

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

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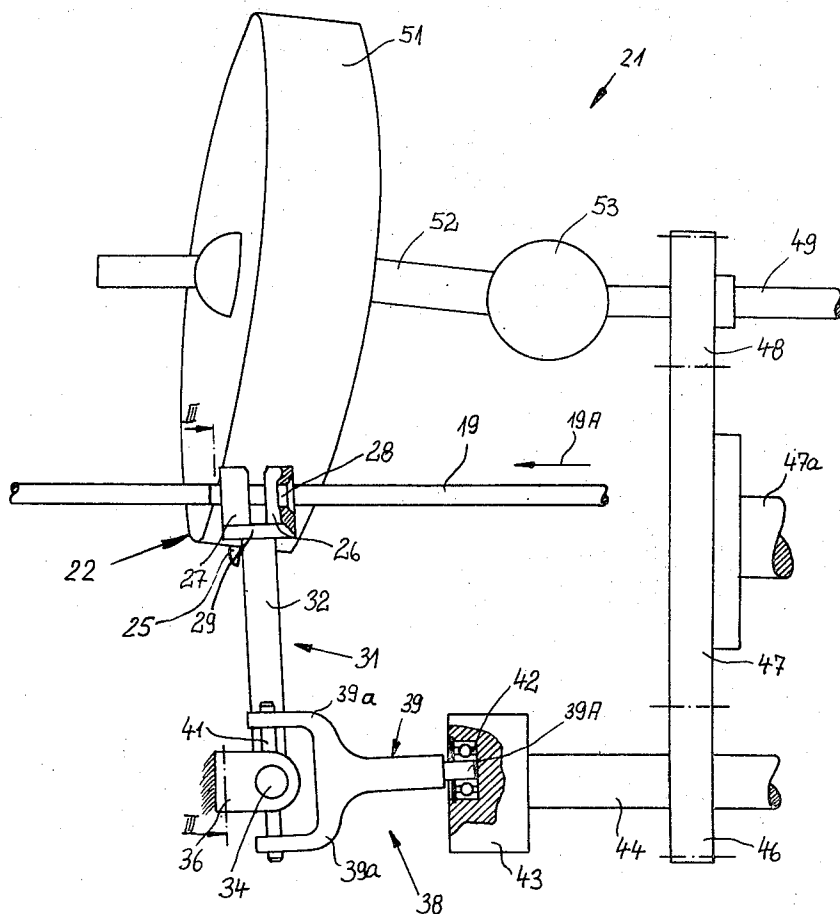
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[57] **ABSTRACT**

A severing apparatus for cigarettes rods wherein a knife orbits along an endless path which intersects the path of the rod and wherein the knife moves during severing in the same direction and at the speed of movement of the rod employs a tubular guide assembly which surrounds the rod and constitutes a counter-knife for the orbiting knife. The drive for the knife includes a Rzeppa joint and the drive which oscillates the guide assembly employs a Hooke's joint or an eccentric drive to thus reduce noise when the knife severs the rod at the rate of up to 70 cuts per second. The guide assembly is mounted on the light metal arms of a carrier whose shaft is turnable in fixed bearings by a pair of motion transmitting pins which form part of the Hooke's joint or by a fork which forms part of the eccentric drive. When the drive for the guide assembly employs a Hooke's joint, its input shaft is parallel to the input shaft of the drive for the knife, and one of these input shafts drives the other input shaft by a train of spur gears or by a power train which utilizes a toothed belt.

