United States Patent [19]

Ringe

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[54] **APPARATUS FOR SEVERING WRAPPED TOBACCO FILLER RODS OR THE LIKE**

[75] Inventor: **Werner Ringe,** Geesthacht, Germany

[73] Assignee: **Hauni-Werke Korber & Co. K.G.,** Hamburg, Germany

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[52] **U.S. Cl.** ..... **83/310,** 83/594, 83/926 C

[51] **Int. Cl.** **B26d 3/22**

[58] **Field of Search** ..... 83/310, 594, 628, 632, 83/926 C

[56] **References Cited**

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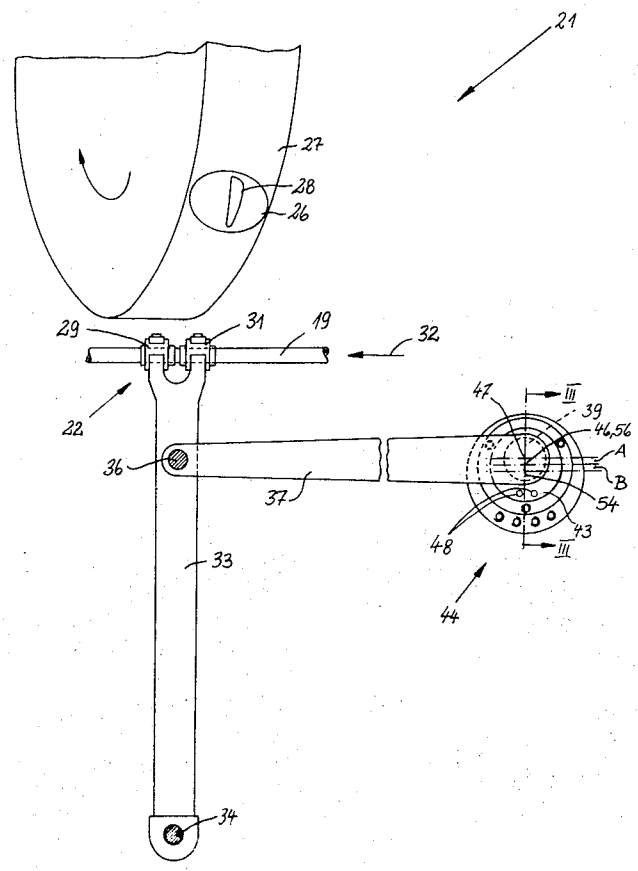
Primary Examiner—Frank T. Yost
Attorney, Agent, or Firm—Michael S. Striker

[57] **ABSTRACT**

A cutoff for a continuously moving cigarette rod or the like has a rod guide which cooperates with the orbiting knife or knives and is reciprocated by an adjustable crank drive. The latter has a cylindrical imput member which is driven by a shaft in synchronism with the knife or knives and has an eccentric socket for a cylindrical output member having an eccentric crank pin which can reciprocate the guide by way of a linkage consisting of a pivotable lever and a connecting rod. The eccentricity of the crank pin relative to the output member equals the eccentricity of the socket relative to the input member, and the output member is angularly adjustable in the socket to thus select the throw of the crank pin. The output member is balanced with respect to its axis prior to assembly of the crank drive, and the entire crank drive is balanced upon insertion of the output member into the socket. The mass of the crank drive exceeds the mass of the linkage.

