EUROPEAN QUALIFYING EXAMINATION 1997

PAPER A
ELECTRICITY / MECHANICS

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INSTRUCTIONS TO CANDIDATES

You are to assume that you have received the annexed letter from your client including a descrip an invention for which he wishes you to obtain a European patent together with references to the pertinent prior art known to your client.

You should accept the facts given in the paper and base your answers upon such facts. Whether and to what extent these facts are used is your responsibility.

You should not use any special knowledge you may have of the subject-matter of the invention, but are to assume that the prior art given is in fact exhaustive.

Your task is to draft an independent claim (or claims) offering the applicant the broadest protection possible while at the same time having a good chance of succeeding before the EPO. In drafting your claim(s) you should bear in mind the need for inventive step over the prior art indicated, the requirements of the Convention, in particular as to the form of claims, and the recommendations made in the Guidelines for Examination in the EPO. Dependent claims should also be drafted so as to enable you to fall back upon them should the independent claim(s) fail and should be kept to a reasonable number.

You are also expected to draft an introduction, i.e. that part of the description which precedes the examples or the explanation of the drawings. The introduction should be sufficient to provide support for the independent claim(s), for example, by referring to selected portions of your claims. In particular, you should consider the advisability of mentioning advantages of the invention in the introduction.

You are expected to draft claims and an introduction for one European patent application only. This application should meet the requirements of the Convention as to unity. If you would in practise seek to protect further inventions by filing one or more separate applications, you should, in a note, clearly identify the subject-matter of the independent claim of such separate application(s). However, it is not necessary to draft the wording of the independent claim for the or each separate application.

In addition to your chosen solution, you may - but this is not mandatory - give, in a note, the reasons for your choice of solution, for example, why you selected a particular form of claim, a particular feature for an independent claim, a particular piece of prior art as starting point or why you rejected or preferred some piece of prior art. Any such note should however be brief.

It is assumed that you have studied the examination paper in the language in which you have given your answer. If this is not so, please indicate on the front page of your answer in which language you have studied the examination paper. This always applies to candidates who - after having filed such a request when enrolling for the examination - give their answer in a language other than German, English or French.

CLIENT'S LETTER

Our firm manufactures dry shavers and, in particular, those having a cutter with a reciprocating movement and driven by a rotary single-phase synchronous motor.

The cutter has a plurality of cutter blades which reciprocate immediately behind a shear foil having openings therethrough, through which hairs to be shaved off extend so as to be cut by the cutter blades.

Single phase synchronous motors are widely used in such domestic appliances owing to their low cost and practically frictionless operation, owing to the absence of brushes in contact with the rotor of the motor. These motors rotate at a constant speed which corresponds to the ac mains frequency. In order to achieve a satisfactory cutting action with the above defined dry shaver, it is necessary that the reciprocating cutter has a sufficiently high speed of movement with respect to the openings in the shear foil. In view of the size of the appliance, a high movement speed of the reciprocating cutter can only be obtained by means of high frequency movement of the cutter. The speed of rotation of single phase synchronous motors is too low to achieve the necessary cutting action with high frequency movement of the cutter when the rotation of the motor is directly converted into a reciprocating movement by means of a simple crank. Higher speed motors are too bulky and expensive for use in such appliances and it is therefore necessary to ensure that the frequency of movement of the cutter is higher than the frequency of rotation of the single phase synchronous motor.

One such dry shaver, which we have successfully sold world-wide for a number of years, is described in the attached Document I. Feedback from our customers has, however, revealed that this appliance is considered to be somewhat noisy, which can be irritating to both the user and members of his family when shaving in the early morning. This noise originates from the meshing gear wheels (numbered 7 and 9 on the enclosed drawings) which are required to achieve the necessary speed of movement of the cutter. We have therefore developed a quieter shaver which produces a sufficient speed of movement of the cutter without the use of gear wheels and which we describe below.