15 Claims, 6 Drawing Figures



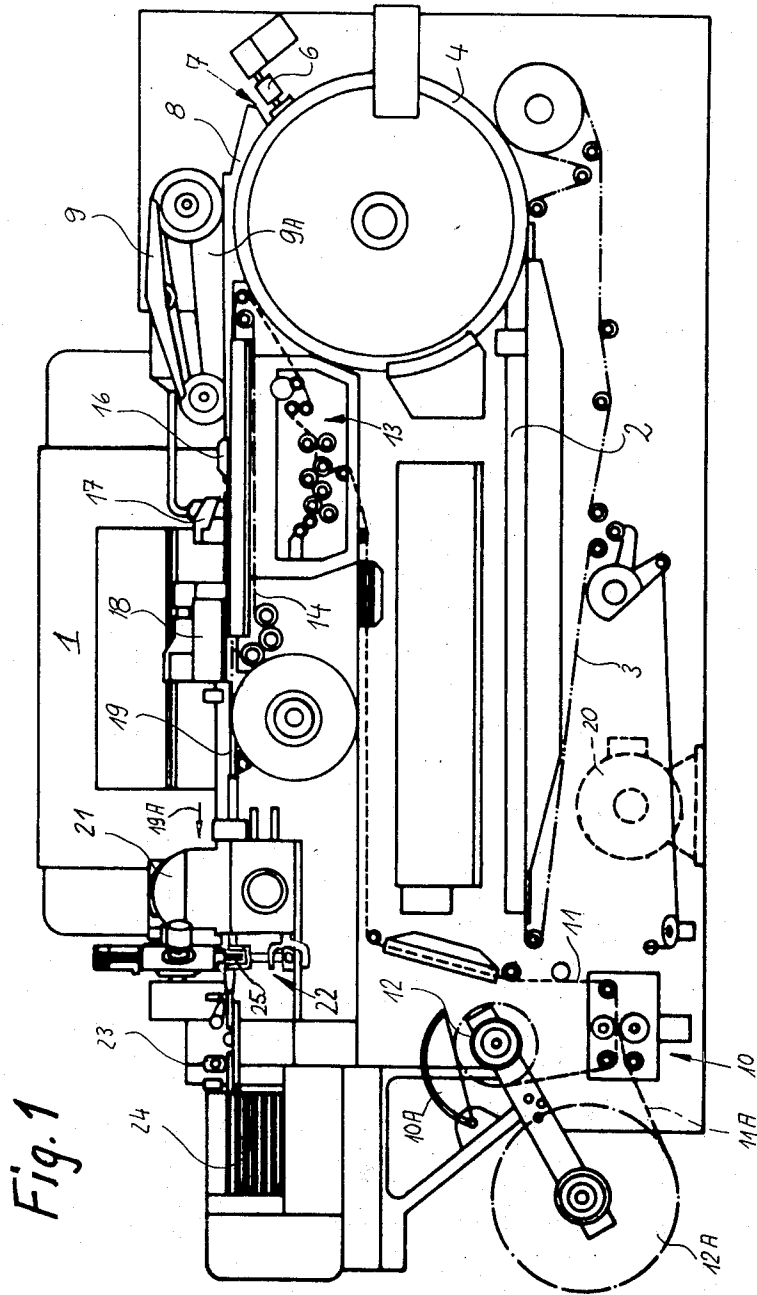


Fig. 1

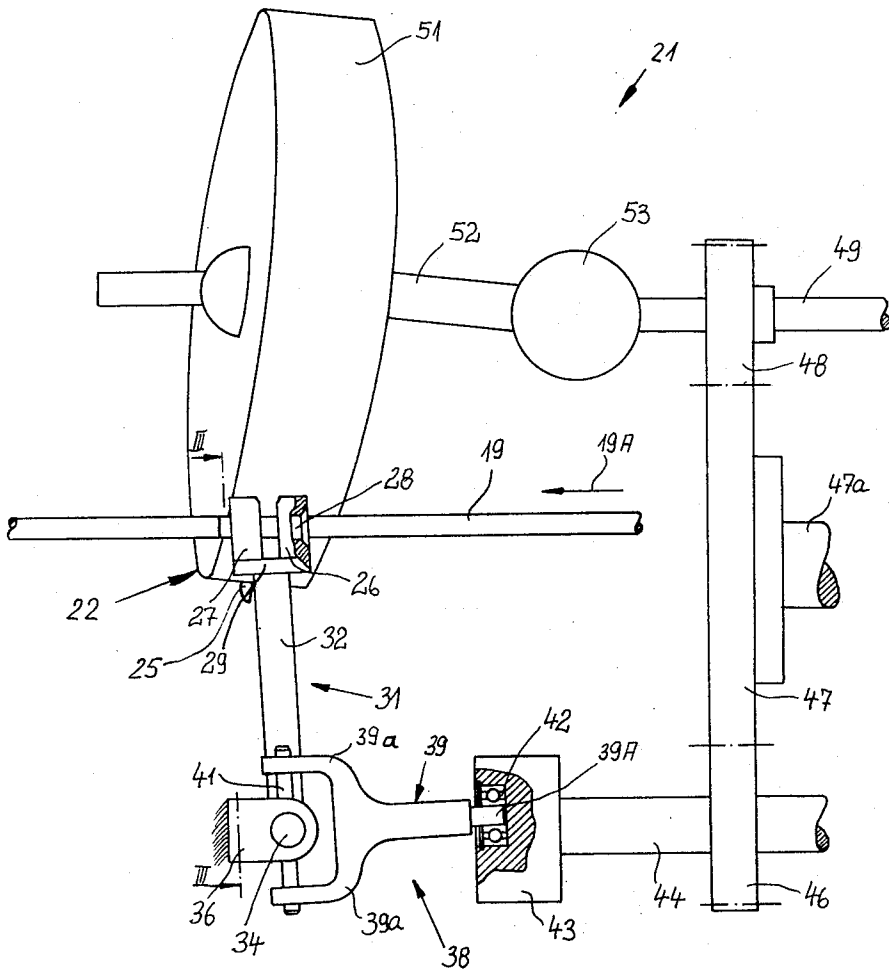