15 Claims, 4 Drawing Figures



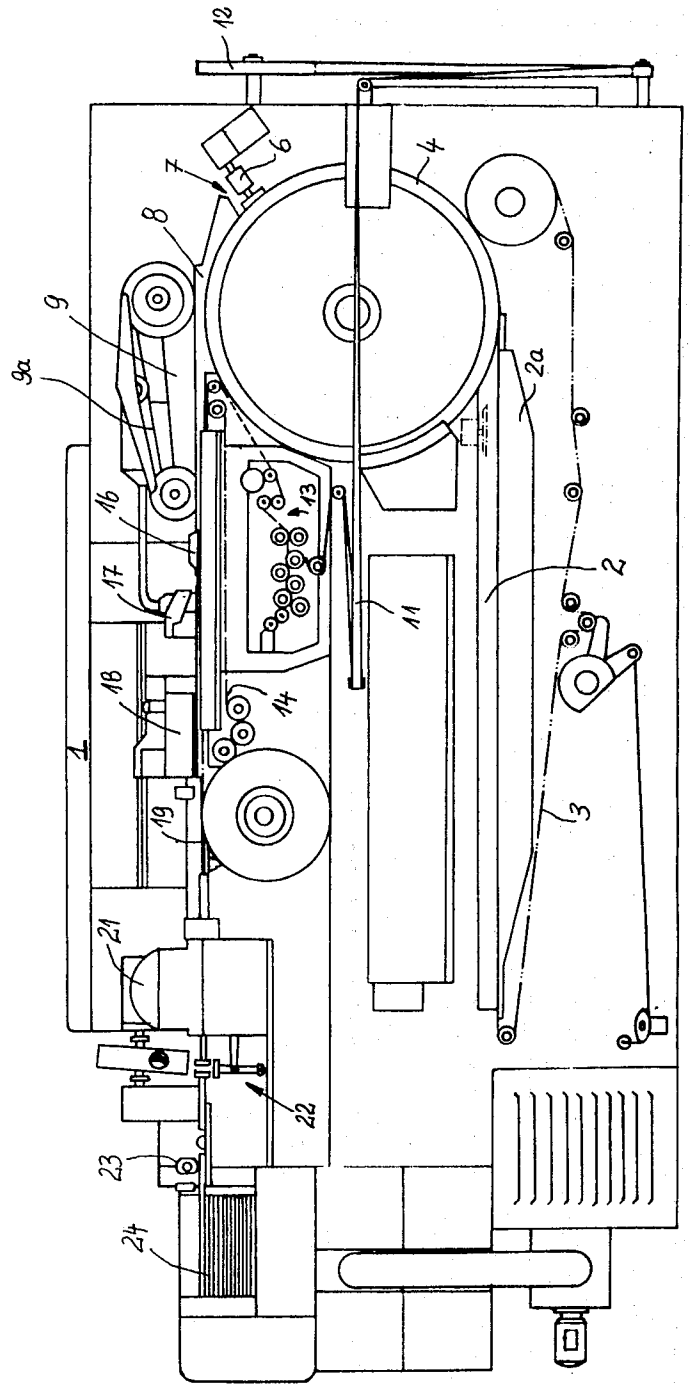


Fig. 1

Fig. 2

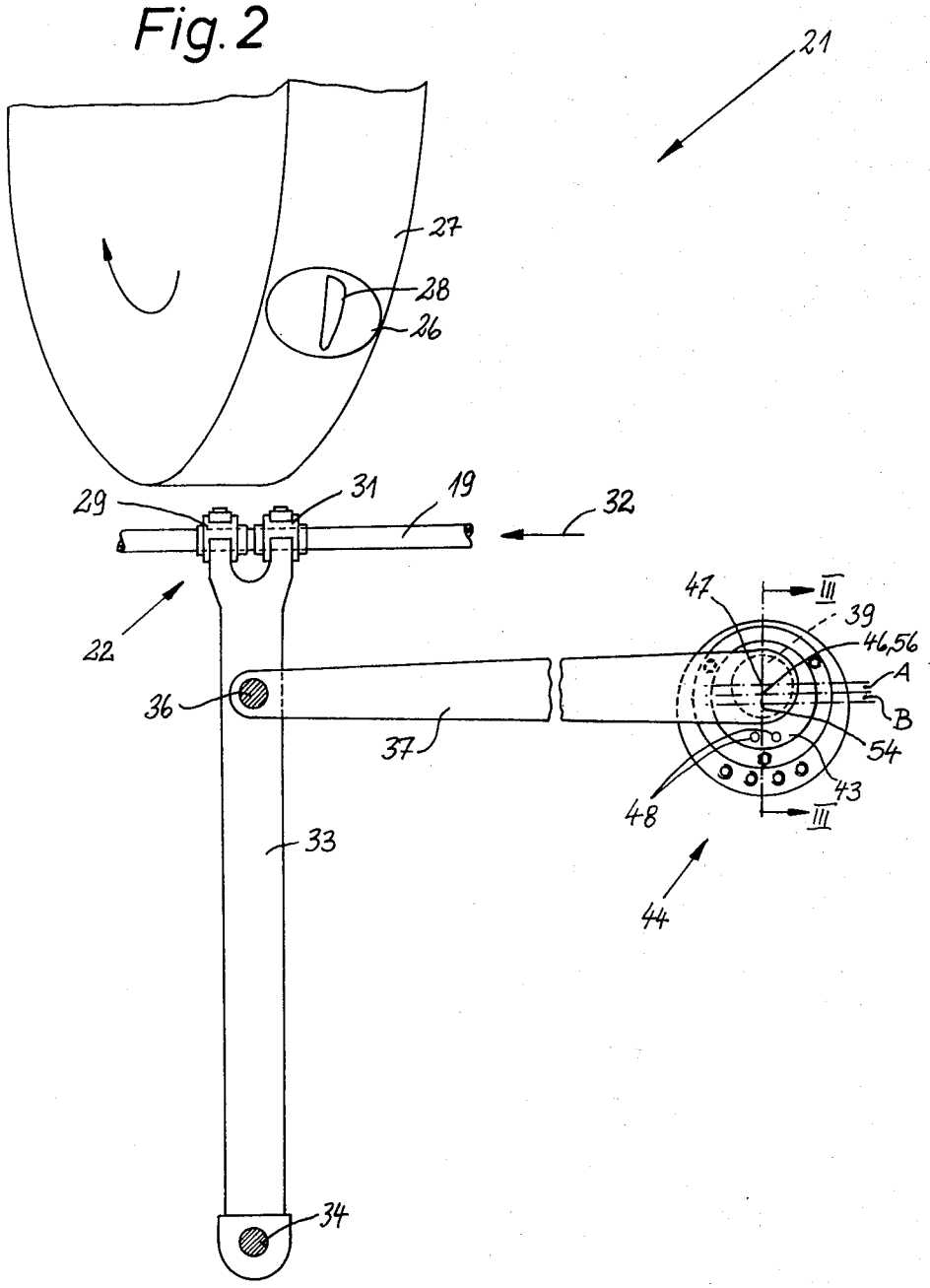

