United States Patent [19]
Braun et al.
[11] 3,802,073
[45] Apr. 9, 1974

[54] DRYSHAVER CONSTRUCTION AND OPERATION

[75] Inventors: **Arthur Braun**, Konigstein/Ts.; **Friedrich Schreiber**, Bad Homburg, both of Germany

[73] Assignee: **Braun Aktiengesellschaft**, Frankfurt/Main, Germany

[22] Filed: **Sept. 13, 1971**

[21] Appl. No.: **179,968**

[30] **Foreign Application Priority Data**

Sept. 14, 1970 Luxembourg 61683

[52] **U.S. Cl.** **30/43.92**, 30/42
[51] **Int. Cl.** **B26b 19/02**
[58] **Field of Search** 30/43.1, 43.91, 43.92, 30/42, 44, 45, 216, 218, 219; 74/40

[56] **References Cited**

UNITED STATES PATENTS

1,806,116 5/1931 Peterson 30/216
2,822,610 2/1958 Kleinman .... 30/43.92 X
3,521,093 7/1970 Harms .... 30/43.92 X

FOREIGN PATENTS OR APPLICATIONS

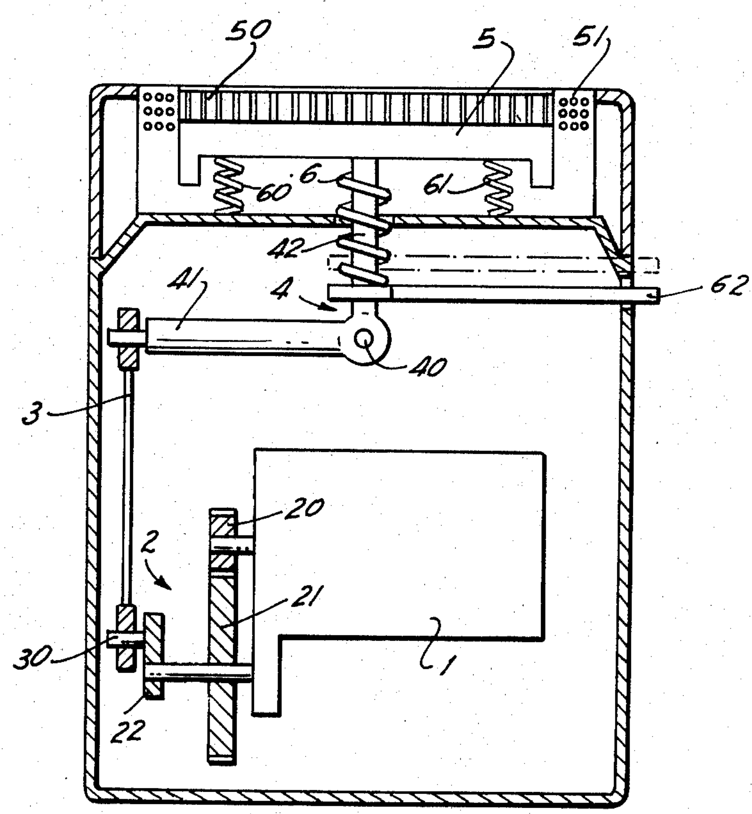
276,797 7/1951 Switzerland 30/44

Primary Examiner—Othell M. Simpson
Assistant Examiner—Gary L. Smith
Attorney, Agent, or Firm—Michael S. Striker

[57] **ABSTRACT**

An electrically driven dryshaver has a shear system composed of an outer shear element and an inner shear element which cooperates with the outer shear element and at least one of these elements is driven for movement with reference to the other. Biasing arrangements bias the shear elements into abutment with a force in excess of 4 kg/cm^2.