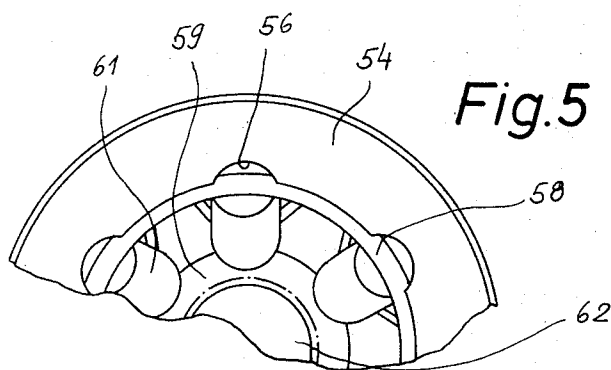
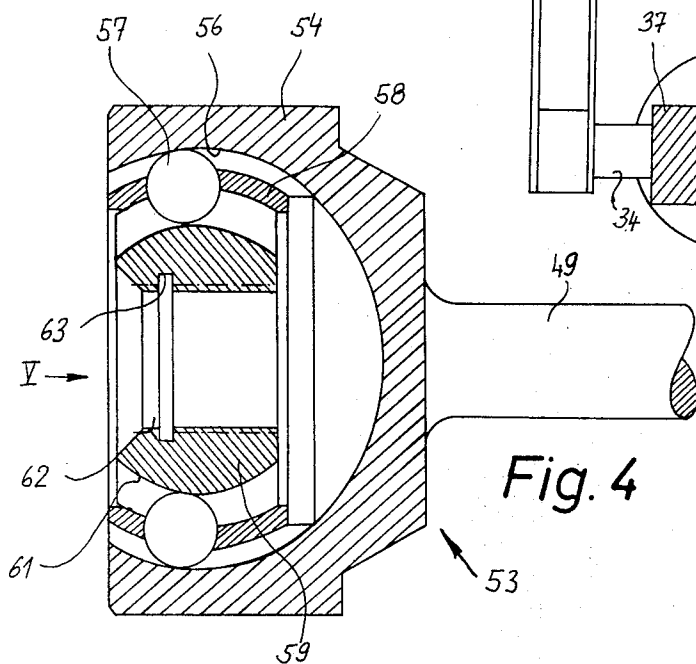
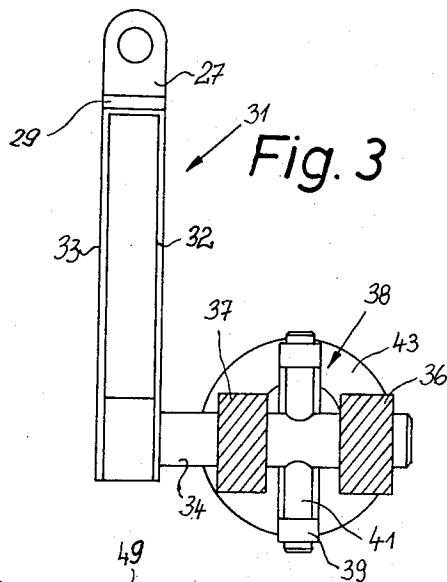