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Fig. 3

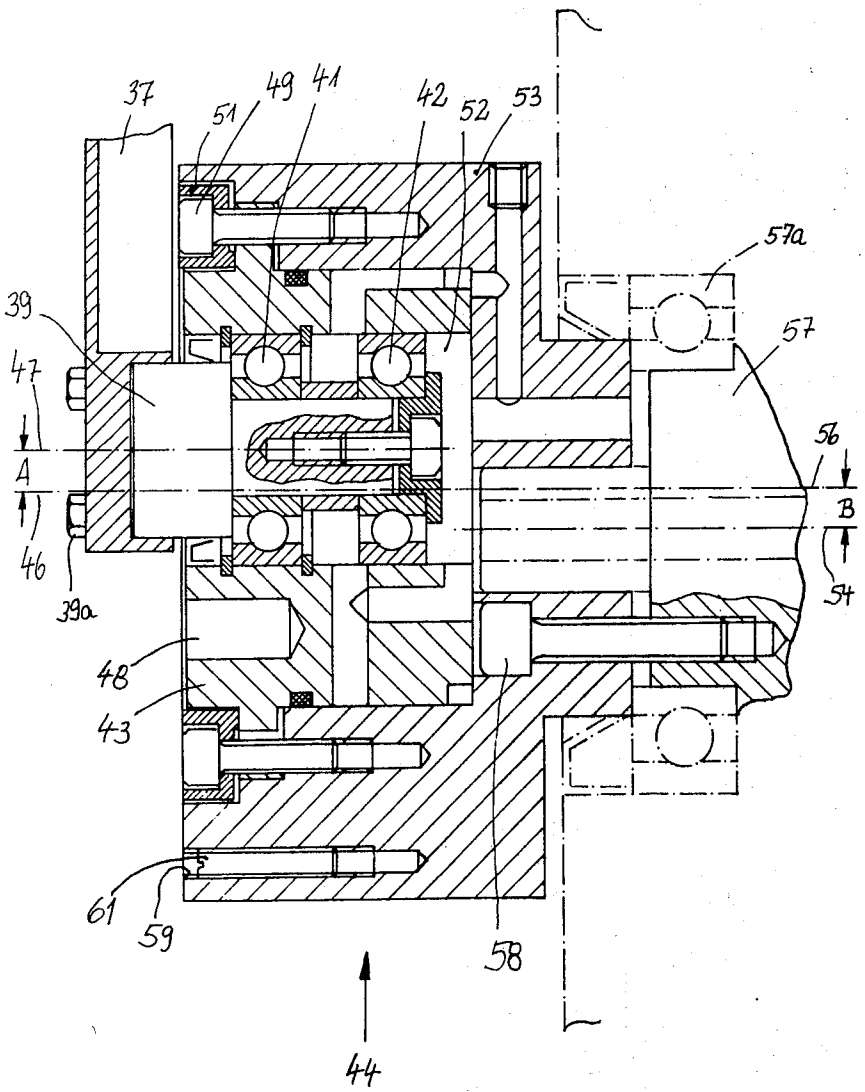
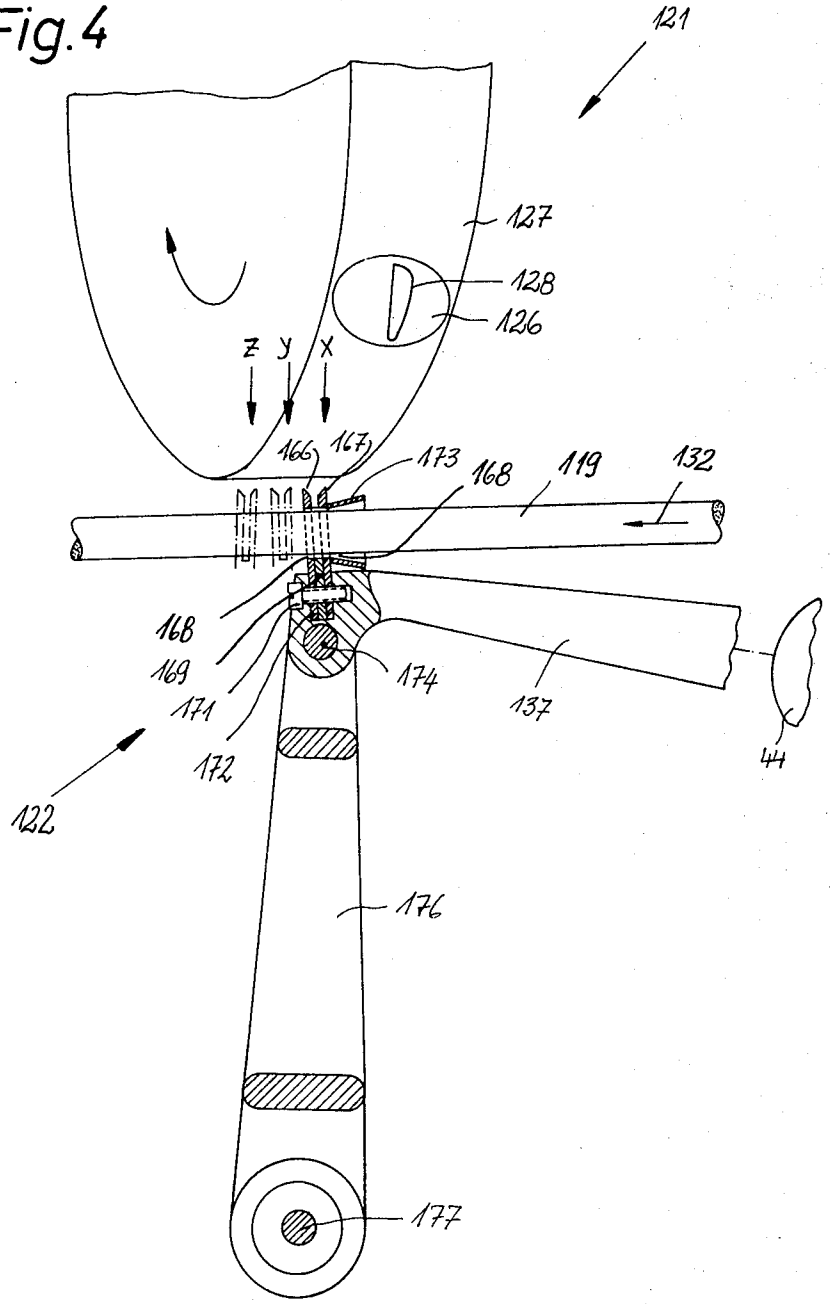


