United States Patent

Nidetzky

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[54] PERFORATED SHEAR-PLATE FOR DRY SHAVERS

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[52] **U.S. Cl.** **148/12.4,** 30/346.51, 76/104, 148/39

[51] **Int. Cl.** **C21d 9/00,** B26b 19/04

[58] **Field of Search** 148/2, 12.4, 12.1, 39; 76/104; 30/346.51

[56] **References Cited**

UNITED STATES PATENTS

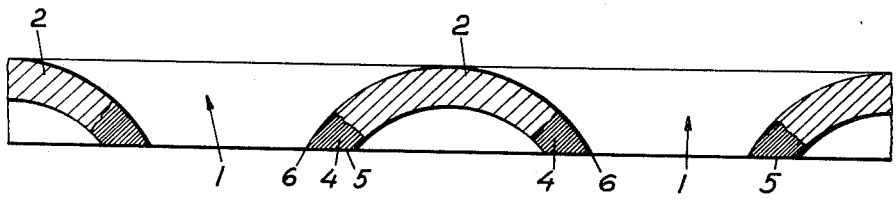
2,300,397	11/1942	Abrams	30/346.51
2,346,489	4/1944	Horrer	30/346.51
3,064,349	11/1962	Fütterer et al.	30/346.51
3,169,317	2/1965	Fütterer et al.	30/346.51
3,409,984	11/1968	Fütterer	30/346.51

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[57] **ABSTRACT**

This invention provides a perforated shear-plate for dry shavers, made of a soft, hardenable steel foil and comprising bridges which form a network between the holes and which have edges forming the rims of the holes, the edges being flanged and ground and the material in the region of the edges having a sub-microscopic, extremely hard martensitic structure containing residual austenite. A process for manufacturing such shear-plates comprises stamping holes into a ribbon of soft, hardenable steel foil containing more than 0.5 percent carbon, flanging and then grinding the edges of the holes with simultaneous pulse heating of the material in the region of the flanged edges up to an austenite forming temperature, and abruptly cooling the ground flanged edges.

3 Claims, 2 Drawing Figures



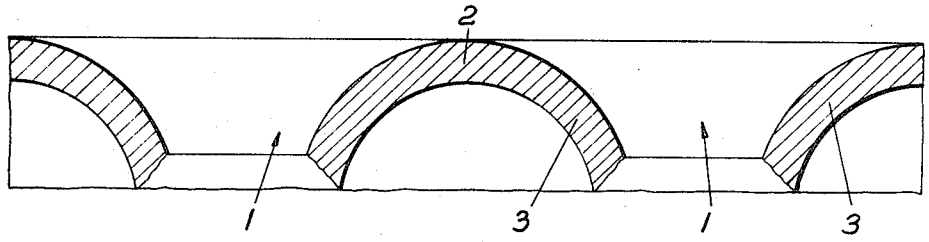


Fig. 1

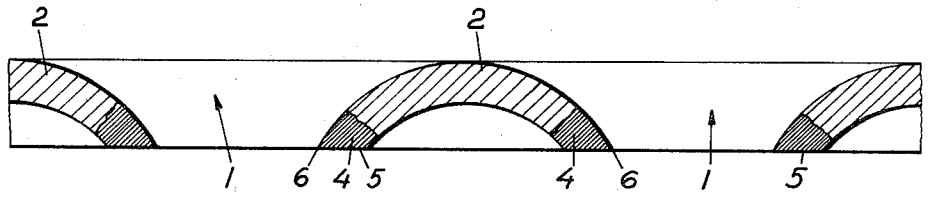


Fig. 2

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PERFORATED SHEAR-PLATE FOR DRY SHAVERS

This invention relates to shear-plates made of steel foil for dry shavers. These plates are perforated and the bridges which form a network between the holes have edges, forming the rims of the holes, which are flanged and ground. The invention also relates to a process for manufacturing shear-plates of this kind, in which the holes are stamped in a ribbon of steel foil, the rims of the holes are upset or flanged, and the resulting flange is then ground.

The known shear-plates of this kind have a hardness all over which is the same as that of the raw material from which they are made, and consequently the cutting edges of the holes, after the grinding operation, have the same hardness as the bridges between the holes. The hardness of a shear-plate of this kind has an upper limit, mainly for the following two reasons. The first reason is because the shear-plate must have a certain flexibility, that is to say it must not be too hard, in order to satisfy the operating conditions. The second reason is because the process of stamping the holes and upsetting their rims runs into difficulties if the raw material is too hard, particularly if the holes are close together, that is to say if the most favorable ratio is to be obtained between the area of the bridges and the area of the holes, to give the best shaving effect.