Fig. 2



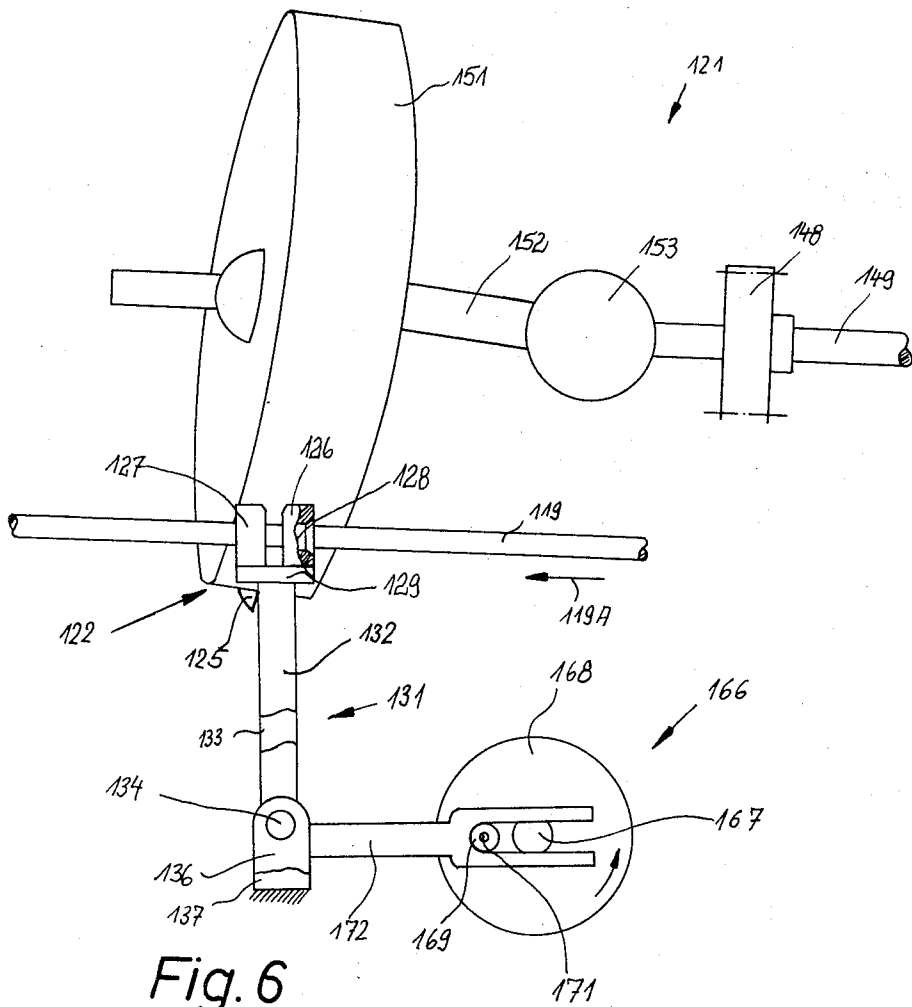


Fig. 6

## APPARATUS FOR SEVERING WRAPPED TOBACCO RODS OR THE LIKE

### BACKGROUND OF THE INVENTION

The present invention relates to improvements in apparatus for severing rods of the type wherein a fibrous filler of tobacco and/or filter material is surrounded by a tubular wrapper consisting of cigarette paper or the like. More particularly, the invention relates to improvements in severing apparatus of the type wherein a knife orbits along an endless path a portion of which intersects the path of lengthwise movement of the rod and wherein the knife moves sideways in the same direction and at the speed of movement of the rod during severing. Such severing apparatus are used in machines for the production of plain or filter tipped cigarettes, cigars or cigarillos, as well as in machines for the production of filter rod sections.

In presently known severing apparatus (also known as cutoffs) which are used in cigarette making or like machines, the rod which is to be severed passes through a guide assembly which moves back and forth in and counter to the direction of lengthwise movement of the rod and cooperates with the knife during severing by acting not unlike a counterknife in order to insure the formation of clean cuts. Since a modern cigarette making machine can turn out up to and in excess of 4,000 cigarettes per minute, the rod which is to be severed must be transported lengthwise at a very high speed (normally in the range of 350 meters per minute).

Therefore, the guide assembly must be oscillated at a very high frequency and its movements must be accurately synchronized with lengthwise movement of the rod as well as with the orbiting and sidewise movements of the knife in order to insure that the rod is invariably severed in planes which are exactly normal to its axis.

As a rule, a guide assembly is a tube which is formed with a notch through which the knife travels during severing of the rod. The tube is mounted on strong leaf springs and is driven by the arm of a crank drive in synchronism with the knife. Such drive means for the guide assembly is satisfactory when the rod is conveyed at a relatively low speed. However, when the rod is to yield up to and in excess of 70 sections (plain or filter cigarettes, cigars or cigarillos or filter rod sections) per second, the guide assembly must be driven at a frequency of about 4,000 oscillations per minute which subjects the bearings and the material of the parts of the drive means to enormous stresses. Moreover, the inertia of presently known crank drives is extremely high and such crank drives create substantial noise which becomes unbearable when a full battery of machines employing conventional severing apparatus is mounted in a single area. The generation of noise is further attributed to use of relatively wide leaf springs which carry the guide assembly and act not unlike a diaphragm.

### SUMMARY OF THE INVENTION

An object of the invention is to provide a severing apparatus for a rod wherein a fibrous filler is surrounded by a tubular wrapper which is quieter, longer lasting and more compact than heretofore known severing apparatus.

Another object of the invention is to provide a severing apparatus wherein the mass of component parts of the drive means for the guide assembly is only a small fraction of the mass of component parts of conventional drive means.

A further object of the invention is to provide a machine which can be used for the making of a continuous rod wherein a fibrous filler of tobacco and/or filter material is surrounded by a tubular wrapper of paper or the like and which embodies the improved severing apparatus.

An additional object of the invention is to provide the severing apparatus with novel and improved means for oscillating the guide assembly which surrounds the rod to be severed in the region where the path for the rod is intersected by the path for one or more orbiting knives.

Still another object of the invention is to provide novel and improved universal and torque-transmitting joints for use in severing apparatus of the above outlined character.

