# United States Patent

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## [54] METAL PLATE HAVING STABILIZED FRICTION PROPERTIES


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**Related U.S. Application Data**

[63] Continuation of Ser. No. 647,659, June 21, 1967, abandoned.

[52] **U.S. Cl.**.....**30/346.54**, 29/191.2, 30/346.51, 30/346.53

[51] **Int. Cl.**.....**B26b 21/54**

[58] **Field of Search**.....29/191.2; 30/346.51, 346.53, 30/346.54; 117/71



[56] **References Cited**

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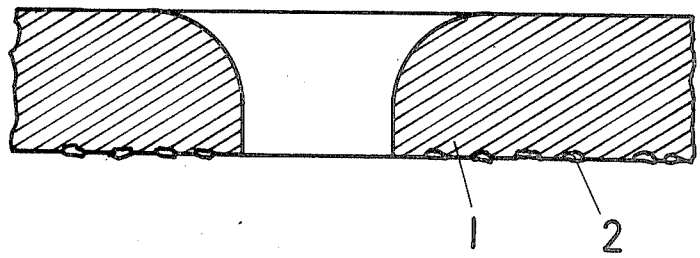
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[57] **ABSTRACT**

A shearing foil for a razor constituted by a metal plate having a surface which is in slidable contact with the surface of another foil, and microscopically small solid particles embedded in the plate at least at the contact surface.


**12 Claims, 2 Drawing Figures**



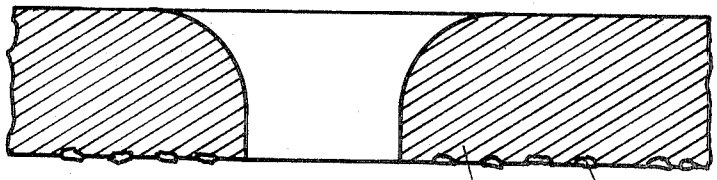



FIG. 1

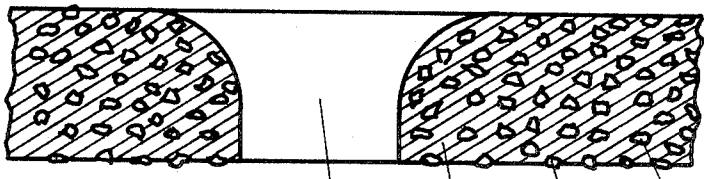



FIG. 2

# METAL PLATE HAVING STABILIZED FRICTION PROPERTIES

This is a continuation of application Ser. No. 647,659, filed June 21, 1967, and now abandoned.

The invention relates to a metal plate having stabilized friction properties and in particular to a perforated cutting plate, cutting foil or a shearing knife or a shearing foil for cutting tools, for example for electric razors.

Electric dry razors generally comprise a stationary cutting plate or cutting foil and a rotating or reciprocating shearing head, shearing knife or shearing foil. These parts are generally as hard and as smooth as possible to prevent wear phenomena and to provide the cutting edges with a long working life. A close contact between the cutting members is of great importance for a good razor effect.

It has been found, however, that after a short period of operation binding or adhesive effects occur between the cutting members which are in sliding contact, particularly if the film of lubricant between the cutting members is broken down by external influences, for example by perspiration on the skin. This results in the cutting members which are in sliding contact becoming very warm on account of the increased level of friction, the speed of cutting being reduced, the power consumption rising and wear increasing. This also results in the shearing effect being worsened.

In the course of the research upon which the invention is based, it has surprisingly been found that it is not desirable to make the surface of the cutting foil as smooth as possible. This results in too close a contact between the sliding surfaces, probably because of adhesive or molecular forces. This phenomenon finally leads to roughened surfaces which have an increased coefficient of friction.

It is an object of the invention to provide a metal plate or metal foil which has a low uniform degree of friction over prolonged periods of service.

It is a further object of the invention to provide an improved perforated cutting plate for electric razors which has a long working life and requires low operating power.

Still another object is the provision of a metal foil or metal plate having embedded microscopically small solid particles in the surface area which is used as the sliding surface. These solid particles should have a diameter of less than about 1/100 mm. A suitable favorable particle size is 1/1,000 mm. Yet another object of the invention is the provision of an improved metal plate or metal foil which has embedded throughout, microscopically small solid particles with a particle size of about 1/1,000 mm.