For these reasons attempts have been made to begin by making the shear-plates out of a comparatively soft steel, the stamped and ground shear-plate then being hardened as a whole. But although this method would overcome the stamping difficulties, since the metal being stamped is a soft steel, it has not been found possible to use this method in practice because the shear-plate always becomes distorted during the hardening process.

It is also known in the galvanoplastic manufacture of shear-plates to produce, by changing the composition of the bath, a comparatively hard surface layer on a foil base, the surface layer extending as far as the rims of the holes. In contrast to this however the present invention relates to shear-plates manufactured from hardenable steel foil.

According to the invention, in a shear-plate of the kind described, the foil material itself consists substantially of a soft but hardenable steel, whereas there is a region around the flanged and ground rims of the holes in which the crystalline structure of the steel consists of a sub-microscopic, extremely hard martensite with some residual sustenite. Due to the nature of the raw material, the shear-plate has relatively soft and flexible bridges but very hard rims around the holes, that is to say the cutting edges of the holes, after flanging and grinding, are extremely hard. The shear-plate is therefore quite flexible as a whole but has hard cutting edges of high quality. The distribution of the holes can be arranged as desired, because no difficulties are encountered in the stamping operation.

Shear-plates in accordance with the invention can be made in various ways, for example by taking advantage of the known process for surface hardening of hardenable steels described in the Austrian Pat. Specification No. 242,725. This known process consists essentially in that the part of the surface which is to be hardened is first of all extremely rapidly heated and then immediately very rapidly quenched, so that a surface layer is obtained which at room temperature has a metastable austenitic structure which is then converted, by an externally applied influence, for example by means of a mechanical shock, into a fine grained, hard martensite structure.

Making shear-plates in accordance with this process involves starting out from a soft, hardenable steel foil, which can be worked without difficulty. Holes are first stamped into the foil, the rims of the holes are then flanged and the rims ground down. At this time the shear-plate has cutting edges, but still consists as a whole of soft steel. In a second operation the flanged and ground rims of the holes are given cutting edges consisting of sub-microscopic extremely hard martensite containing residual austenite. This is done by briefly heating the cutting edges with a plasma burner up to a temperature at which austenite is formed, this being followed by a rapid cooling. The result is a very hard cutting edge on the flanged and ground rims of the holes, whereas the remainder of the shear-plate still retains the characteristics of the initial material.

A particularly favorable method of manufacturing shear-plates in accordance with the invention comprises stamping holes into a ribbon of hardenable, soft steel foil containing more than 0.5 percent carbon, the rims of the holes being flanged and then ground while simultaneously pulse heating the material in the region of the rims up to austenite forming temperature, followed by a rapid cooling.

What is obtained in this way is that the main part of the shear-plate is made of a soft steel, whereas the rims of the holes are hardened near their cutting edges, producing extremely hard cutting edges. The shear-plate as a whole is still very flexible, but the cutting edges, which are precisely manufactured, show a very high degree of hardness. The holes can be spaced as closely as desired, so that the bridges between the holes are very narrow. The process is extremely simple, because the grinding of the flanged hole rims, to form the cutting edges, can be combined in one operation with the hardening process.

The hardening properties of the soft steel raw material can be chosen within wide limits, depending on the characteristics desired in the shear-plate. For example the starting material can be a hardenable steel containing exclusively a ferrite structure, or alternatively there can be used a steel whose structure is mainly a hard martensite. A particularly favorable material has been found to be a soft foil steel annealed to have a hardness of at least 450 kp/mm.^{2} Vickers hardness.

This raw material allows the foil to be stamped and the holes to be flanged without the least difficulty, any shape of hole and distribution of holes being obtainable.

An example of a shear-plate in accordance with the invention and a method of producing the plate will now be described with reference to the accompanying drawings, in which:

FIG. 1 is a cross section through a perforated steel foil, the holes being already flanged; and,

FIG. 2 is a cross section through the finished product, that is to say the shear-plate has been ground and hardened.

In this example the raw material is a strip of hardenable carbon steel, or alternatively may be a strip of hardenable, non-rusting martensite steel, the thickness being for example 0.05 mm. The strip of steel has previously been hardened and then preferably annealed to have between 350 and 400 kp/mm.^{2} Vickers hardness. This is a comparatively soft steel, for the stamping operation. The holes are then stamped in the steel strip. A suitable stamping process is described in British Pat. Specification No. 934,548, which has been called a rubber-tension-shearing process. This process allows the foil to be stamped and the holes flanged in the same operation. The foil is supported on a rubber base and the holes are stamped out by projections on the face of a stamping die. FIG. 1 is a cross section through a foil which has been stamped in this way, showing two neighboring holes 1 on either side of a bridge 2, which is part of a continuous bridge network. FIG. 1 shows the rims 3 of the holes already flanged. The softness of the foil material allows a free choice, within wide limits, of the shape of the hole and the number of holes per square unit of surface. The deformation of the material presents no difficulties. In particular, it is possible to make shear-plates in this way which have very narrow bridges 2, whilst still giving the rims of the holes sufficient height, for example 0.1 mm.