The invention is embodied in an apparatus for severing a rod wherein a fibrous filler is surrounded by a tubular wrapper of paper or the like. The apparatus comprises conveyor means (e.g., the so-called garniture belt of a cigarette rod making machine) for advancing a rod lengthwise in a predetermined direction and at a predetermined speed along a first path, at least one knife or cutter, first drive means for moving the knife along an endless second path a portion of which intersects the first path and for moving the knife in the direction of movement of the rod and at the speed of movement of the rod during travel along the aforementioned portion of the second path, a guide assembly which at least partially surrounds the rod in the first path in the region of the aforementioned portion of the second path, and second drive means for moving the guide assembly back and forth in and counter to the direction of movement of the rod so that the guide assembly moves in the direction of travel of the rod and at the speed of movement of the rod during travel of the knife along the aforementioned portion of the second path.

In accordance with a feature of the invention, the second drive means comprises fixed bearing means, carrier means including a shaft or an analogous member which is turnably mounted in the bearing means and arm means extending from the shaft and fixedly supporting the guide assembly at a point which is remote from the shaft, and oscillating means which serves to turn the shaft in the bearing means back and forth and includes a motion transmitting portion (e.g., one or more pins or a fork) which is connected with the shaft in immediate or close proximity of the bearing means.

The arm means of the carrier means preferably constitutes a simple cantilever beam one end of which is rigid with the shaft of the carrier means and the other end of which is rigid with a supporting plate for the guide assembly. The motion transmitting portion of the oscillating means is preferably connected with the shaft in such a way that it shares the angular movements of the shaft relative to the bearing 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 ad-

vantages 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 schematic side elevational view of a cigarette rod making machine including a severing apparatus which embodies one form of the invention;

FIG. 2 is an enlarged partly elevational and partly sectional view of the severing apparatus of FIG. 1;

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

FIG. 4 is an enlarged axial sectional view of a joint in the apparatus of FIG. 2;

FIG. 5 is a fragmentary end elevational view of the joint as seen in the direction of arrow V in FIG. 4; and

FIG. 6 is a partly elevational and partly sectional view of a second severing apparatus.

#### DESCRIPTION OF THE PREFERRED EMBODIMENTS

Referring first to FIG. 1, there is shown a cigarette rod making machine of the type known as GARANT produced by the West German firm of Hauni-Werke, Hamburg-Bergedorf. The cigarette rod making machine comprises a distributor 1 which contains a supply of shredded tobacco and includes means for showering tobacco into an elongated tobacco channel 2 which accumulates a growing narrow tobacco stream on the upper stretch of an endless tobacco transporting belt 3. The tobacco stream which is formed in the channel 2 is transported by the belt 3 into the circumferential groove of a suction wheel 4 which rotates in a counterclockwise direction, as viewed in FIG. 1, and has a rotating perforated wall in the bottom region of the circumferential groove as well as a stationary suction chamber which is surrounded by the perforated wall. The suction chamber insures that the tobacco stream which is delivered by the belt 3 adheres to the perforated wall during transport through an angle of a little less than 180°. The suction at the inner side of the perforated wall brings about a certain compression of the tobacco stream, and the thus compacted tobacco stream is equalized by a customary trimming device 6 which converts the stream into a rod-like tobacco filler 7. The surplus of tobacco which is removed by the trimming device 6 is preferably returned into the main supply of shredded tobacco in the distributor 1.

The filler 7 is removed from the circumferential groove of the suction wheel 4 by a stripping finger 8 and is attracted to the underside of an endless transfer conveyor 9 whose lower stretch travels below a stationary suction chamber 9a and consists of foraminous material. The filler 7 is transferred onto the upper stretch of an endless garniture belt 14 which also receives and advances a running web 11 of cigarette paper. The web 11 is being withdrawn from an expiring roll 12 of cigarette paper and passes through a splicing device 10 which also receives the leading end of a fresh web 11A of cigarette paper. The fresh web 11A is stored on a fresh roll 12A. A detector 10A scans the diameter of the expiring roll 12 and produces a signal when the diameter of the roll 12 decreases to a predetermined minimum value. Such signal actuates the splicing device 10