We hope that this device is patentable, and we ask you to prepare a European patent applicatio

In the accompanying drawings:-

Fig. 1 is a plan view of a first embodiment of the drive mechanism of a dry shaver in accordance with the invention;

Fig. 2 is a plan view of a second embodiment of the drive mechanism of a dry shaver in accordance with the invention;

Figs. 2a and 2b show a cam and part of a cam follower forming part of the embodiment of Fig. 2 in different positions; and

Figs. 3 and 4 show alternative embodiments of the cam of the drive mechanism of Fig. 2.

Fig. 1 shows the drive mechanism mounted on a wall 1 forming part of the housing of the shaver. The remainder of the housing is not shown for the sake of clarity. The drive mechanism is driven by a synchronous motor 2 which comprises a permanent magnet rotor 3 rotatably mounted in an air gap 4 between two pole pieces 5. An exciter coil 6 is mounted on each pole piece and the pole pieces are connected by a stator iron 7.

A drive shaft 8 projects from the rotor 3 out of the plane of the drawing. The drive shaft 8 carries a substantially elliptical cam 9 having a circumferential surface 10. A cam follower 11 is pivotably mounted about a pivot 16 and comprises a lever having first and second arms 14 and 15 rigidly connected to each other, and a wheel 12 which is journalled in a bearing 13 on the first arm 14. By virtue of the shape of the elliptical cam, that is, a cam having two lobes, the cam follower makes two excursions with each rotation of the cam. The cam follower thus oscillates at twice the frequency of rotation of the rotor 3.

The wheel 12 is provided with an elastic ring or tyre 26 and is biassed into contact with the cam surface 10 by means of a compression spring 17. Optionally, the elastic ring or tyre may be omitted. The

initial force of the spring 17 is adjustable by means of a set screw 18. This enables the desired force to be set in the factory prior to shipping of the completed appliance. The desired force will depend on the frequency of the ac mains supply in the country in which the appliance is to be used, a higher frequency and thus a higher rotational speed of the motor necessitating a higher spring force in order to retain the cam follower 11 in contact with the cam 9.

The axis 19 of the spring 17 extends essentially through the axes of the wheel 12 and the rotor 3 and perpendicularly to the line 20 connecting the pivot 16 and the bearing 13.

The free end of the second arm 15 is provided with a driving member 21 which engages with a gripping member 22 of a cutter 23. Guide means 24 restrain the cutter 23 to reciprocating movement in the direction indicated by arrow 25.

Thus, as the cam 9 is rotated by the motor 2, the cam follower 11 undergoes a reciprocating movement which is transmitted to the cutter which reciprocates in the direction indicated by the arrow 25 at twice the frequency of rotation of the rotor.

Reference is now made to Fig. 2. The features of the embodiment of Fig. 2 which are identical to the corresponding features of the embodiment of Fig. 1 are allocated the same reference numerals and will not be further described in detail. In the embodiment of Fig. 2 it is not necessary to exert force on a wheel by means of a spring in order to maintain it in contact with the cam surface.

The cam follower 41 differs from that of the embodiment of Fig. 1 in that it has first, second and third arms 42, 43 and 44 rigidly connected to each other, first and third arms 42 and 44 each having a wheel 45 and 46 rotatably mounted thereon. Each wheel is provided with an elastic ring or tyre 26 in contact with the cam surface 10. As illustrated in Figs. 2a and 2b, both wheels remain constantly in contact with the cam surface 10. Figure 2 illustrates the centre position of the cam follower 41, in which the wheels 45,46 are symmetrically disposed on each side of the long axis of the cam 9. Fig. 2a shows the wheel 46 in contact with the portion of the cam having the greatest diameter and the wheel 45 in contact with the portion of the cam having the smallest diameter. In this position, the cam follower drives the cutter 23 to its extreme leftmost position as indicated by the orientation of the second arm 43.

Fig. 2b shows the wheel 45 in contact with the portion of the cam having the greatest diameter, wheel 46 in contact with the portion of the cam having the smallest diameter. In this position, the follower drives the cutter 23 to its extreme rightmost position as indicated by the orientation of the second arm 43. The geometry of the mechanism is such that each wheel in each position of the cam prevents the other wheel from losing contact with the cam surface.

