yoke 145. A pair of threaded bolts 151 are utilized and extend through associated openings in each cradle 42 and cooperating threaded openings 152 in the yoke 145 to firmly fasten each cradle 42 within its yoke 145 while the key 148 precisely locates each cradle at the desired radial position about the central shaft 35 Of the machine 25.

Each cradle 42 has a plurality of antifriction rollers 156 rotatably thereon and the antifriction rollers enable supported within rotation of an associated can 26

while it is supportedwithin the cradle **42** and rotated by an associated holding device **43** and in the manner previously described. The rollers **145** are preferably arranged in three sets with two axially aligned rollers in each set and comprise an inner set and a pair of spaced apart outer sets arranged approximately 150° apart from each other with each outer set being arranged 75° from the inner set. Each set of rollers has a central shaft **157** suitably supported by its associated cradle **42** and a pair of ball bearings **158** are held in position at opposite ends of the shaft **157** with the outer race of each ball bearing **158** being fastened to an associated roller **156** to enable free rotation of the rollers **156** and hence a can **26** carried thereon.

Each of the rollers **156** may be made of any suitable material; however, the outer surface of such rollers is preferably made of a resilient friction material, such as rubber or the like, which assures that once a particular can **26** is placed on its associated rollers **156** and rotated by an associated holding device **43** the cylindrical side wall **27** of such can **26** will not move with respect to the outer surface of its rollers **156** and the holding device **43** will rotate such can **26** and supporting rollers **156** to provide precise rotary movement of the can **26** in a nonsliding manner at all times during orbiting movement of such can.

The machine **25** also has suitable guides to guide the cans **26** as they move downwardly along the infeed screw conveyor **80** and are deposited within associated pockets **81** of the infeed star wheel **76.** The machine **25** also has an arcuate guide **160,** see FIG. **3,** which is held by a portion of the frame structure **34** and the guide **160** supports the lower outer periphery of the cans **26** as they are moved by the infeed star wheel **76** into the main star wheel **41.** In particular, the movement of cans **26** is guided so that each can **26** is precisely positioned in a positive manner into an associated cradle **42.**

It will also be seen that a guide **161A** is also provided to guide the cans **26** as they are moved by the main star wheel **41** into engagement with the sickle blade **45** and a guide **161B** guides the trimmed cans **26** away from such sickle blade to the discharge chute **60.**

Reference is now made to FIGS. **3** and **4** of the drawings for a more detailed presentation of the sickle blade **45** with its arcuate cutting edge **46.** In particular, it will be seen that the arcuate cutting edge **46** has an arcuate length which is preferably greater than the circumference of the cylindrical cans **26** which are to be trimmed by the machine **25.** The length of the arcuate cutting edge **46** is greater than the circumference of each particular can so that a plurality of cans may be trimmed in a simultaneous manner by the machine **25** and as each can **26** is moved in an orbiting and rotating manner past the arcuate cutting edge **46;** and, in this example of the invention the arcuate cutting edge **46** extends through an arc of approximately 95°.

The cutting edge **46** is a comparatively sharp edge and is defined by a substantially annular surface **163** intersected by a cooperating inclined surface **162** to define the edge **46,** see FIG. **20.** Further, the sickle blade **45** is preferably made of a high quality steel which maintains a sharp cutting edge **46** even after extended use.

To facilitate easy maintenance of the sickle blade **45** and its arcuate cutting edge **46** the sickle blade **45** may be mounted on a supporting member **164.** The supporting member **164** may have one end mounted in a hinged manner so that it is pivotable about a shaft **165** and has an opposite swinging end which is suitably supported and fastened around a shaft **166** by a pair of bolts **167** cooperating with suitable structure provided at the end of the member **164.** The supporting member **164** may be pivoted about the shaft **165** by loosening the bolts **167** and pivoting it to the position illustrated at **171** to thereby enable easy maintenance of the sickle blade **45** and sharpening of its arcuate cutting edge **46,** if desired.