9 Claims, 3 Drawing Figures



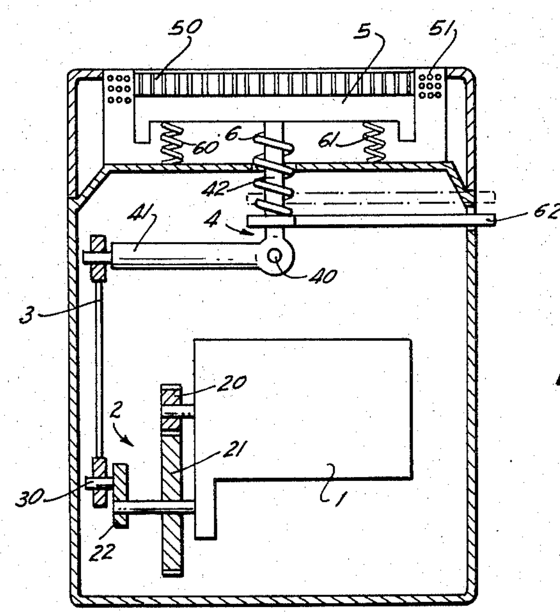

50
5
51
60
6
61
42
41
4
62
40
3
20
2
21
30
1
22

FIG. 1

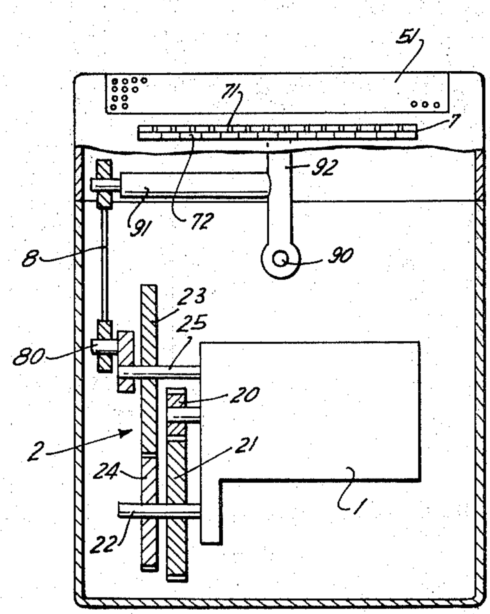

51
71
7
92
91
72
8
90
23
25
80
20
2
21
24
1
22

FIG. 2

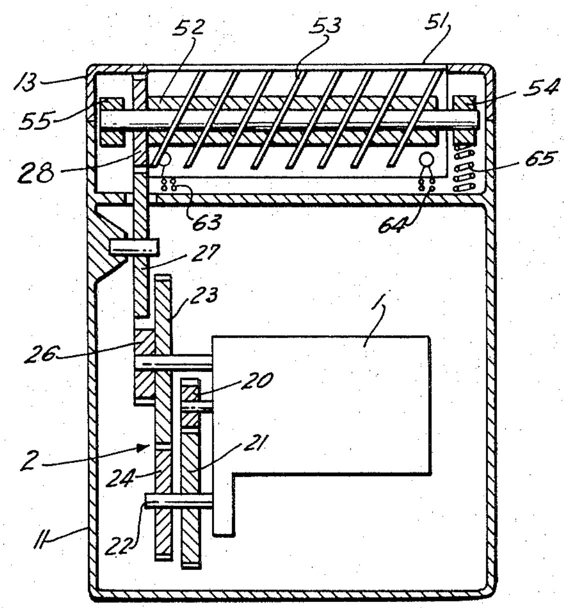


FIG. 3

DRYSHAVER CONSTRUCTION AND OPERATION

BACKGROUND OF THE INVENTION

The present invention relates generally to dryshavers, and more particularly to electrically driven dryshavers. Still more particularly the invention relates to a novel dryshaver construction and to a method of operating a novel dryshaver construction.

Generally speaking, electrically operated dryshavers utilize an outer shear foil which is apertured and which is usually arcuately curved, and an inner shear element which presses against the inner side of the outer shear foil and is moved with reference thereto, either linearly or in rotation. The inner element usually is in form of a block or member provided with a plurality of cutting edges which are in contact with the inner side of the shear foil, with the block being pressed against the inner side of the shear foil and being linearly reciprocated. Another construction utilizes a more or less cylindrical or part-cylindrical element which is turnably or pivotally mounted in the housing of the shaver and pressed against the semi-cylindrically curved shear foil. Either rotational motors or oscillating-armature motors are utilized.

Of course, there is a constant endeavor on the part of industry to improve the shaving effectiveness of such dryshavers. Generally speaking, all such improvements have three basic purposes, namely to improve the quality and quantity of the shear or shaving operation, to make the power requirements as low as possible, and to make the vibration and noise resulting from operation of the dryshaver as insignificant as possible.