Fig. 4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APPARATUS FOR SEVERING WRAPPED TOBACCO FILLER RODS OR THE LIKE

BACKGROUND OF THE INVENTION

The present invention relates to apparatus for severing rods which consist of or contain tobacco, filter material and/or other fibrous substances and are surrounded by tubular wrappers consisting of cigarette paper, reconstituted tobacco or the like. More particularly, the invention relates to apparatus for subdividing continuous wrapped rods of tobacco or filter material into sections of unit length or multiple unit length.

It is known to subdivide a continuous wrapped tobacco filler rod into plain cigarettes of unit length or multiple unit length. As a rule, the subdividing or severing apparatus (known as a cutoff) comprises one or more orbiting knives which intersect at preselected intervals the path wherein a wrapped filler rod moves lengthwise so as to subdivide the rod into sections of required length. The knives are normally orbited in such a way that each thereof has a component of movement in the direction of lengthwise movement of the rod during severing of the wrapper and filler to thereby insure the formation of clean cuts and to further insure that the rod is severed in planes which are normal to its axis. It is further customary to provide the cutoff with a guide which comprises one or more tubes wherein the rod moves at the severing station whereby the tube or tubes support the rod during severing and thus contribute to the formation of clean cuts. The tube or tubes are normally reciprocated by a crank assembly which causes them to move in the direction and at the exact speed of movement of the rod during each of a series of consecutive severing operations. Reference may be had to the commonly owned U.S. Pat. No. 3,518,911 granted July 7, 1970 to Niemann et al., and to the commonly owned copending application Ser. No. 347,346 filed by Dietrich Bardenhagen on Apr. 2, 1973 for "Apparatus for severing wrapped tobacco rods or the like." The severing apparatus of Niemann et al., and Bardenhagen, as well as the severing apparatus of the present invention, may be used for severing of continuous rods which contain fillers of tobacco and/or filter material and tubular wrappers of cigarette paper, reconstituted tobacco or the like, as well as continuous rods which constitute hollow tubes suitable for use in the making of certain types of filter mouthpieces or in the making of smokers' products known as papyrossi. In the following description of prior art and of the present invention, reference will be had (for the sake of simplicity and convenience) to apparatus for severing cigarette rods which contain fillers of tobacco and tubular wrappers of cigarette paper or reconstituted tobacco with the understanding, however, that such apparatus are equally suited for the severing of empty tubes, tubular wrappers which contain cigar or cigarillo fillers, and/or tubular wrappers which contain filter material.

In presently known severing apparatus or cutoffs, the guide, which includes one or more tubes through which the cigarette rod passes, further serves as a counterknife for the orbiting knife or knives of the cutoff. The cigarette rod moves continuously, ie., also during severing, and at a substantial speed which, in a modern cigarette rod making machine, can approximate or even exceeds 350 meters per minute. Since the severing of cigarette rod in planes other than those which are normal to the axis of the rod affects the appearance of plain cigarettes and/or filter cigarettes which employ such plain cigarettes, it is highly desirable to make sure that the knife or knives will sever the rod only while moving in a plane which is exactly normal to the rod axis. Consequently, and since the tube or tubes of the aforementioned guide serve as a counterknife, they must move with and at the exact speed of the moving rod during each severing operation. This is achieved by resorting to the aforementioned crank assembly which moves the guide back and forth, i.e., with the rod during severing and counter to the direction of lengthwise movement of the rod during each interval between two successive severing operations. As a rule, the guide employs two tubes which define a gap for the passage of the knife or knives or a single tube having a slot through which the knife or knives travel during severing of the cigarette rod. Such mode of operation of the severing device is quite satisfactory when the speed of the rod is below a certain value. However, several problems arise when the cutoff is to sever the rod at such high frequency that the machine which embodies the cutoff turns out up to and in excess of 4,000 cigarettes per minute. Thus, the mass of the guide which is reciprocated at a frequency of 4,000 oscillations per minute subjects the material of and the bearings for its moving parts as well as the material of and the bearings for the parts of the crank assembly to enormous stresses. Moreover, the inertia of moving parts of the guide and crank assembly is such that these units of the cutoff generate excessive noise which is often unbearable to attendants. Reference may be had to the aforementioned patent to Niemann et al., which discloses a streamlined housing for the knife or knives of the cutoff for the express purpose of reducing noise to a bearable level.