Reference is now made to FIGS. **1** and **9** of the drawings for a more detailed discussion of the cam plate **53.** The cam plate **53** is held at a fixed position adjacent the terminal ends of the telescoping assemblies **50** which are arranged remotely from the sickle blade **45.** The camplate has an annular main portion **175** which is arranged substantially in a vertical plane and a precisely controlled cam section **176** which is arranged parallel to the plane of the arcuate cutting edge **46.** A pair of substantially identical transition sections **177** interconnect main portion **175** of the cam plate **53** to the precisely controlled cam section **176.** Thus, it will be appreciated that as the central shaft **35** rotates and orbits the telescoping assemblies **50** about the outer periphery of the cam plate **53** the cam rollers **55** move along the opposed annular surfaces **56** and **57** of the cam plate **53.** However, at a position corresponding to the point at which the forward end of the arcuate cutting edge **46** is approached by a particular can **26** the associated telescoping assembly **50** is orbited so that its cam rollers **55** move from the main portion **175** of cam plate into the transition section **177.** As the cylindrical side wall **27** of a particular can **26** is moved against the arcuate cutting edge **46** the associated telescoping assembly **50** is in position in the precisely controlled cam section **176** so that the male knife **52** of the associated assembly extends radially outwardly and cooperates with the arcuate cutting edge **46** to provide a shear cut of high quality in the side wall **27.**

Reference is now made to FIGS. **13** and **14** of the drawings for a more detailed presentation of a typical one of the telescoping assemblies **50** comprising the machine **25.** The telescoping assembly **50** has a base portion **179** defining its rear end portion and the cam rollers **55** are in the form of antifriction rollers which are rotatably mounted on a pair of spaced apart shafts **180.** Each shaft **180** has a threaded end portion about which a nut **181** is fastened to hold the shaft **180** and its roller **55** fastened in position on the base portion **179.**

Each telescoping assembly **50** is supported within an associated housing **182** of tubular configuration which is fixed in a precisely controlled radial position about the periphery of the central shaft **35.** Each assembly has a cylindrical outer surface **183** which is slidably supported by a pair of spaced apart sleeve bearings **184** fixed to the housing **182** and the telescoping assembly **50** may be axially slid within the sleeve bearings **184** and toward and away from the sickle blade **45.** A key **186** is fixed by bolts **187** to the tubular housing **182** to prevent rotating movement of the assembly **50** with respect to the outer housing **182** as the assembly **50** is axially slid back and forth by the cam plate **53.**

The assembly **50** has a central shaft **190** extending therethrough which is axially adjustable relative to its cylindrical outer surface **183.** The shaft **190** has threads **191** provided adjacent its rear end portion. A substan-

tially split sleeve **192** is also provided and is threaded over the threads **191** so that with the cylindrical portion **183** fixed in position by bolts **194** to base portion **179** it is possible to adjust the position of the shaft **190** axially within the assembly **50**. This adjustment is achieved by inserting a suitable wrench, or the like, within slot **200** provided in cylindrical outer portion **183** and rotating the sleeve **192** with respect to the shaft **190** whereby with the outer portion **183** remaining in a fixed position, the net effect is to move the shaft **190** with respect to the sleeve **183** and for a purpose which will be apparent later in this specification.

The assembly **50** has its stop **141** suitably fixed thereto as previously described and the action of the telescoping assembly **50** is controlled by the cam plate **53** so that the telescoping assembly **50** is moved axially toward the sickle blade **45** until the stop **141** strikes the control surface **140**. The action of the cam plate is then effective to cause the male knife **52** provided within the telescoping assembly **50** to telescope outwardly and cooperate with the arcuate cutting edge **46** to trim the end **32** from an associated cylindrical can **26**.

Each telescoping assembly **50** may have an air passage **197** extending axially therethrough and preferably extending axially through the center of the shaft **190** and each passage **197** has an air line **198** suitably connected thereto. Each air line **198** has its inlet suitably connected to member **135** and in flow communication with a passage **198A** in member **135** which is provided with air under pressure from any suitable source. The discharge end **199** of each passage **197** exits the terminal outer end **49** of the assembly **50** and air is ejected through the discharge end **199** at high velocity. With this construction it will be appreciated that air under pressure may be introduced into each passage **197** and blown toward the inside of an associated can **26** to help hold such can against its vacuum cup **104**.