Evidently, to increase the quality and quantity of the shear effectiveness means that the beard stubble should be cut off as rapidly as possible, as close to the skin as possible and with the minimum possible skin irritation. Attempts to provide improvements in this respect heretofore were seen in various changes as to the size and configuration of the apertures in the outer shear foil, usually a highly flexible thin foil of metallic material, as well as by improving the cutting edges bounding these apertures and the cutting edges on the cutting element itself. In fact, it is generally assumed that the maximum improvement which can be achieved in this respect has now been obtained with the present state of the art, and that further improvements—at least of any significance—cannot be achieved in this respect, that is by further changing the aforementioned considerations.

The other problem, namely to make the power requirements as small as possible, particularly important when the dryshaver is battery-operated so that it can operate for relatively long periods of time, and also important in dryshavers which are to be operated off the net and in which undesired heating of the device is to be avoided, has largely been achieved by proper selection of the motors and drives which are used.

Improvements have also been forthcoming in suppressing vibration and noise during the operation of the dryshavers, but particularly where the motor is of the oscillating-armature type these improvements are not yet very significant so that the problem cannot yet be considered solved.

Attempts have been made in the prior art to improve the shear effectiveness of a dryshaver further by utilizing a motor having several operational stages, that is a motor which can be operated at different numbers of cycles per unit of time. It was thought that a higher number of rotations, or a higher frequency of operation, would provide for a generally improved shaving effectiveness. Such apparatus are known in which motors can be adjusted between 6,000 and 12,000 RPM, with 8,000 RPM being utilized for readily irritated sensitive skin, 10,000 RPM for normal shaving, and 12,000 RPM for strong and/or heavy beards. However, despite all attempts at providing an improvement in this respect it was found in the final analysis that no actual improvement was achieved thereby.

It was therefore determined that any further improvements in shear effectiveness would have to come from improvements in the shear system itself. One of the basic considerations in constructing such a shear system is, of course, that the inner and outer elements be in good contact or abutment. In the so-called comb-type shear systems this was achieved in that both cooperating shear elements were ground to configurations and tolerances which assured tight engagement. In the so-called circular-head dryshavers, that is the type originated by Norelco, the shear foil is essentially of planar configuration and relatively rigid, and a plurality of cutter blades are located at the inner side of the shear foil and are pressed by springs against the latter when the cutter element of the shear system is rotated. This abutment of the cutter blades against the outer shear foil is simpler than other constructions because these cutting blades have sharpened edges, which is not usually the case in other types of constructions. Thus, in the Norelco-type dryshaver the beard stubble is cut off, whereas in other dryshavers they are sheared or punched off because the cutting edges are usually only in form of a relatively sharp right-angular edge which cooperates with the edge bounding the respective aperture in the shear foil to sever the beard stubble.

Any improvements which had been attempted heretofore in the type of construction in which specific sharpened cutter blades are not utilized, that is in the type other than the Norelco-type, were heretofore only seen in attempting to provide proper biasing pressure in order to maintain the two elements of the shear system in good abutment with one another. A variety of approaches has been attempted in this respect, and the forces with which the two elements of the shear systems in different constructions are pressed against one another, vary widely, but, as extensive tests have shown, are all of such magnitude that they do not assure proper and continuous contact of the elements of the shear system during operation.

The cause of this is that a high biasing pressure would at the same time require a stronger motor, and this in turn would require more power. This, at least, is the conviction which has heretofore been held in the industry and it was also believed that as a result of the greater pressure with which the elements of the shear system are biased against one another, the shear system would become excessively warm or hot if the elements were to be pressed against one another by a force stronger than that required to bring them into good contact when the device is in the rest position, that is when the system is not in movement.

It has been determined that the known dryshavers of the type here under discussion have a specific contact pressure of the two shear elements or components of the shear system with reference to one another, of approximately 1–2 kg/cm^2. The Norelco-type dryshavers have a contact pressure of just slightly below 1 kg/cm^2. The apertured-foil dryshavers (as opposed to the first-mentioned ones, which utilize the properly ground upper and lower shear elements) have been found to have a specific contact pressure which may vary between 2 and 4 kg/cm^2. It was believed that if these values were exceeded to any appreciable extent, so many disadvantages would have to be accepted that the total effectiveness of the apparatus would decrease significantly.