which then connects the running web 11 to the leading end of the fresh web 11A. The exact construction of the splicing device 10 forms no part of the present invention. The running web 11 advances through an imprinting device 13 which provides longitudinally spaced portions of the web 11 with indicia representing the trademark of the manufacturer, the name of the manufacturer and/or other information. The upper stretch of the belt 14 transports the web 11 and the filler 7 through a conventional wrapping mechanism 16 wherein the web 11 is draped around the filler so that one of its marginal portions extend upwardly and substantially tangentially of the filler and is coated with adhesive by a paster 17. The thus coated marginal portion is thereupon folded over the other marginal portion to form therewith a seam which is heated by a sealer 18 to cause the adhesive to set. The resulting cigarette rod 19 is advanced through a severing apparatus or cutoff 21 which includes a guide assembly 22 and an orbiting knife or cutter 25 cooperating with the guide assembly to sever the cigarette rod 19 at regular intervals so that the cigarette rod yields a single file of discrete plain cigarettes of unit length or multiple unit length. Successive plain cigarettes are accelerated by a rotary cam 23 which propels the cigarettes into successive flutes of a continuously rotating drum-shaped transfer conveyor 24. The conveyor 24 converts the single file of plain cigarettes into one or more rows of plain cigarettes which travel sideways and are introduced into a conventional filter cigarette making machine (not shown), into a tray filling machine (not shown) or directly into a packing machine (not shown). The reference character 20 denotes the main prime mover of the cigarette rod making machine. This prime mover drives the suction wheel 4, the belts 3 and 14, the conveyors 9 and 24, the accelerating device 23, and the movable parts of the severing apparatus 21 at one or more predetermined speeds. The belt 14 constitutes a conveyor which advances the cigarette rod 19 lengthwise in the direction indicated by an arrow 19A and at a predetermined speed depending on the RPM of the prime mover 20.

The details of the improved severing apparatus or cutoff 21 are illustrated in FIGS. 2 and 3. The guide assembly 22 comprises two coaxial tubes 26 and 27 having aligned axial bores or passages 28 (only one shown). The diameter of each bore 28 slightly exceeds the diameter of the cigarette rod 19 which passes through and is severed by the knife 25 in the space between the tubes 26 and 27. The tubes 26 and 27 are secured to or made integral with a supporting plate 29 which is rigid with the upper end portions of two flat arms 32, 33 of a carrier 31. The arms 32 and 33 preferably consist of a light metal and their planes are parallel to the common axis of the bores 28 in the tubes 26 and 27. The lower end portions of the arms 32 and 33 are rigid with a horizontal shaft 34 which is turnable in stationary bearings 36 and 37. In addition to the arms 32 and 33, the carrier 31 includes the supporting plate 29 and the shaft 34.

The drive means which serves to move the tubes 26, 27 back and forth in and counter to the direction indicated by the arrow 19A includes the carrier 31 and a universal joint 38 of the type known as Hooke's joint. The joint 38 constitutes a means for oscillating the shaft 34 back and forth in the bearings 36, 37 and comprises a fork 39 having two prongs 39A which rotatably

support two coaxial motion transmitting pins 41 which are rigid with the shaft 34 in immediate proximity of the bearings 36, 37. A stub 39A of the fork 39 is received in the inner race of an anti-friction bearing 42 which is eccentrically mounted in a rotary driver disk 43 mounted on an input shaft 44 which carries a spur gear 46 preferably having a helical thread. The gear 46 meshes with a larger spur gear 47 which is mounted on a shaft 47a and further meshes with a third spur gear on an input shaft 49. The input shaft 49 is parallel with the input shaft 44 and forms part of a drive means which moves the knife 25 along an endless path through the intermediary of an output shaft 52, a housing 51 and a specially designed torque transmitting joint 53 of the type known as Rzeppa joint the details of which are illustrated in FIGS. 4 and 5. The torque transmitting joint 53 is similar to those which are used in the front axle drives of automotive vehicles.

As shown in FIGS. 4 and 5, the torque transmitting joint 53 comprises a cup-shaped outer member 54 which is rigid or integral with the input shaft 49 and spherical inner member 59 which is received in the spherical socket of the outer member 54. The internal surface of the outer member 54 is formed with six equidistant arcuate tracks 56 in the form of grooves each of which receives a portion of a discrete spherical element 57. The six spherical elements 57 are mounted in a cage 58 which is disposed between the members 54 and 59. The member 59 has an external surface which is also provided with six equidistant arcuate tracks in the form of grooves 61 each of which receives a portion of a spherical element 57. The inner member 59 has a bore 62 with axially parallel teeth which mesh with similar teeth on the output shaft 52. The output shaft 52 is held against axial movement by a split ring (not shown) which extends into the internal groove 63 of the spherical member 59 and into a complementary groove machined into the periphery of the output shaft 52. The torque transmitting joint 53 enables the output shaft 52 to swivel relative to the input shaft 49 while it shares the angular movement of the shaft 49. The exact construction of the mechanism in the interior of the housing 51 forms no part of the present invention. Reference may be had to U.S. Pat. No. 3,518,911 granted July 7, 1970 to Niemann et al. and owned by the assignee of the present application. It suffices to say that the knife 25 orbits along an endless path surrounding the output shaft 52 at a speed which is synchronized with the speed of lengthwise movement of the cigarette rod 19 and that the blade of the knife 25 is normal to the axis of the rod 19 at the time when the knife 25 travels along that portion of the endless path which extends through the gap between the tubes 26 and 27 of the guide assembly 22. During travel in the gap between the tubes 26, 27, the knife 25 moves in the direction indicated by the arrow 19A and at the speed of the cigarette rod 19.