As explained earlier in connection with the air pressure system which may be used to blow off each trimmed annulus **32** from an associated trimmed can **26**, the arrangement for providing air under pressure to each air line **198** and its associated passage **197** in each assembly **50**, even with orbiting movement of the assemblies **50**, may be similar to the arrangement used to provide a vacuum on each device **43**.

With an overall understanding of the operation of the telescoping assembly **50** the detailed description will now proceed with a description of the male knife **52** provided in each telescoping assembly **50**, see FIG. **14**. The telescoping assembly **50** has a front plate **201** which is provided with a rear surface **202** against which the front surface **203** of the disc-like male knife **52** abuts. The male knife **52** has a shaft-like portion **204** which is rotatably supported by a pair of antifriction roller bearings **205** carried by a carrier **207** and the knife **52** has a cutting edge **206** defined by a beveled annular surface **208** cooperating with the front surface **203** previously mentioned.

The carrier **207** has a cavity **213** which receives a projection **214** from a bell crank member **215** which is rotatably mounted on a shaft **216** carried within the assembly **50**. The bell crank **215** helps to support the carrierr **207** and has another projection **220** extending therefrom which is received in a cavity **221** provided in a structural member **222** fixed in position within the assembly **50** at the forward end of the shaft **190**. The bell crank **215** is used to move, i.e., extend, the male knife **52** substantially radially outwardly during the time interval that an associated can **26** is being orbited and rotated beneath the arcuate cutting edge **46** of the sickle blade **45**.

Having described the detailed arrangement of the component portions of the telescoping assembly **50** a brief description will now be made of the manner in which each telescoping assembly operates to extend its male knife **52** into cutting position to enable cooperation thereof with the arcuate cutting edge **46** and thereby enable trimming the end from an associated cylindrical can **26**. As each telescoping assembly **50** is telescoped toward an associated can **26** the stop **141** is moved by the cam plate **53** so that it strikes the control surface **140**. This occurs with the cam rollers **55** engaging the upstream transition section **177**. Continued rotation of the shaft **35** causes the cam rollers **55** to move into the precisely controlled cam section **176** whereupon with the stop **141** firmly held against the control surface **140** the effect of movement into the cam section **176** is to move an inner cylindrical portion **183** of assemlby **50** axially toward the control surface **140** by sliding portion **183** relative to a pair of sleeve bearings **184** fixed to the outer housing **182**. Movement of the cylindrical portion **183** causes the shaft **190** to be moved therewith whereby the member **222** is also moved to rotate the bell crank **215** counterclockwise as viewed in FIG. **14** of the drawings. This counterclockwise rotation of the bell crank **215** extends the male knife **52** radially outwardly in the manner previously described. The male knife **52** is freely rotatable in its bearings **205** and thus as the outer cylindrical surface **27** of the particular can **26** being trimmed engages the arcuate cutting edge **46** the male knife **52** is moved so thst it is positioned in spaced apart relation from the plane of the arcuate cutting edge **46** and as illustrated in FIG. **20** to trim the annulus **32** from the particular can **26** in a rapid and efficient manner.

The carrier **207** has a suitable valve member **210** associated therewith. As the carrier **207** is moved by the bell crank **215** to extend the male knife **52**, the valve **210** releases air from that portion of passage **197** adjacent the valve member **210** into the cavity **211** adjoining the rotating male knife to prevent chips, metal dust, and the like from entering the knife area.

The cam plate **53** may be made of any suitable material and is preferably made of a metal having high hardness and precisely controlled cam surfaces. To minimize the wear of such cam plate and in particular wear of the opposed annular cam surfaces **56** and **57** provided on cam sections **175**, **176**, and **177** a passage **229** is provided adjacent the periphery of the plate **53**. The passage **229** has a supply passage **230** interconnected to its inner end and passage **230** has a conduit **231** suitably connected thereto and to a source of lubricating oil. The outer end of passage **229** has a pair of metering orifices **232** which extend outwardly and intercept the annular cam surfaces **56** and **57** whereby a lubricating oil is introduced into the passage **230** and flows through the passage **229** and orifices **232** so as to provide lubrication for the outer periphery of the cam rollers **55** and minimize wear of the cam plate **53**.