SUMMARY OF THE INVENTION

It is, accordingly, an object of the present invention to overcome the aforementioned disadvantages of the prior art.

More particularly it is an object of the present invention to provide an improved electrically driven dryshaver which provides substantial improvements over what is known from the prior art.

Another object of the invention is to provide a method of operating an electrically driven dryshaver.

With these objects in view, and others which will become apparent hereafter, one feature of the invention resides in an electrically driven dryshaver, having a shear system which comprises an outer shear element, an inner shear element for cutting off beard stubble in cooperation with the outer shear element, with at least one of these elements being driven for movement with reference to the other, and biasing means which biases the shear elements into abutment with one another with a force in excess of 4 kg/cm^2.

It has been found, quite surprisingly, that the shear effectiveness of a dryshaver can actually be increased by increasing the contact pressure with which the shear elements of the shear system are pressed against one another. This is an approach which is contradictory to all beliefs heretofore held by the industry and which was entirely unpredictable. Although values in excess of at least 4 kg/cm^2 are already capable of affording such improvements, values of 7 kg/cm^2 already provide substantially improved effectiveness and it is currently believed that the optimum increase in effectiveness is obtained at a value of 10 kg/cm^2. However, it has been determined that it is possible to utilize values on the order of between 15 and 20 kg/cm^2.

If the contact pressure is increased with reference to what is known in the art by not more than 50 percent, then it is not necessary to provide additional means to make the dryshaver, particularly of the apertured-foil type, properly operational because the motors used in such constructions until now are entirely capable to overcome the resistance resulting from the increased contact pressure. Of course, there will be a noticeable increase in the heating of the shear system and the motor will require more power; however, the improved shear effectiveness of the dryshaver overcomes these considerations and compensates for them.

However, if the optimum improvement is to be achieved, then it is necessary to provide additional means to obtain proper operation. Thus, it is possible according to the invention to correspondingly decrease the number of rotations of the drive motor per unit of time, or the frequency thereof, so that the same drive motor can be utilized but will yield a higher torque. In case of rotary motors this can be achieved by interposing between the motor and the driven component of the shear system a step-down drive or gear. If the motor is of the oscillating-armature type, a polarized oscillating-armature motor can be used to obtain the increased output. True, both measures require an increased expense, and of course a step-down drive will itself require some additional power. However, what appears initially to be disadvantageous has been found to actually provide advantages which were entirely surprising and not to be expected.

Thus, when the driven—usually the inner—shear element moves slower than heretofore, it will not become significantly heated despite the increased contact pressure. The lower power requirement of the motor—despite the provision of a step-down drive—prevents the heating of the motor and substantially increases the period fow which a battery-operated dryshaver can be utilized with the charge of the battery. In fact, it has been found that a single set of batteries or a single charge of a rechargeable battery permits the use of a battery-operated dryshaver without changing batteries or recharging for periods of time which heretofore could not be achieved except in overly large-dimensioned shavers.

Also, when the driven shear foil component moves slower than heretofore, better and deeper entrance of the beard stubble through the apertures of the apertured shear foil is achieved, because there is more time available for such entry than in the more rapidly operating devices, meaning that they can be cut off much more closely to the skin than was the case heretofore.

It is thus clear that each of the aforementioned two features—namely increasing the contact pressure and operating the shear system at lower speed than heretofore—provides substantial advantages. By combining them, however, a complete range of advantages is achieved which are entirely surprising and completely unexpected. Not only will a dryshaver constructed along these lines provide a better shave and have a much lesser tendency to irritate the skin, but it will be subject to substantially less wear and less heating of all components involved, it will require less power, it will be quieter and it will be subject to fewer vibrations. All of these are features which heretofore could not be realized or, if they were indeed realized, could be achieved only at substantial additional expense.

It is preferred to use motors having between substantially 2,000 and 2,500 RPM, although these are not binding values. If the motor is of the polarized oscillating-armature type, an operating frequency of substantially 3,000–3,600 cycles is advantageous, meaning that the driven shear component will move between 3,000 and 3,600 times over the juxtaposed surface of the stationary shear system component.

The invention is suitable with all currently known types of dryshaver, but it is especially advantageous when used with the type of dryshaver having an apertured shear foil because in this type of construction there is more of a tendency for the shear foil components to move out of engagement with one another and such movement will result in a more marked deterioration of the shear effectiveness than in other types.