After the stamping operation, the foil is ground and simultaneously hardened. An important point to observe here is that the heat must be supplied to the material in the form of a pulse, and the material must be brought up to the temperature at which austenite is formed. A further important point is that the material must be cooled abruptly. The heat is transferred into the main body of the material. By this method whereby the heat is supplied in the form of pulses, the present invention differs fundamentally from the known processes using frictional abrasion, which have only a limited hardening effect

produced by the practically continuous development of heat by friction. During this grinding process, in which a thickness of for example 0.04 mm. is removed, the shear-plate being brought down to a desired final thickness of for example 0.06 mm., a narrow rim zone is formed where the grinding is applied, this zone consisting of sub-microscopic, extremely hard martensite containing residual austenite, an extremely hard material. The rim zones, formed by grinding the flanged rims of the holes, are shown at **4** in FIG. **2**, and form the cutting surfaces **5** and the cutting edges **6** of the shear-plate. A shear-plate made in this way has excellent cutting characteristics but is nevertheless very flexible and not in the least brittle, because the main body of the foil material still consists of soft steel. It is important to ensure that the shear-plate as a whole is flexible so that it can accommodate itself to the curved surface of the cutter block.

This manufacturing process is capable of producing shear-plates having cutting edges of hardnesses exceeding 1,000 kp/mm.^{2}, which are hardness values quite unattainable by the usual hardening processes for steel. It has also been found that the cutting edges produced in this way are very tough and resistant to abrasion. They do not tend to break away. The working life of a shear plate manufactured by this method is exceptionally long. These favorable results derive in particular from the fact that just behind the hardened edge zones there are formed thin layers of a hardness less than that of the initial raw material. The tensile strength and the flexibility of the shear-plate can be established within wide limits by choosing a suitable initial steel. The thin layer of hardened material near the cutting edges of the holes has little influence on the characteristics of the shear-plate as a whole. The cutting edges produced in this way have the highest degree of hardness obtainable in steel, even exceeding the hardness of cutting edges of hard chrome steel.

The thickness of the hardened edge zone in the present example is preferably approximately **0.04** mm. This thickness depends not only on the characteristics of the initial steel, but also on the rapidity with which material is removed in the grinding process. It has been found preferable to use steels containing more than 0.5 percent carbon, and preferably approximately 1 percent carbon.

The removal of material, with simultaneous pulse heating, followed by abrupt cooling, to obtain the hardening effect, is preferably performed as follows. A strip of foil which has been stamped to produce several shear-plates, for example 12 shear-plates, is mounted on a massive metal drum, with the flanges of the holes facing outwards. The drum is rotated slowly and the shear-plates are thrust against the surface of a disc of high-speed steel, which is rotating rapidly. The pressure between the shear-plate and the rapidly rotating disc determines the rate of removal of material from the shear-plate, and also determines the abrupt development of heat where the surface is being ground. The temperature must be high enough to produce austenite, that is to say approximately 900° C. As soon as the high temperature has been reached, the heat is rapidly removed by the mass of the slowly rotating drum, against which the shear-plate must lie as flush as possible. The strip of foil is finally separated into individual shear-plates.

The process can of course be modified in various ways without leaving the scope of the invention. For example the initial foil material can if desired be cold rolled, non-hardened steel. The stamping and flanging of the holes can be separate operations. The hardness of the raw material can be chosen within wide limits, so as to have the desired degree of deformability.

I claim:

1. In a perforated shear-plate for dry shavers, made of steel foil and comprising bridges which form a network and which have edges forming the rims of the holes through the shear-plate, said edges being flanged and ground, the improvement wherein the main body of said shear-plate consists substantially of a soft, hardenable steel, whereas in the region of said flanged and ground edges the material has a sub-microscopic, extremely hard martensitic structure containing residual austenite.

2. A process for manufacturing perforated shear-plates from steel foil, comprising the steps of stamping sections from a ribbon of soft, hardenable steel foil containing more than 0.5 percent carbon, to form a plurality of holes in said foil ribbon, flanging the edges of said holes, grinding said flanged edges with simultaneous pulse heating of the material in the region of said flanged edges up to an austenite forming temperature, and abruptly cooling the ground flanged edges.

3. A process as set forth in claim **2**, wherein the initial ribbon of foil is of soft steel which has been annealed to form a hardened foil with at least 450 kp/mm.^{2} Vickers hardness.

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