Having described the component parts of the machine **25** in detail the description will now proceed with a general description of the overall operation of the trimming machine **25** and such description will be

made referring particularly to FIGS. 1, 4, 9, and 15 through 19 of the drawings.

In particular, it will be seen that cans 26 are fed into the machine 25 by the infeed 36 and received by the head assembly 40 for simultaneous orbiting and rotating movement. The machine 25 will have a plurality of cans 26 introduced therein so that the cans are supported in various cradles 42 of the main starwheel 41 essentially in the manner illustrated in FIG. 4 of the drawings. In the particular position shown in FIG. 4, there are a plurality of four cans carried within the head assembly 40 with one of the cradles 42 being empty, having ejected its can 26 into the discharge chute 60 at a location immediately preceding the position illustrated. However, for ease of presentation and to enable a more thorough understanding of the general operation of the machine 25 the discussion will proceed by describing the action which takes place in connection with one exemplary can 26 at each of the plurality of five positions illustrated in FIG. 4 and designated for convenience as positions A, B, C, D, and E. Further, the associated holding device 43 and telescoping assembly 50 and their related components are also illustrated in FIGS. 15 through 19 of the drawings at positions corresponding to positions A through E of FIG. 4. Similarly, the presentation of FIG. 9 of the drawings shows the various positions of the telescoping assembly along the cam plate 53.

The illustrations of FIGS. 15–19 of the drawings also show the stop 141 and sickle blade 45 in the same relative positions in several figures; however, it is to be understood that this has been done for simplicity because the actual positions of these components change from station to station when viewed from the same point.

Thus, it will be seen that a can 26 is moved from the screw conveyor 80 to the infeed star wheel 76 and picked up by the main star wheel 41 so that it is received in an associated cradle 42 as illustrated at position A. At this point the vacuum through an associated vacuum cup 104 has not yet been applied and the relative positions of the can 26, associated can holding device 43, and associated telescoping assembly 50 are more clearly illustrated in FIGS. 9 and 15.

The can 26 is orbited rapidly toward the arcuate cutting edge 46 and as the outer periphery of the can 26 strikes the edge 235 of the guide 161A the vacuum to the vacuum cup 104 is applied and simultaneously air under pressure is blown through passage 197 in the holding assembly 50 whereupon the joint action of vacuum and pressure urges the can axially along its cradle 42 and with its bottom 30 against the vacuum cup 104. The vacuum is applied to passage 105 because the inlet 120 for such passage 105 has moved into alignment with the vacuum groove 123. It will be seen from FIG. 9 that in position A the telescoping assembly 50 is in its retracted position inasmuch as its associated cam rollers 55 are engaging the main portion 175 of the cam plate 53. With the untrimmed can 26 being held firmly against vacuum cup 104 of the holding device 43, after the can 26 passes edge 235, continued rotation of the central shaft 35 causes orbiting movement of the holding device 43 and its rotatable gear 110 engaging the ring gear 113 causes the holding device 43 and can 26 to be simultaneously rotated therewith.

At position B, which is also illustrated in FIG. 16, the can is still held by vacuum against its vacuum cup 104 and the stop 141 of the telescoping assembly 50 has moved into engagement with control surface 140 and the cam rollers 55 are in the upstream transition section 177 of the cam plate 53. Continued rotation of the shaft 35 of machine 25 causes movement of the rollers 55 into the precisely controlled cam section 176 and causes the can 26 to be orbited and simultaneously rotated against the arcuate edge while the male knife 52 is also extended radially outwardly in the manner previously described in detail whereby action is started to trim an annulus 32 from the open end of the can 26 by the cooperating action of the male knife 52 and the arcuate cutting edge 46 of the sickle blade 45. This trimming action starts at a location between positions B and C.

At position C of FIG. 4, also illustrated in FIG. 17, the trimming of can 26 is continued by the arcuate edge 46 and the male knife 52 and it will be seen that the rollers 55 are in the center of the precisely controlled cam section 176. It will also be seen that the vacuum through passage 105 and air under pressure through passage 197 are still acting against opposite sides of the bottom wall 30 of such can 26. The trimming action continues until a point intermediate positions C and D.