As an alternative to the provision of elastic rings or tyres 26, one or both of the first and third arms 42,44 may be elastic. As a further alternative, the bearings of one or both of the wheels may be elastically mounted on the respective arm.

In the embodiment of Fig. 3, the elliptical cam of Figs. 1 and 2 is replaced by a substantially triangular cam 59 having a cam surface 60, that is, a cam having three lobes. The use of such a cam means that the cutter reciprocates in the direction of the arrow 25 at three times the frequency of rotation of the rotor. As in the case of the elliptical cam, the geometry of the mechanism is such that each wheel in each position of the cam prevents the other wheel from losing contact with the cam surface.

In the embodiment of Fig. 4, a substantially square cam 69 having a cam surface 70 is used, that is, a cam having four lobes. Thus, the cutter reciprocates at four times the frequency of rotation of the rotor. As in the case of the other cams, the geometry of the mechanism is such that each wheel in each position of the cam prevents the other wheel from losing contact with the cam surface.

It is thus possible to attain various frequency multiplications merely by the selection of the appropriate cam.

List of reference numerals used

1 wall
2 motor
3 rotor
4 air gap
5 pole pieces
6 exciter coils
7 stator iron
8 drive shaft
9 elliptical cam
10 elliptical cam surface
11 cam follower
12 wheel
13 bearing
14 first arm
15 second arm
16 pivot
17 compression spring
18 set screw
19 spring axis
20 centre line of arm
21 driving member
22 gripping member
23 cutter
24 guide means
25 arrow
26 elastic ring or tyre

41 cam follower
42 first arm
43 second arm
44 third arm
45 first wheel
46 second wheel