Proper balancing or truing of conventional crank assemblies for the guides of cutoffs was considered impractical or plain impossible because the crank assembly must be adjustable so as to enable the cutoff to subdivide the cigarette rod into longer or shorter cigarettes. Thus, if a conventional crank assembly is properly balanced when the guide is to perform strokes of a first length, it is not balanced when the guide is to perform longer or shorter strokes. As a rule, the length of cigarettes will vary within a range of up to and in excess of 20 millimeters so that, if the crank assembly is properly balanced at a time when it is set to move the guide through strokes of shortest length, it is invariably unbalanced when the guide is to perform strokes of maximum length. This results in the generation of excessive noise as well as in excessive wear upon the moving parts and their bearings when the cutoff is set to subdivide the rod into cigarettes of maximum length.

SUMMARY OF THE INVENTION

An object of the invention is to provide a cutoff for continuous cigarette rods or the like with a novel and improved guide and with a novel and improved drive for the guide, and to construct and assembly the drive in such a way that it is properly balanced irrespective of the length of strokes which the guide must perform in and counter to the direction of lengthwise movement of the rod.

Another object of the invention is to provide a cutoff with a novel and improved crank assembly which

serves as a drive for reciprocating the guide of the cutoff and which is constructed and assembled in such a way that it runs true irrespective of the selected length of strokes of the guide in and counter to the direction of movement of the rod.

A further object of the invention is to provide a crank assembly which can be rapidly and accurately adjusted to move the guide through strokes of desired length.

An additional object of the invention is to provide a crank assembly whose balance is altered very little or not at all if its parts are adjusted for the purpose of changing the length of strokes of the guide.

Still another object of the invention is to provide a crank assembly which can be used as a superior substitute for the crank assemblies of conventional cutoffs for cigarette rods or the like.

The invention is embodied in an apparatus for severing a continuous rod which moves lengthwise in a predetermined direction and at a predetermined speed, particularly for severing a rod which consists of a tube or wherein a tubular wrapper surrounds a filler of fibrous material. The severing apparatus comprises a substantially tubular guide defining a portion of the path for the rod and being movable in and counter to the direction of movement of the rod through distances of variable length, drive means for moving the guide, and motion transmitting means articulately connecting the guide with the drive means.

In accordance with a feature of the invention the drive means constitutes a crank assembly which comprises a preferably cylindrical input member rotatably by a drive shaft about a first axis and provided with a preferably cylindrical socket having a second axis which is parallel to and spaced apart from the first axis by a first distance, and a preferably cylindrical output member angularly adjustably mounted in the socket and having a third axis which coincides with the second axis. The output member includes an eccentric portion which drives the motion transmitting means and has a fourth axis parallel to and spaced apart from the third axis by a second distance which preferably equals the first distance so that the axis of the eccentric portion may coincide with the first axis in a neutral angular position of the output member in which the throw of the eccentric portion is zero.

The output member is balanced prior to insertion into the socket, and the entire crank assembly is balanced upon insertion of the output member into the socket. If desired, the output member can be balanced together with a component part of the motion transmitting means.

The novel features which are considered as characteristic of the invention are set forth in particular in the appended claims. The improved severing apparatus itself, however, both as to its construction and its mode of operation, together with additional features and advantages thereof, will be best understood upon perusal of the following detailed description of certain specific embodiments with reference to the accompanying drawing.

BRIEF DESCRIPTION OF THE DRAWING

FIG. 1 is a diagrammatic elevational view of a cigarette rod making machine including a severing apparatus which embodies one form of the invention;

FIG. 2 is an enlarged elevational view of a portion of the severing apparatus shown in FIG. 1;

FIG. 3 is an enlarged sectional view as seen in the direction of arrows from the line III—III of FIG. 2; and

FIG. 4 is a fragmentary elevational view of a modified severing apparatus.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