At position D, also illustrated in FIG. 18, the trimming action is complete. The telescoping assembly 50 starts moving along the opposite or downstream transition section 177, the vacuum through passage 105 against the bottom of the can 26 is turned off, and the air under pressure supplied through the passage 197 of the telescoping assemlby 50 is also simultaneously turned off at a position immediately preceding position D. It will also be noted that at position D the trimmed annulus 32 is supported concentrically around the terminal end of the assembly 50. At position D the holding device 43 has moved the open end 120 of the passage 105 out of flow communication with the vacuum groove 123 and exposed such open end so that air under normal atmospheric pressure enters the passage 105. With the passage 105 now at normal atmospheric pressure the vacuum cup 104 releases the trimmed can and allows it to be supported in its associated cradle 42 solely by the rollers 156 comprising such cradle. As the can 26 is orbited by its cradle 42 into alignment with the chute 60, the can 26 drops by gravity into the chute 60 and is moved away from the machine 25.

With the cradle 42 now empty, it moves toward position E, also illustrated in FIG. 19. The telescoping assembly 50 is retracted by the cam plate 53 until its cam rollers 55 engage the main portion 175 of such cam plate. During this retraction of assembly 50, the annulus 32 trimmed from the can 26 engages the stripper ring 144, whereupon the trimmed annulus 32 is removed from the terminal end of the telescoping assembly 50 and drops into an associated chute and is moved away from machine 25 in any suitable manner. As the trimmed annulus 32 is stripped by the stripper ring 144, air under pressure is applied thereagainst through an associated air pressure line 133 to assure such trimmed annulus is moved rapidly away from its associated assembly and into the associated chute.

Continued orbiting movement of the holding device 43, cradle 42, and telescoping assembly 50 results in the particular cradle 42 illustrated at position E being moved from position E to position A to pick up another can 26 from the infeed starwheel 76 and repeat the cycle for another can in the manner described in detail above.

The description presented above has proceeded with a step by step presentation of the operation of the machine and the manner in which the major components move with respect to each other to provide trimming of the cans **26** in a rapid manner and so as to provide a terminal edge **33** at the open end of each can **26** which lies essentially in a commpn plane. However, such detailed presentation may have tended to de-emphasize the rapidity with which the various component parts are moving. In particular it is to be appreciated that the cans **26** are fed into the machine **25** and trimmed at a rapid rate of speed, whereby in excess of 600 cans per minute are being trimmed in an efficient nonindexing manner.

It will also be appreciated that a high quality shear cut is provided by the cooperating action of the male knife **52** cooperating with the arcuate cutting edge **46** and the dimension between the knives is precisely controlled and adjusted through the unique construction of the telescoping assembly **50** so that the distance between the knife edges is held to a dimension generally of the order of 0.0002 inch to 0.0003 inch, or more. Further, the cooperating arrangement of partially split sleeve **192** and threads **191** in shaft **190** assure that the male knife **52** is fully extended once its associated cam rollers **55** engage the precisely controlled cam section **176.**

Although this description has proceeded with a detailed presentation wherein the exemplary cans **26** are constructed having a cylindrical side wall **27** and an integral bottom wall **30,** it will be appreciated that cans of conventional construction may also be trimmed by the unique apparatus and method of this invention. For example, a can having a single-piece cylindrical side wall which is fastened along a rectilinear vertically arranged seam and which has a separate end closure suitably fixed thereto may also be trimmed in accordance with the teaching of this invention, as desired.

While a present exemplary embodiment of this invention, and method of practicing the same, have been illustrated and described, it is to be recognized that this invention may be otherwise variously embodied and practiced within the scope of the following claims.