The operation of the severing apparatus 21 is as follows:

The input shaft 49 receives torque from the prime mover 20 of the cigarette rod making machine shown in FIG. 1 which latter also drives the conveyor belt 14 so that the rotary movement of the output shaft 52 is synchronized with lengthwise movement of the cigarette rod 19. The input shaft 49 drives the housing 51 by way of the torque transmitting joint 53 and output shaft 52. At the same time, the power train including

the gears 48, 47, 46 with helical teeth drives the input shaft 44 for the driver disk 43. The disk 43 causes the bearing 42 to oscillate the fork 39 of the universal joint 38 about the axis of shaft 34. The shaft 34 shares such oscillatory movement because it is rigid with the motion transmitting pins 41 which are rotatable in the prongs 39a of the fork 39 and oscillates the carrier 31 which in turn moves the tubes 26 and 27 back and forth in and counter to the direction of lengthwise movement of the cigarette rod 19 (arrow 19A). When the disk 43 rotates, the anti-friction bearing 42 causes the stub 39A to orbit about the axis of the input shaft 44 at a speed which is proportional to the speed of lengthwise movement of the cigarette rod 19. The carrier 31 oscillates in a plane which includes the axis of the cigarette rod 19. When the anti-friction bearing 42 reaches its upper dead center position, the carrier 31 maintains the tubes 26 and 27 in a left-hand end position, as viewed in FIG. 1 or 2. Such end position of the tubes 26 and 27 is shown in FIG. 2. When the anti-friction bearing 42 reaches its lower dead center position, the tubes 26 and 27 assume their right-hand end positions. The arrangement is such that the tubes 26 and 27 travel with and at the exact speed of the cigarette rod 19 when the knife 25 approaches, passes through and moves beyond the gap between the bores 28 of the tubes 26 and 27. These tubes act as a counterknife for the knife 25 and cooperate therewith to insure the formation of clean cuts each of which is located in a plane that is normal to the axis of the cigarette rod 19. During travel through the gap between the tubes 26 and 27, the knife 25 not only orbits about the output shaft 52 but also moves sideways in the same direction and at the exact speed of lengthwise movement of the cigarette rod 19. The surfaces surrounding the bores 28 in the tubes 26 and 27 support the wrapper of the cigarette rod 19 during severing. Due to its movement about the axis of the shaft 34 while the knife 25 severs the rod 19, the carrier 31 insures that the angular positions of the tubes 26 and 27 change substantially in the same way as the angular position of the knife 25 which orbits about the output shaft 52 and simultaneously swivels with this shaft and the spherical inner member 59 of the torque transmitting joint 53 relative to the outer member 54.

It has been found that the interposition of the Hooke's joint 38 between the shafts 34 and 44 of the drive means for the guide assembly 22 results in a substantial reduction of noise. A further reduction of noise is attributed to the fact that the input shaft 49 of the drive means for the knife 25 is parallel to the input shaft 44 of the drive means for the guide assembly 22; this renders it possible to connect the shafts 44 and 49 by a power train which employs simple spur gears. Such gears produce less noise than other types of power trains.

The inclination of the axis of the output shaft 52 relative to the axis of the rod 19 is about 7 degrees. Such inclination is necessary in order to insure that the knife 25 will move in the direction indicated by the arrow 19A during travel in the gap between the tubes 26, 27 of the guide assembly 22. In presently known severing apparatus, the slightly inclined shaft which carries the housing for the knife is driven by a set of bevel gears. It has been found that the Rzeppa joint 53 constitutes a superior substitute for such bevel gears because it creates much less noise. Additional reduction of noise is achieved by utilizing a carrier whose arm or arms

consist of sheets of light metal. Such light metal arms replace leaf springs which are used in conventional severing apparatus. Since the planes of the arms 32, 33 are preferably located in parallel planes which are normal to the axis of the shaft 34, these arms encounter minimal resistance to oscillation and thus create minimal turbulence in the surrounding air. This also contributes to a reduction of noise.

The power train including the gears 46-48 can be modified by replacing the gear 47 with a toothed belt trained over the gears 46, 48.

FIG. 6 illustrates a modified severing apparatus 121 wherein all such parts which are identical with or clearly analogous to the corresponding parts of the severing apparatus 21 are denoted by similar reference characters plus 100. The only difference between the apparatus 21 and 121 is that the apparatus 121 comprises a different mechanism for oscillating the carrier 131 and the tubes 126, 127 of the guide assembly 122 about the axis of the shaft 134. The oscillating mechanism for the carrier 131 is an eccentric drive 166 having a motion-transmitting fork 172 one end of which is rigid with the shaft 134 and the other end of which is bifurcated to receive an antifriction bearing 169 surrounding an eccentric pin 171 of a driver disk 168 rotated by an input shaft 167 corresponding to the input shaft 44 of FIG. 2 but being parallel to the shaft 134. The input shaft 149 of the drive for the knife 125 can rotate the input shaft 167 of the drive for the guide assembly 122 through the intermediary of a power train including a spur gear 147 shown in the upper portion of FIG. 6 and additional gears which preferably include a pair of bevel gears because the axis of the input shaft 149 is normal to the axis of the input shaft 167. The eccentric drive 166 serves to convert the rotary movement of the input shaft 167 into oscillatory movement of the carrier 131 and guide assembly 122. The shaft 134 is rigid with the lower end portions of the arms 132, 133 of the carrier 131. These arms preferably consist of light metal.