FIG. 1 illustrates a cigarette rod making machine of the type known as GARANT produced by Hauni-Werke, Korber & Co. K.G., Hamburg-Bergedorf, Western Germany. The machine comprises a distributor 1 which contains a magazine for a supply of shredded tobacco and means for showering tobacco shreds into a tobacco channel 2 onto the upper stretch of a narrow endless foraminous belt 3 which transports the growing tobacco stream in a direction to the right, as viewed in FIG. 1, and into the circumferential groove of a suction wheel 4. The upper stretch of the belt 3 travels above the upper side of a suction chamber 2*a*. The bottom wall of the groove in the periphery of the suction wheel 4 is perforated and rotates about a stationary suction chamber (not shown) which attracts the tobacco stream during transport toward a trimming device 6 which removes the surplus of tobacco shreds so that the tobacco stream is converted into a rod-like filler 7. The latter is expelled from the groove of the suction wheel 4 by a stripping finger 8 and adheres to the underside of the lower stretch of an endless foraminous belt 9*a* forming part of a suction conveyor 9 which transfers the filler 7 into a wrapping mechanism 16 wherein the filler is provided with a tubular wrapper of cigarette paper. The cigarette paper is supplied in the form of a web 11 which is being withdrawn from an expiring roll 12 and passes through an imprinting device 13 severing to provide longitudinally spaced portions of the web 11 with printed matter representing the name of the manufacturer, the brand name, the trademark of the manufacturer and/or other indicia. The web 11 thereupon passes below the finger 8 and is advanced by the upper stretch of an endless band 14 which cooperates with the wrapping mechanism 16 to drape the web 11 around the filler 7. The mechanism 16 first folds one marginal portion of the web 11 over the filler 7 and causes the other marginal portion to extend upwardly so that it can be coated with a film of adhesive during travel past a conventional paster 17. The thus coated marginal portion is thereupon folded over the one marginal portion to form therewith a seam which extends lengthwise of the resulting cigarette rod 19 and is heated by a sealer 18 which causes the adhesive to set so that the tubular wrapper of the rod 19 does not open during subdivision of the rod into sections (plain cigarettes) of unit length or multiple unit length. The severing apparatus comprises a cutoff 21 which is constructed and assembled in accordance with one embodiment of the present invention and includes a guide 22 which supports and guides the rod 19 during severing. The thus obtained plain cigarettes are accelerated by a rapidly rotating cam 23 and are propelled into successive flutes of a transfer drum 24 which converts the single file of plain cigarettes moving lengthwise past the cam 23 into one or more rows of plain cigarettes which travel sideways. The cigarettes of the row or rows formed by the transfer drum 24 can be introduced into a filter cigarette making machine, into a tray filling ma-

chine, into storage or directly into a packing machine.

FIG. 2 illustrates certain details of the cutoff 21 and of its guide 22. The drive means for moving the guide 22 back and forth in and counter to the direction of lengthwise movement of the cigarette rod 19 (see the arrow 32) comprises a crank assembly 44 the details of which are illustrated in FIG. 3.

The cutoff 21 further comprises a substantially cylindrical streamlined housing 27 for a holder 26 which supports a knife 28. The housing 26 rotates in the direction indicated by arrow and the holder 26 for the knife 28 is mounted in such a way (by one or more universal joints and in a manner known from the art of cutoffs for cigarette rods or the like) that the orbiting knife 28 has a component of movement in the direction indicated by the arrow 32 at the time its cutting edge severs the rod 19 in the space between two coaxial tubes 29, 31 of the guide 22. The speed at which the knife 28 moves in the direction of arrow 32 during severing equals the speed of lengthwise movement of the cigarette rod 19.

The tubes 29, 31 of the guide 22 are mounted on the prongs of a bifurcated supporting lever 33 which is fulcrumed in the frame of the cigarette rod making machine, as at 34, and is pivotable back and forth by a connecting rod 37 forming with the lever 33 a linkage which transmits motion from the crank assembly 44 to the guide 22. The left-hand end of the connecting rod 37 is articulately connected to an intermediate portion of the supporting lever 33 by a horizontal pivot pin 36 which is parallel to the pivot member 34. The right-hand end of the connecting rod 37 is secured to a rotary crank pin 39 of the crank assembly 44 by means of bolts 39*a*. The crank pin 39 is rotatable in antifriction bearings 41 and 42 and constitutes a separable eccentric portion of a cylindrical output member 43 of the crank assembly 44. The axis of the crank pin 39 is shown at 47, the axis of the cylindrical output member 43 at 46, and the eccentricity of the crank pin 39 relative to the output member 43 at A.

The parts 39, 41, 42 and 43 constitute a prefabricated output unit which is fully assembled prior to connection to the connecting rod 37 and to other parts of the crank assembly 44 and is properly balanced with respect to the axis 46 of the output member 43. Note the balancing bores 48 which are drilled into the body of the output member 43 to insure uniform distribution of material about the axis 46.

The cylindrical output member 43 is separably secured to a cylindrical input member 53 of the crank assembly 44 by means of bolts or similar fasteners 49 and a ring 51 so that it extends into an eccentric bore or socket 52 of the input member 53. The angular position of the output member 43 in the socket 52 can be changed infinitely upon removal of the fasteners 49. The axis of the input member 53 is shown at 54, the axis of the socket 52 at 56, and the eccentricity of the socket 52 relative to the input member 53 is shown at B. When the crank assembly 44 is fully assembled, the axis 46 of the cylindrical output member 43 coincides with the axis 56 of the socket 52 in the cylindrical input member 53.