What is claimed is:

1. An apparatus for cutting circumferentially around a cylindrical member having opposed ends in a continuous nonindexing manner, said apparatus comprising, a supporting structure, a substantially circular head assembly carried by said supporting structure and having a central longitudinal axis, a device carried by said head assembly adjacent the outer periphery thereof for holding and rotating said cylindrical member by grasping one of said opposed ends and holding said member in a cantilevered manner, means rotating said head assembly and said device relative to said head assembly to provide simultaneous orbiting and rotating movement of said device and hence said member through an arcuate path upon holding said member using said device, and a sickle blade fixed to said supporting structure and having an arcuate cutting edge which is concave toward said longitudinal axis and is arranged to extend over a portion of said arcuate path, said blade being adapted to cut circumferentially around the other of said opposed ends of said member upon engagement of said member thereagainst during said orbiting and rotating movement.

2. An apparatus as set forth in claim **1** in which said arcuate cutting edge has a length which is greater than the circumference of said cylindrical member.

3. An apparatus as set forth in claim **1** in which said cylindrical member comprises a tubular container and said arcuate cutting edge is adapted to cut circumferentially around said container to effectively trim an annulus from said other end thereof.

4. An apparatus as set forth in claim **1** in which said cylindrical member comprises a tubular member and further comprising a telescoping assembly carried by said supporting structure, said assembly being telescoped within said tubular member a distance which is lesS than half the height of said tubular member to support the inside surface of said tubular member during engagement thereof against said arcuate cutting edge and said assembly being removed from within said tubular member after cutting circumferentially therearound.

5. An apparatus as set forth in claim **1** in which said cylindrical member is in the form of a tubular member and further comprising a telescoping assembly carried by said supporting structure, said assembly having a radialy extendible male knife carried adjacent its terminal end, said assembly being telescoped within said tubular member so that its terminal end is arranged outwardly of the inside surface of said sickle blade and its male knife extended radially outwardly toward said arcuate cutting edge during engagement of said tubular member against said arcuate cutting edge so that said male knife cooperates with said arcuate cutting edge to provide said cut circumferentially around said tubular member and said assembly being removed from within said tubular member after cutting circumferentially therearound.

6. An apparatus as set forth in claim **5** and further comprising a cam plate supported by said supporting structure and a cam roller assembly carried by said telescoping device, said cam roller assembly operatively associating with said cam plate to control the telescoping movement of said telescoping assembly.

7. An apparatus as set forth in claim **5** and further comprising a stop carried by said telescoping assembly, said stop being adapted to engage a control surface arranged adjacent said head assembly and control the amount said assembly is telescoped within said tubular member to assure said male knife is positioned in a plane arranged parallel to and substantially adjoining the plane of said arcuate cutting edge to provide a shear cut circumferentially around said tubular member and thereby trim an annulus therefrom.

8. An apparatus as set forth in claim **7** in which said male knife comprises a freely rotatable disc-like member having a circular cutting edge which is moved radially toward and overlaps a portion of said arcuate cutting edge during cutting of said tubular member and is moved radially inwardly within the peripheral outline of said assembly to enable said removal of said assembly from within said tubular member.

9. An apparatus as set forth in claim **8** and further comprising a stripper ring supportPd by said supporting structure concentrically around said telescoping assembly to enable easy telescoping movement of said telescoping assembly therethrough, said stripper ring operating to strip a trimmed annulus carried on the terminal end portion of said telescoping assembly upon moving said telescoping assembly away from said arcuate cut-

ting edge causing said annulus to strike said stripper ring and be stripped from said telescoping assembly.

10. An apparatus for trimming cylindrical containers comprising, a supporting structure, a central shaft rotatably supported on said supporting structure, a substantially circular head assembly fixed to said shaft for rotation therewith, said head assembly having a star wheel comprising a plurality of cradles arranged in equally spaced apart relation about the periphery thereof for supporting associated containers for orbiting movement, a plurality of holding devices carried by said head assembly adjacent the outer periphery thereof and corresponding in number to said plurality of cradles, means rotating said head assembly and said devices relative to said head assembly to provide simultaneous orbiting and rotating movements of said devices with said orbiting movement being in a circular path, each of said holding devices being axially aligned with an associated cradle and being adapted to hold an associated container at a predetermined axial position for orbiting movement therewith as well as rotate the associated container therewith within its cradle, and a fixed sickle blade having an arcuate cutting edge which is concave toward said central shaft and is arranged to extend over a portion of said circular path, said blade being adapted to cut circumferentially around each container upon engagement of each container thereagainst during orbiting and rotating movement thereof.