59 substantially triangular cam
60 substantially triangular cam surface

69 substantially square cam
70 substantially square cam surface

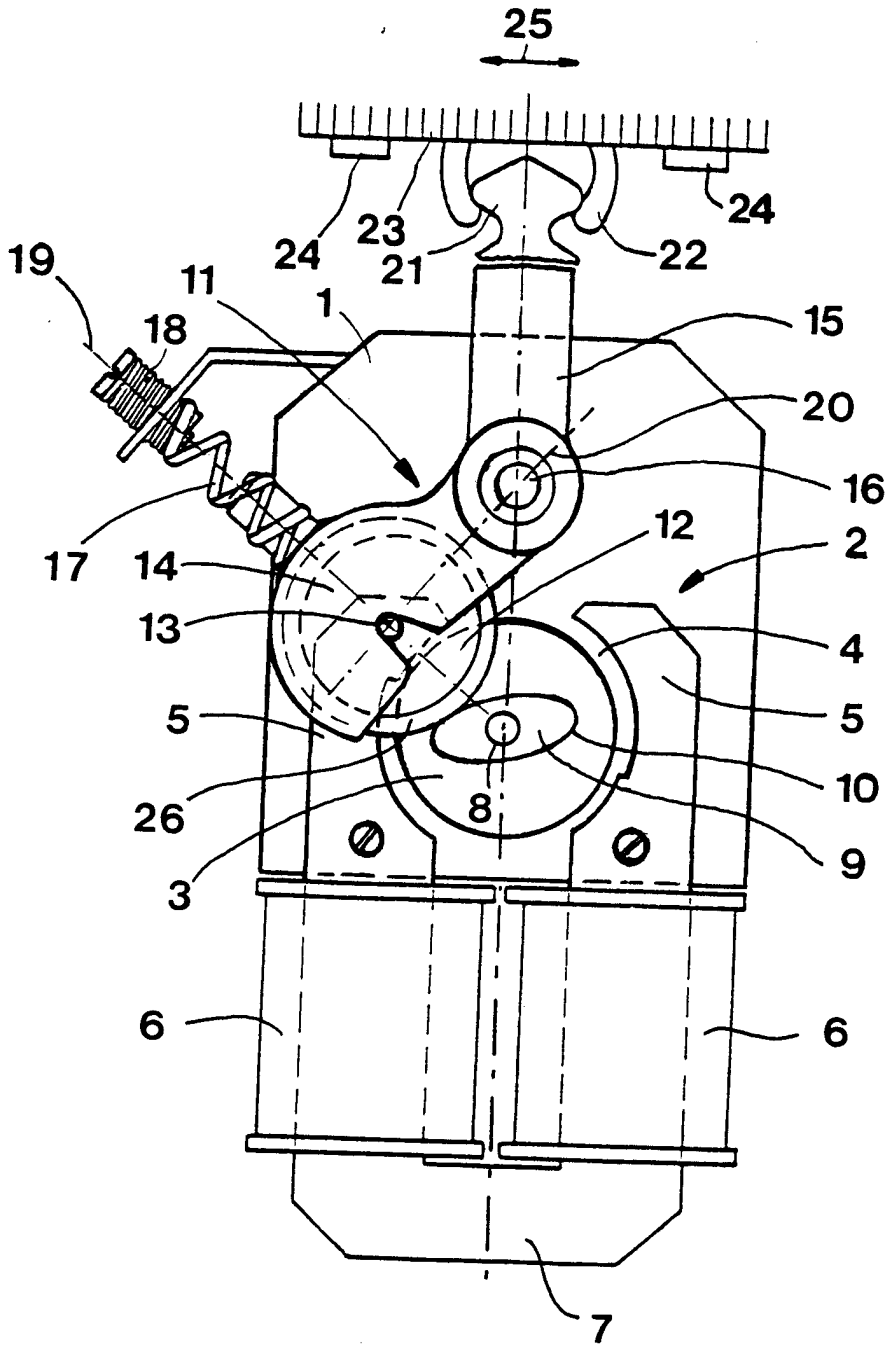

Fig. 1

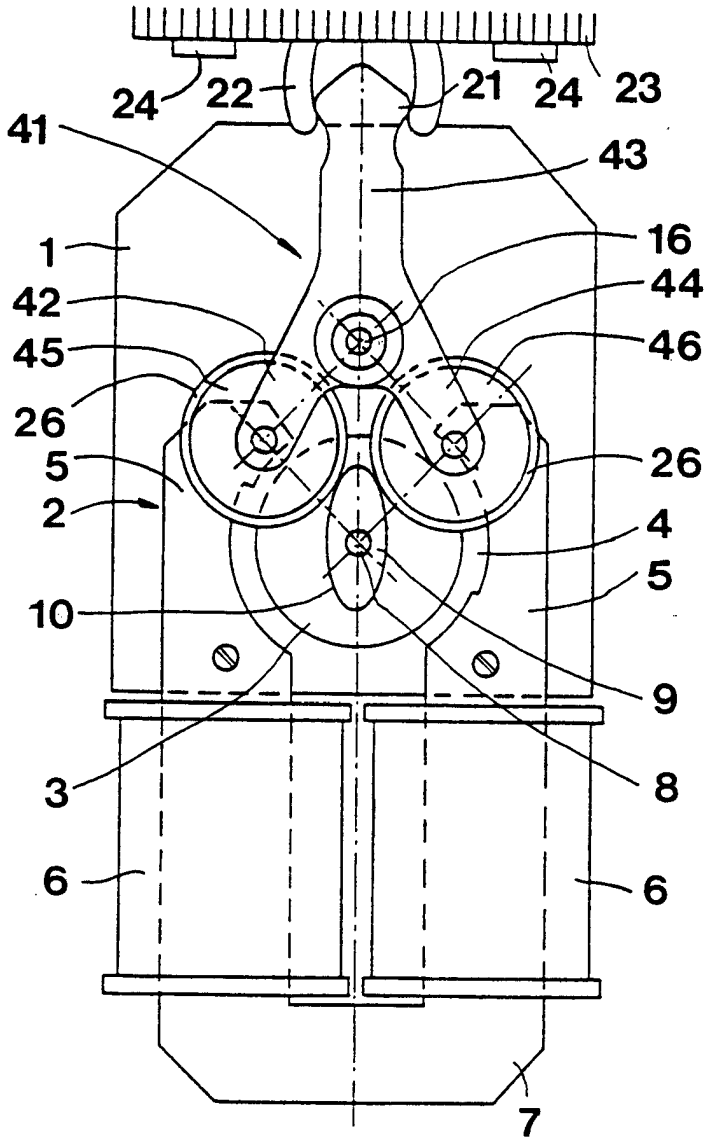

Fig. 2

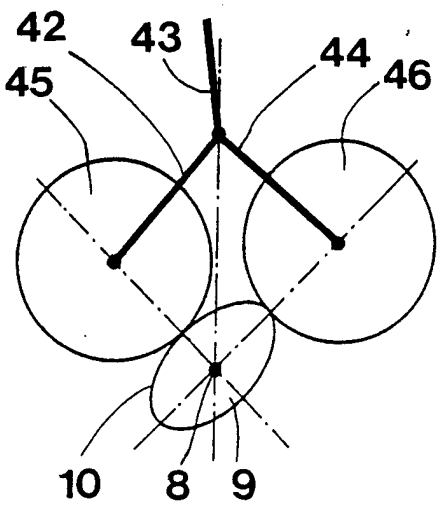

Fig. 2a

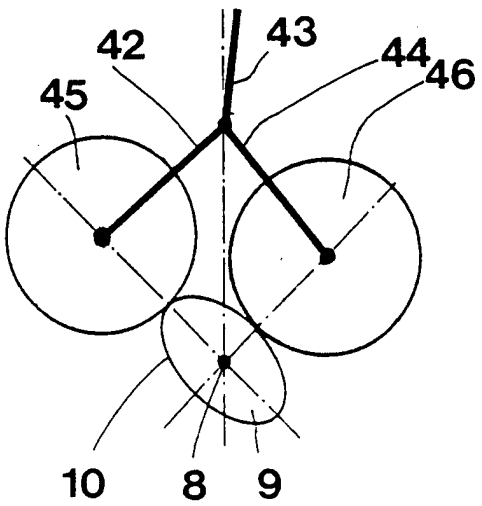

Fig. 2b

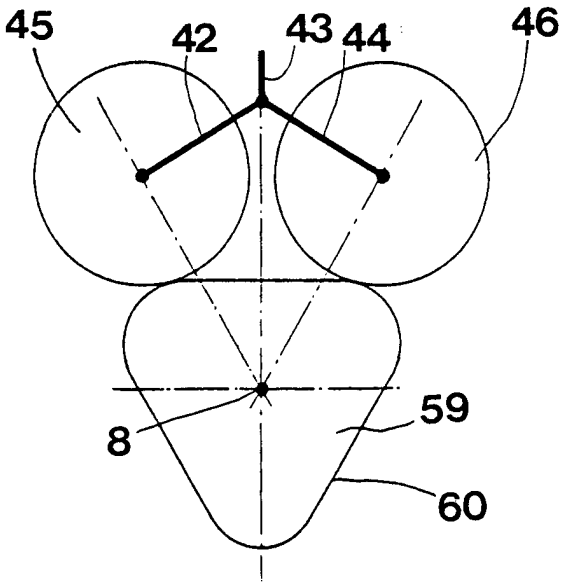

Fig. 3

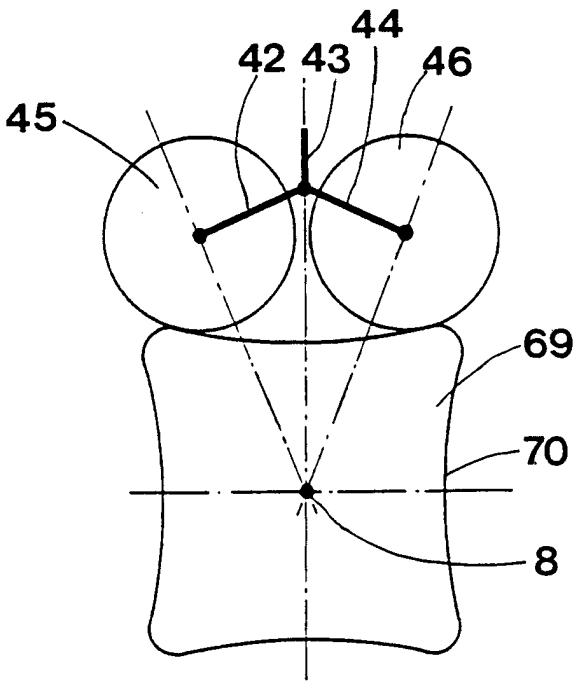

Fig. 4

DOCUMENT I (State of the Art)

The invention relates to a dry shaving apparatus for connection to an ac mains source.

Such dry shavers are generally powered by a single phase synchronous motor. The motor comprises a rotor in the form of a permanent magnet and a stator in the form of a U-shaped ferrous core having two pole pieces, one on each side of the rotor and separated therefrom by an air gap. Each pole piece is provided with a coil fed with single phase ac mains current, which has a frequency of 50 Hz in Europe and 60 Hz in the United States. The continuous reversal of the direction of current flow causes the rotor to rotate at the ac frequency, since it requires one positive and one negative half wave to cause a 360° turn of the permanent magnet rotor. Thus, at 50 Hz, the motor will run at 50 revolutions per second. The constant speed makes the provision of a speed regulator unnecessary.