The means for rotating the cylindrical input member 53 about the axis 54 comprises a drive shaft 57 which is rotatable in one or more antifriction bearings 57*a* and is coaxially secured to the input member 53 by bolts 58 or other suitable fasteners. The input member 53 is balanced with respect to its axis 54 upon completed assembly with other parts of the crank drive 44 (note the balancing bores 59) so that the entire drive 44 runs true about the axis 54. The eccentricity A of the crank pin 39 relative to the cylindrical output member 43 preferably equals the eccentricity B of the socket 52 relative to the cylindrical input member 53. Consequently, the angular position of the output member 43 in the socket 52 can be selected in such a way that the axis 47 of the crank pin 39 coincides with the axis 54 of the cylindrical member 53; in such angular position of the crank pin 39, its throw equals zero.

The various grooves and channels shown in FIG. 3 serve for admission and circulation of a suitable lubricant.

The mass of the crank assembly 44 preferably greatly exceeds the mass of the motion transmitting linkage 33, 37 and guide 22. This insures the generation of a highly satisfactory and pronounced damping action which compensates for inertia of oscillating parts 33, 37 and 22.

The operation of the cutoff 21 is as follows:

In order to select the stroke of the tubes 29, 31 in and counter to the direction indicated by the arrow 32 for a desired length of plain cigarettes, the operator removes the bolts 49 and rotates the output member 43 in the socket 52 so that the axis 47 of the crank pin 39 coincides with the axis 54 of the input member 53, i.e., so that the throw is zero. This is the zero or neutral position of the supporting lever 33 and tubes 29, 31. Such zero position is noted and the operator thereupon rotates the output member 43 in the socket 52 whereby the tubes 29, 31 move lengthwise in or counter to the direction indicated by the arrow 32. When the lengthwise displacement of the tubes 29, 31 reaches a desired value (the desired length of plain cigarettes which are to be obtained in response to severing of the cigarette rod 19), the output member 43 is fixed to the input member 53 in the new angular position and the cutoff 21 is ready for use. The necessary angular displacement of the output member 43 from its neutral position (zero throw of the crank pin 39) can be readily calculated by dividing the desired length of plain cigarettes by π. The ring 51 is deformable by the bolts 49 to insure that the output member 43 cannot leave the selected angular position relative to the input member 53.

When the cigarette rod making machine is in use, the crank assembly 44 moves the guide 22 back and forth in synchronism with the orbital movement of the knife 28 so that the latter passes through the gap between the tubes 29, 31 and severs the rod 19 while the tubes 29, 31 move in the direction indicated by the arrow 32 and at the exact speed of the rod 19. The speed of the tubes 29, 31 in the direction of the arrow 32 equals the speed of the rod 19 during the entire interval of movement of the cutting portion of knife 28 across the path of the cigarette rod. The knife 28 has a component of movement in the direction of arrow 32 which equals the speed of the rod 19 while the cutting edge severs the wrapper and the filler of the rod.

Since the crank assembly 44 is accurately balanced and runs true even if the cylindrical output member 43 (which is balanced separately with the crank pin 39 and bearings 41, 42) is caused to assume any one of an infinite number of angular positions in the socket 52, the

operation of the crank assembly **44** is surprisingly quiet and smooth so that the wear on its parts is minimal.

The balancing bores **59** of the cylindrical input member **53** are preferably tapped so that they can receive externally threaded balancing or truing elements in the form of screws **61** or the like which serve to counterbalance some or all of the forces which arise as a result of oscillatory movements of the guide **22**, supporting lever **33** and connecting rod **37**. The externally threaded elements **61** thus constitute simple counterweights which can be inserted into one or more balancing bores **59** and which can be furnished in several sizes to insure an accurate compensation for oscillatory movements of the parts **22, 33** and **37**.

If the angular adjustments of the cylindrical output member **43** are relatively small, the parts **39, 41, 42, 43** of the crank assembly **44** can be balanced for an average plain cigarette length together with the connecting rod **37** because minor changes in the length of plain cigarettes above or below such average length cannot overly affect the balance of the assembly **44** and parts **22, 33, 37**, i.e., the increasing noise is hardly noticeable. If the connecting rod **37** is balanced with the parts **39, 41, 42, 43**, it can be considered as a part of the output member of the crank assembly.

FIG. **4** illustrates a portion of a modified cutoff **121** wherein all such parts which are clearly analogous to or identical with the corresponding parts of the cutoff **21** are denoted by similar reference characters plus 100.

The main difference between the cutoff **21** and the cutoff **121** of FIG. **4** is that the latter comprises a modified guide **122**. The guide **121** comprises two relatively thin tubes **166, 167** which may consist of sheet metal and are provided with bores or openings **168** having diameters which exceed the diameter of the cigarette rod **119**. The tubes **166, 167** (which actually constitute flat rings) are spaced apart by a tubular distancing member **169** and are held with no clearance in a slot **172** of the connecting rod **137** by means of a screw **171** or a similar fastener. The combined axial length of the tubes **166, 167** and distancing member **169** is less than the diameter of the cigarette rod **119**. The tube **167** which is located upstream of the tube **166**, as considered in the direction of the arrow **132**, is provided with a funnel **173** which can introduce the leading end of a fresh rod **119** into the openings **168**.

The connecting rod **137** is coupled to the upper end portion of an oscillatable supporting lever **176** by means of a horizontal pin **174** which is parallel to a fixed pivot pin **177** for the lever **176**. The pivot pin **177** is mounted in the frame of the cigarette rod making machine which is preferably (but not necessarily) identical with the machine of FIG. **1**. The parts **137** and **176** are preferably made of titanium. The crank assembly for moving the connecting rod **137** is preferably identical with the crank assembly **44** of FIGS. **2** and **3**.