The invention also contemplates to make the pressure at which the shear foil components are pressed against one another variable. For instance, an additional spring can be provided which can be used to add to or subtract from the contact pressure as desired.

Also, the pretension of the spring or springs can be varied to obtain such a change in the contact pressure.

If a dryshaver is provided with a separate long-hair trimmer, that is in addition to the main cutter which is a cutter for the beard stubble, then it is customary in the art to drive the movable component of the long-hair trimmer with the same frequency as the movable component of the shear system, that is at high freuquency. The present invention, however, suggests that the movable component of such a long-hair trimmer be driven at a lower frequency, by interposing an additional step-down drive. It has been found particularly advantageous if the movable component of the long-hair trimmer is driven at a frequency of less than 1,000 up to approximately 1,500.

It has been found that if the trimmer for long hair is driven in this slower manner, the shear effectiveness which it obtains is a multiple of that achieved with the conventional constructions of the prior art. The rapidly driven long-hair trimmer hardly affords time for the long hair to enter into the openings in which it is to be cut, whereas the openings are exposed for relatively long periods of time with the slower-driven long-hair trimmer so that the hair can enter properly into the openings and then be cut off.

Of course, the long-hair trimmer according to the present invention can also be subjected to the increased contact pressure mentioned before, so that long hair can also be cut much more effectively than heretofore. Also, the lower force requirements for operating such a long-hair trimmer make it possible to include it for the first time economically and reasonably in battery-operated dryshavers, where heretofore the utilization of long-hair trimmers resulted in a substantial and rapid draining of the battery charge.

The novel features which are considered as characteristic for the invetion are set forth in particular in the appended claims. The invention itself, however, both as to its construction and its method of operation, together with additional objects and advantages thereof, will be best understood from the following description of specific embodiments when read in connection with the accompanying drawing.

BRIEF DESCRIPTION OF THE DRAWING

FIG. 1 is a somewhat diagrammatic section illustrating a shear-foil type dryshaver with a linearly reciprocable movable shear component;

FIG. 2 is a view similar to FIG. 1 illustrating a dryshaver having a long-hair trimmer; and

FIG. 3 is a view similar to FIG. 1 but illustrating a dryshaver of the shear-foil type with a turnably mounted cutting component of the shear system.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

Discussing firstly the embodiment in FIG. 1, it will be seen that reference numeral 1 identifies an electromotor which may be of any known type utilized heretofore in the art. Reference numeral 2 identifies a step-down drive which is composed of a gear 20 and a gear 21 in the illustrated embodiment, it being understood that such a step-down drive could also be composed of more than two components. The step-down drive acts via a shaft 22 on the eccentric 30 of a rod 3 which in turn acts upon an arm 41 of the angular lever 4 which is journalled at 40. The other arm 42 of the lever 4 engages in known manner the movable cutting member 5, that is the movable component of the shear system, which is composed of a plurality of blade portions 50 whose free circumferential edges are approximately of semi-circular contour. The stationary component of the shear system is an apertured shear foil 51 which is connected rigidly or movably to the housing so that it surrounds these portions 50 approximately semi-cylindrically.

According to the present invention there are provided springs 6, 60 and 61 which press the member 5 against the inner side of this outer shear component, namely the outer shear foil 51, so that the two are in constant good contact with one another. The contact pressure achieved by the springs 6, 60 and 61 should be at least 5 kg/cm^2, and preferably no more than approximately 15 kg/cm^2. Actually, the springs 60 and 61 can be made to supply this contact pressure by themselves, and the spring 6—which in the illustrated position does not provide contact pressure—can be moved by the lever 62 to another position (see the other position of the lever 62) in which it adds its own pressure to the contact pressure supplied by the springs 60 and 61.

Of course, the entire contact pressure can be supplied by a single spring, and the spring characteristic of such a member could be varied, for instance via a lever such as the lever 62, so that depending upon its length it will supply a contact pressure ranging between substantially 5 and 15 kg/cm^2.