11. An apparatus as set forth in claim 10 wherein each of said containers has a bottom adjoined by a cylindrical side wall terminating in an open end and in which each of said holding devices has a vacuum unit which engages and holds as associated container in position outwardly thereof substantially in a cantilevered manner by applying a controlled vacuum against the bottom of the associated container, said vacuum being released after trimming the associated container.

12. An apparatus as set forth in claim 11 in which each of said holding devices has passage means extending therethrough, said passage means having one end in flow communication with an associated vacuum unit, and said passage means having its opposite end in flow communication with an associated vacuum source during trimming of the associated container to enable said controlled vacuum to be applied through said passage means against said bottom of the associated container and said opposite end being exposed to normal atmospheric pressure after trimming of the associated container to assure release thereof.

13. An apparatus as set forth in claim 10 in which each of said cradles has antifriction rollers which support an associated container and enable free rotation thereof while it is supported within its associated cradle.

14. An apparatus as set forth in claim 11 in which said rotating means comprises a fixed gear attached to said supporting structure adjacent the outer end of said head assembly and a rotatable gear fixed to each of said holding devices, each rotatable gear operatively engaging said fixed gear to rotate its associated holding device and the container held thereby during rotation of said shaft and orbiting movement of the holding devices.

15. An apparatus as set forth in claim 14 in which said fixed gear comprises a ring gear having gear teeth provided on its inside periphery for engagement by cooperating gear teeth on each of the rotatable gears.

16. An apparatus as set forth in claim 10 in which said arcuate cutting edge has a length which enables a plurality of said containers to be trimmed simultaneously.

17. An apparatus as set forth in claim 11 and further comprising a plurality of telescoping assemblies corresponding in number to said plurality of holding devices, each telescoping assembly being supported by said shaft at a fixed radial position and in axially aligned relation with an associated holding device and cradle, each telescoping assembly being adapted to be telescoped within a container carried by an associated cradle a distance which is less than half the height of the container to thereby support its inside surface during engagement of said associated container against said arcuate cutting edge, and each telescoping assembly being removed from within its associated container after trimming an annulus from the open end thereof by said arcuate cutting edge.

18. An apparatus as set forth in claim 10 and further comprising a plurality of telescoping assemblies corresponding in number to said plurality of holding devices, each telescoping assembly being supported by said shaft at a fixed radial position and in axially aligned relation with an associated holding device and cradle, each telescoping assembly having a radially extendible male knife carried adjacent its terminal end with each male knife being adapted to be moved radially outwardly toward said arcuate cutting edge during engagement of said associated container against said arcuate cutting edge, each male knife cooperating with said arcuate cutting edge to trim an annulus from an open end of its associated container, and each telescoping assembly being removed from within its associated container after trimming said annulus therefrom.

19. An apparatus as set forth in claim 18 and further comprising a cam plate supported by said supporting structure adjacent said telescoping assemblies and a pair of cam rollers carried by each of said telescoping assemblies, each pair of cam rollers engaging opposite surfaces of said cam plate and controlling the axial position of each assembly during orbiting thereof by said shaft.

20. An apparatus for trimming cylindrical containers comprising, a supporting structure, a central shaft rotatably supported on said supporting structure, a head assembly fixed to said shaft for rotation therewith, said head assembly having a star wheel comprising a plurality of cradles arranged in equally spaced apart relation about the periphery thereof and each supporting an associated container for orbiting movement and having a plurality of holding devices corresponding in number to said plurality of cradles, each of said devices being axially aligned with an associated cradle for orbiting movement therewith and serving the dual purpose of holding an associated container at a predetermined axial position as well as rotating said associated container therewith within its cradle during orbiting movement thereof in a substantially circular path, a fixed sickle blade having an arcuate cutting edge arranged to extend over a portion of said circular path and being positioned to cut circumferentially around each container upon engagement of each container thereagainst during said orbiting and rotating movement, a plurality of telescoping assemblies corresponding in number to said plurality of holding devices and each telescoping assembly carrying a pair of cam rollers, each telescop-