The operation of the cutoff **121** is as follows:

When the cigarette rod making machine is in use, the connecting rod **137** receives motion from the crank pin of the crank assembly so that the tubes **166, 167** move in and counter to the direction indicated by the arrow **132**. Since the parts **166, 167** and **169** of the guide **122** are mounted directly on the connecting rod **137**, they perform some pivotal movements during movement in and counter to the direction indicated by the arrow **132**. Such changes in inclination of the tubes **166, 167** are used to enable these tubes to conform with a greater degree of accuracy to the changes in angular position of the knife **128** on the holder **126**. The guide **122** assumes the solid-line position X of FIG. **4** at the start of a severing operation, and this guide assumes the phantom-line position Y of FIG. **4** during an intermediate stage of a cutting operation when the cutting edge of the knife **128** has passed halfway through the wrapper and rod-like filler of the rod **119**. The guide **122** assumes the phantom-line position Z of FIG. **4** at the end of a severing operation when the cutting edge of the knife **128** is about to leave the path for the rod **119**. The distance which the guide **122** covers from the position X to the position Y constitutes only a portion of the distance which the tubes **166, 167** cover in the direction indicated by the arrow **132**, i.e, during one-half of a full revolution of the input member of the crank assembly **44**.

An important advantage of the improved cutoff **21** or **121** is that the parts of the crank assembly **44** can be properly balanced and remain balanced even if their mutual positions must change in order to enable the cutoff to subdivide the rod **19** or **119** into longer or shorter sections. This, in turn, insures a smooth operation of the cutoff and reduces the noise so that the attendants can remain at their stations during a full shift.

Without further analysis, the foregoing will so fully reveal the gist of the present invention that others can, by applying current knowledge, readily adapt it for various applications without omitting features which fairly constitute essential characteristics of the generic and specific aspects of my contribution to the art and, therefore, such adaptations should and are intended to be comprehended within the meaning and range of equivalence of the claims.

What is claimed as new and desired to be protected by Letters Patent is set forth in the appended claims:

1. In an apparatus for severing a continuous rod which moves lengthwise in a predetermined direction and at a predetermined speed, particularly for severing a rod which consists of a tube or wherein a tubular wrapper surrounds a filler of fibrous material, a combination comprising a substantially tubular guide defining a portion of said path and being movable in and counter to said direction, dirve means for moving said guide, said drive means constituting a crank assembly and including an input member rotatable about a first axis and provided with a socket having a second axis which is parallel to and spaced apart from said first axis by a first distance, and an output member mounted in said socket and having a third axis coinciding with said second axis, said output member including an eccentric portion having a fourth axis parallel to and spaced apart from said third axis by a second distance, said output member being angularly adjustable in said socket, said output member being balanced with respect to said third axis and said input and output members being balanced together with reference to said first axis; and motion transmitting means articulately connecting said guide with said eccentric portion of said output member.

2. A combination as defined in claim **1**, wherein said output member is angularly adjustable in said socket between an infinite number of positions, and further comprising fastener means for separably fixing said output member in a selected angular position.

3. A combination as defined in claim 1, wherein said first distance equals said second distance and said output member is angularly movable in said socket to a position in which said fourth axis coincides with said first axis.

4. A combination as defined in claim 1, wherein said output member is a cylinder and said eccentric portion thereof is a crank pin.

5. A combination as defined in claim 1, wherein said input member is a cylinder and said socket is an eccentric bore provided in said cylinder.

6. A combination as defined in claim 1, wherein said crank assembly further comprises a rotary drive shaft coaxially secured to and arranged to rotate said input member.

7. A combination as defined in claim 1, further comprising at least one counterweight separably secured to one of said members to balance at least some of the forces which are furnished by said guide and said motion transmitting means while said guide reciprocates in and counter to said direction.

8. A combination as defined in claim 1, wherein said output member further comprises a connecting rod coupled to said eccentric portion and arranged to transmit motion to said motion transmitting means.

9. A combination as defined in claim 1, wherein said motion transmitting means comprises supporting means pivotable about a fifth axis and carrying said guide, and a connecting rod connected with said eccentric portion and arranged to pivot said supporting means.

10. A combination as defined in claim 1, wherein said motion transmitting means comprises a connecting rod connected to said eccentric portion and supporting said guide and a supporting lever articulately connected with said connecting rod in the region of said guide and pivotable by said connecting rod about a fifth axis which is parallel to said first mentioned axes.

11. A combination as defined in claim 1, wherein said guide comprises two coaxial tubes.

12. A combination as defined in claim 1, wherein said guide comprises two spaced-apart concentric rings having circular openings whose diameters exceed the diameter of the rod.

13. A combination as defined in claim 1, further comprising a knife and means for orbiting said knife along an endless path having a portion which intersects said first mentioned path in the region of said guide while said guide moves in said direction.

14. A combination as defined in claim 1, wherein at least one of said input and output members is provided with at least one balancing bore.

15. A combination as defined in claim 1, wherein at least a portion of said motion transmitting means consists of titanium.

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