Such single phase synchronous motors are comparatively cheap, but have a long working life, in view of the fact that it is not necessary to supply any current to the rotor, so there is no necessity for the provision of brushes or other contacts which cause friction and wear over time. A disadvantage of such motors is that the motor speed is not fast enough to reciprocate the cutter element of a dry shaver sufficiently quickly.

The present invention overcomes this problem by the provision of a drive mechanism utilising such a single phase synchronous motor, but which is capable of reciprocating a cutter element at whatever speed is desired. The ac mains frequency varies from country to country, and the present invention permits a simple modification of the drive mechanism to select the desired reciprocation speed.

In the single Figure of the accompanying drawing, there is shown a plan view of a dry shaving apparatus according to the invention with a part of the housing removed.

A synchronous motor 1 comprises a permanent magnet rotor 2 rotatably mounted in an air gap 3 between two pole pieces 4. An exciter coil 5 is mounted on each pole piece and the pole pieces are connected by a stator iron 6. The exciter coils are connected to a socket 24 to enable them to be

connected to an ac mains source. The motor drives a first gear wheel 7 by means of a drive
The first gear wheel 7 meshes with a second gear wheel 9, which is rotatably mounted on the housi
by means of a spindle 11. A first lever 12 is pivotably connected to the second gear wheel 9 by mean
of a pin 13 eccentrically mounted on the second gear wheel 9. A second lever 14 is connected to the first
lever 12 by means of a hinge 15 and is pivotably mounted to the housing 10 by means of a bearing 16.

The free end of the second lever 14 is connected to a cutter element 17 by means of a ball 18 provided on the free end of the second lever, which is received in a sleeve 19 forming part of the cutter element 17. The cutter element 17 is mounted on the housing 10 by means of springs 20 which extend between the cutter element and blocks 21 formed on the housing, which permits the cutter element to reciprocate between two extreme positions. A stainless steel foil 22 (shown partly removed) is positioned over the cutter element and mounted in a shaving head 23 detachably mounted on the housing 10.

By the selection of gear wheels 7 and 9 having an appropriate gear ratio, the speed of rotation of the second gear wheel, and hence the rate of reciprocation of the cutter element, can be varied. For use in countries with a 50 Hz mains source, it is necessary to at least double the speed of rotation of the first gear wheel 7, so that the second gear wheel 9 should have at most half the number of teeth of the first gear wheel 7.

DRAWING OF DOCUMENT 1 (State of the Art)