ing assembly being supported by said shaft at a fixed radial position and in axially aligned relation with an associated holding device and cradle, each telescoping assembly having a radially extendible male knife carried adjacent its terminal end with each male knife being adapted to be moved radially outwardly toward said arcuate cutting edge during engagement of said associated container against said arcuate cutting edge, each male knife cooperating with said arcuate cutting edge to trim an annulus from the open end of its associated container, each telescoping assembly being removed from within its associated container after trimming said annulus therefrom, and a cam plate supported by said supporting structure adjacent said telescoping assemblies, each pair of cam rollers engaging opposite surfaces of said cam plate and controlling the axial position of each assembly during orbiting thereof by said shaft, said cam plate having a precisely controlled cam section arranged in a plane which is parallel to the plane of said arcuate cutting edge, said precisely controlled cam section having an arcuate length corresponding to the arcuate length of said arcuate cutting edge and said precisely controlled cam section controlling the extension of said radially extendible male knife.

21. An apparatus as set forth in calim **19** and further comprising a stripper ring supported at a fixed position concentrically around each telescoping assembly while allowing unobstructed telescoping movement of each assembly therethrough, each stripper ring being adapted to engage and strip a trimmed annulus carried around each telescoping assembly as said cam plate telescopes each telescoping assembly away from said sickle blade causing the annulus to strike an associated stripper ring and be stripped therefrom.

22. An apparatus as set forth in claim **18** and further comprising a planar control surface fixed to said central shaft and provided adjacent said holding devices and a step fixed to each telescoping assembly, each stop being adapted to engage said control surface and control the amount its telescoping assembly is telescoped within an associated container to assure said male knife is precisely positioned in a plane arranged parallel to and substantially adjoining the plane of said arcuate knife edge to provide a shear cut circumferentially around said associated container.

23. An apparatus for cutting circumferentially around a cylindrical member having opposed ends in a continuous nonindexing manner, said apparatus comprising, a supporting structure, a substantially circular head assembly carried by said supporting structure and having a central longitudinal axis, a device carried by said head assembly adjacent the outer periphery thereof for holding and rotating said cylindrical member, said device engaging and grasping only the exterior surface of said member adjacent one of said opposed ends and holding said member in a cantelevered manner with the major portion of said member extending outwardly beyond said device, means rotating said head assembly and said device relative to said head assembly to provide simultaneous orbiting and rotating movement of said device and hence said member through an arcuate path upon holding said member using said device, and a sickle blade fixed to said supporting structure and having an arcuate cutting edge which is concave toward said longitudinal axis and is arranged to extend over a portion of said arcuate path, said blade being adapted to cut circumferentially around the other of said opposed ends of said member upon engagement of said member thereagainst during said orbiting and rotating movement.

24. Apparatus for trimming cylindrical can bodies comprising a rotatable head assembly, a holding device rotatably mounted on the head assembly to support a can body with its axis parallel to the axis of rotation of the head assembly, means for rotating the head assembly to move the holding device along an arcuate path and for rotating the holding device to turn the can body about its axis, a sickle blade mounted adjacent the arcuate path and having an arcuate cutting edge for engagement with the can body, and a back-up device mounted on the head assembly for movement along the arcuate path in register with the holding device, the holding and back-up devices being relatively movable in an axial direction to locate the back-up device within the can body and the back-up device having a radially displaceable knife for cooperation with the sickle blade to trim an annulus from the can body.

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UNITED STATES PATENT OFFICE
CERTIFICATE OF CORRECTION

Patent No. 3,756,103 Dated September 4, 1973

Inventor(s) Daniel S. Cvacho and Edward S. Partyka

It is certified that error appears in the above-identified patent and that said Letters Patent are hereby corrected as shown below:

On the cover sheet item [63], for "Ser. No. 745,447", read --Ser. No. 745,474--.

Column 1, line 4, for "No. 745,447", read --No. 745,474--.

Signed and sealed this 18th day of December 1973.

(SEAL)
Attest:

EDWARD M. FLETCHER, JR.
Attesting Officer

RENE D. TEGTMEYER
Acting Commissioner of Patents