The operation of the severing apparatus 121 is as follows:

The input shaft 167 is driven by the power train including the gear 148 and rotates the driver disk 168. This causes the eccentric pin 171 and the antifriction bearing 169 to oscillate the motion transmitting fork 172 with the shaft 134 which turns in the bearings 136, 137 and oscillates the carrier 131 together with the tubes 126 and 127 of the guide assembly 122. The cigarette rod 119 passes through the axial bores 128 of the tubes 126, 127 and is severed in the same way as described in connection with FIGS. 2 to 5.

An important advantage of the improved severing apparatus is that the oscillatory movements of the carriers 31 and 131 create very little noise and also that the inertia of oscillating parts is extremely small. This is attributed to the lightweight construction of the oscillating parts which include the aforementioned arms 32, 33 and 132, 133. The reduced inertia of oscillating parts reduces the wear so that the elements of the severing apparatus have much longer useful life than the corresponding elements of conventional severing apparatus. The reduction of noise is especially pronounced in the presently preferred embodiment of FIGS. 2 and 3 because the antifriction bearing 42 is recessed into the driver disk 43 and also because the parts of the uni-

versal joint 33 need not reverse the direction of their movement.

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. Apparatus for severing a rod wherein a fibrous filler is surrounded by a tubular wrapper of paper or the like, comprising conveyor means for advancing a rod lengthwise in a predetermined direction and at a predetermined speed along a first path; at least one knife; first drive means for moving said knife along an endless second path a portion of which intersects said first path and for moving said knife in said direction and at said speed during travel along said portion of said second path; a guide assembly at least partially surrounding the rod in said first path in the region of said portion of said second path; and second drive means for moving said guide assembly back and forth in and counter to said direction so that said guide assembly moves in said direction and at said speed during travel of said knife along said portion of said second path, comprising bearing means, carrier means including a member turnably mounted in said bearing means and arm means extending from said member and supporting said guide assembly and oscillating means for turning said member back and forth in said bearing means and including a motion transmitting portion connected with said member in immediate proximity of said bearing means.

2. Apparatus as defined in claim 1, wherein said bearing means includes at least one fixed bearing and said guide assembly is rigid with said carrier means.

3. Apparatus as defined in claim 1, wherein the axis of said member is normal to and crosses in space with said first path.

4. Apparatus as defined in claim 1, wherein said arm means oscillates in a predetermined plane in response to turning of said member in said bearing means and wherein said motion transmitting portion of said oscillating means shares the movements of said member in said bearing means.

5. Apparatus as defined in claim 4, wherein said motion transmitting portion extends substantially or radially from said member.

6. Apparatus as defined in claim 1, wherein said oscillating means further includes a rotary driver element and means for converting the rotary movement of said driver element into oscillatory movement of said motion transmitting portion.

7. Apparatus as defined in claim 1, wherein said first drive means comprises a first rotary input element and said second drive means further comprises a second rotary input element and a power train connecting said first input element to said second input element, the axis of said second input element being normal to the axis of said first input element.

8. Apparatus as defined in claim 1, wherein said oscillating means comprises an eccentric drive including said motion transmitting portion.

9. Apparatus as defined in claim 1, wherein said oscillating means comprises a universal joint including said motion transmitting portion.

10. Apparatus as defined in claim 9, wherein said universal joint is a Hooke's joint.

11. Apparatus as defined in claim 9, wherein said first drive means comprises a rotary input element and said second drive means further comprises a second rotary input element for said joint and a power train connecting said input elements, the axis of said second input element being parallel to the axis of said first input element.

12. Apparatus as defined in claim 1, wherein said arm means comprises at least one light metal plate, said arm means being oscillatable by said member in a predeter-

mined plane which includes the plane of said light metal plate.

13. Apparatus as defined in claim 12, wherein said arm means comprises a plurality of parallel light metal plates.

14. Apparatus as defined in claim 1, wherein said first drive means comprises a rotary input element, a rotary output element, a housing connected with said output element and supporting said knife, and a torque transmitting joint articulately connecting said input element with said output element.

15. Apparatus as defined in claim 14, wherein said joint is a Rzeppa joint.

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