The small particles may comprise a solid lubricant, perhaps molybdenum sulphide. It has appeared, however, that with hard or extremely hard and wear-resistant particles, for example of boron carbide, aluminum oxide, silicon carbide, as are used for abrasive and polishing media, the intended effect of stabilizing the friction properties is obtained, too, In particular the last named substances stabilize the friction properties over a long period, i.e., prevent a rise in the coefficient of friction with increasing length of operation. A further object of the invention is the provision of an improved sliding bearing which may be operated without any fluid lubricant.

The phenomenon that particles of various materials lead to reducing and stabilizing the coefficient of friction seems to point to the fact that it merely depends on providing discontinuities at the sliding surfaces, and that the intimate contact is likely to occur only on these embedded small particles.

These and other objects of the invention will become apparent from the following description in connection with the accompanying drawings, in which:

FIG. 1 is a cross-sectional view through a shearing foil of an electric dry razor with microscopically small particles embedded in a surface of the foil;

FIG. 2 is a cross-sectional view corresponding to FIG. 1 and showing a shearing foil according to the invention in which the microscopically small particles are uniformly distributed throughout the material of the foil.



FIG. 1 shows a portion of a shearing foil 1 for a dry razor, which foil is perforated to form shearing apertures 4. In the bottom surface of foil 1, which surface is in sliding contact with another shearing element (not shown in the drawings) microscopically small particles of aluminum oxide are embedded. The gauge of the metal foil 1 is about 1/10 mm. while the embedded particles 2 have an average grain size of less than 1/100 mm., preferably 1/1,000 mm. FIG. 2 shows a cross section corresponding to FIG. 1 of another embodiment of a metal foil according to the invention in which microscopically small particles of aluminum oxide are uniformly distributed throughout the material of the foil. Embedding the small particles in the foil material can be of advantage if the sliding surface of the foil is exposed to abrasion, as new particles are always present on the surface and thus maintain a constant coefficient of friction.

The microscopically small particles may be embedded in the surface or throughout the body of the metal plate by any known process. A preferred process comprises manufacturing the metal plate galvanoplastically while adding the microscopically small particles to the galvanizing bath. Alternatively, the particles may be embedded during production of rolled stock, while the metal is melted or while it is rolled to form a plate.

When using the metal foil according to the invention as a perforated external shearing foil or as a perforated internal shearing foil for a shearing head of a dry razor, the base metal of the foil may be nickel. Both the stationary external shearing foil and the moving internal shearing foil or shearing head may be provided with microscopically small particles in their sliding surfaces.

In general, the metal plates and metal foils according to the invention are useful where metal elements perform a sliding movement, for example in optical shutters and choppers and in sliding bearings. However, the invention is not limited to these applications.

The term metal plate or metal foil is intended to comprise such parts which are smooth only over a certain region of the surface which is in frictional contact with another sliding part. The metal plates or foils need not be plain but may have a configuration which is adapted for sliding movement with a different element of complementary surface configuration.

We claim:

1. A shearing foil for electric shavers which have a moving cutting member, said foil comprising a substrate body having perforations, said body having microscopically small particles of a solid having a maximum grain size of 1/100 mm. embedded in at least the surface of the shearing foil which is in frictional contact with the moving cutting member.

2. The shearing foil of claim 1, wherein the microscopic particles are abrasive particles.

3. The shearing foil of claim 1, wherein the microscopic particles are polishing material particles.

4. The shearing foil of claim 1, wherein the microscopic particles are constituted of different substances.

5. The shearing foil of claim 1, wherein the microscopic particles are solid lubricant particles.

6. The shearing foil of claim 1, wherein the microscopic particles are embedded uniformly in the body of the shearing foil.

7. In a pair of shearing foils for electric shavers having a stationary external shearing foil and a moving internal shearing foil, at least one of said shearing foils comprising a substrate body having perforations, said body having microscopically small particles of a solid having a maximum grain size of 1/100 mm. embedded in at least the surface of the said one shearing foil which is in frictional contact with the other of said shearing foils.

8. The pair of shearing foils of claim 7, wherein the microscopic particles are abrasive particles.

9. The pair of shearing foils of claim 7, wherein the microscopic particles are polishing material particles.

10. The pair of shearing foils of claim 7, wherein the microscopic particles are constituted of different substances.

11. The pair of shearing foils of claim 7, wherein the microscopic particles are solid lubricant particles.

12. The pair of shearing foils of claim 7, wherein the microscopic particles are embedded uniformly in the body of the shearing foil.

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