In the embodiment of FIG. 2 it will be seen that the illustrated drive additionally has a long-hair trimmer 7 composed of the components 71 and 72 which, as pointed out above, may also contact one another with the increased contact pressure according to the present invention. In this embodiment the step-down drive 2 comprises an additional pair of gears 23 and 24, and the eccentric 80 is connected via shaft 25 with the rod 8, which in turn is connected with the arm 91 of a lever which is journalled at 90. The other arm 92 of the lever is connected with the movable component 72 of the long-hair trimmer 7. As pointed out earlier, it is found to be particularly advantageous if the movable component 72 is driven at a frequency of below 1,000 up to approximately 1,500.

In FIG. 3, finally, there is illustrated a somewhat modified embodiment analogous to that of FIG. 1, in which the inner movable shear system component is constructed as a rotary element 52. It has inclined blades 53, but in place of these it would also be possible to provide helical or axially parallel straight blades and cutting edges, which themselves are known per se.

In this embodiment springs 63 and 64 are provided which draw the shear foil 51 over the member 52, in order to obtain the necessary contact pressure between them. However, the springs could also be connected with the journals 54 and 55 of the member 52 in order to press the latter with the required contact pressure against the inner side of the shear foil 51, and this is illustrated by way of example with respect to the journal 54 and the spring 65. Again, combinations of the arrangements of the springs 63, 64 and 65 can also be provided. The contact pressure, which again should be at least 5 kg/cm^2, and preferably, no more than approximately 15 kg/cm^2, is obtained by appropriate dimensioning of the springs or spring combinations.

Here, also, the motor 1 drives the member 52 via the modified step-down drive 2, and the gears 26, 27 and

28 in order to reduce the RPM of the motor to the desired lower RPM which are to be imparted to the member 52.

In the embodiment of FIG. 3, as in the embodiments of FIGS. 1 and 2, the entire drive is accommodated in a lower housing portion 11, whereas the shear system or head is covered by a frame 13.

It will be understood that each of the elements described above, or two or more together, may also find a useful application in other types of constructions differing from the types described above.

While the invention has been illustrated and described as embodied in an electrically driven dryshaver, it is not intended to be limited to the details shown, since various modifications and structural changes may be made without departing in any way from the spirit of the present invention.

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 that from the standpoint of prior art fairly constitute essential characteristics of the generic or specific aspects of this invention and, therefore, such adaptations should and are intended to be comprehended within the meaning and range of equivalence of the following claims.

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

1. In an electrically driven dryshaver, a shear system comprising an outer shear element, and an inner shear element for cutting beard stubble in cooperation with said outer shear element; biasing means biasing said shear elements into abutment with one another at a contact pressure between substantially 4 and 20 kg/cm^2; and means for moving said shear elements relative to one another while said shear elements are in abutment at said contact pressure, said moving means including an electric motor, and a step-down gear train connected with said motor and one of said shear elements and being always operative for converting the rotation of said motor into at most about 2,500 movements per minute of said one shear element relative to the other shear element when said motor is activated.

2. In a dryshaver as defined in claim **1**, wherein said biasing means biases said elements into abutment with a pressure in excess of 7 kg/cm^2.

3. In a dryshaver as defined in claim **1**, wherein said biasing means biases said elements into abutment with a pressure of 10 kg/cm^2.

4. In a dryshaver as defined in claim **1**, wherein said biasing means biases said elements into abutment with a pressure in excess of 15 kg/cm^2 but smaller than 20 kg/cm^2.

5. In a dryshaver as defined in claim **1**; and further comprising control means for varying said pressure at the will of an operator.

6. In a dryshaver as defined in claim **1**, said biasing means comprising a plurality of springs and further comprising control means for adjusting the pretension of at least one of said springs to thereby vary said biasing force.

7. In a dryshaver as defined in claim **1**, said biasing means comprising a plurality of biasing springs acting upon and pressing one of said elements into abutment with the other; at least one additional spring; and control means for selectively adding the pressure exerted by said additional spring to said biasing force.

8. In a dryshaver as defined in claim **1**, said outer shear element being a perforate shear foil, and said inner shear element being a cutter block having a plurality of cutting edges in abutment with one side of said shear foil, said inner shear element being mounted for linear reciprocatory movement with reference to said outer shear element; and wherein said biasing means comprises biasing springs.

9. In a dryshaver as defined in claim **1**, said outer shear element being a perforate shear foil and said inner shear element being a movably mounted cutter member provided with a cutting edge in abutment with one side of said shear foil; and wherein said biasing means comprises biasing springs.

* * * * *