April 21, 1936. H. L. CLAISSE 2,038,415

MANUFACTURE OF SAFETY RAZOR BLADES

Filed April 21, 1933

Fig. 1.

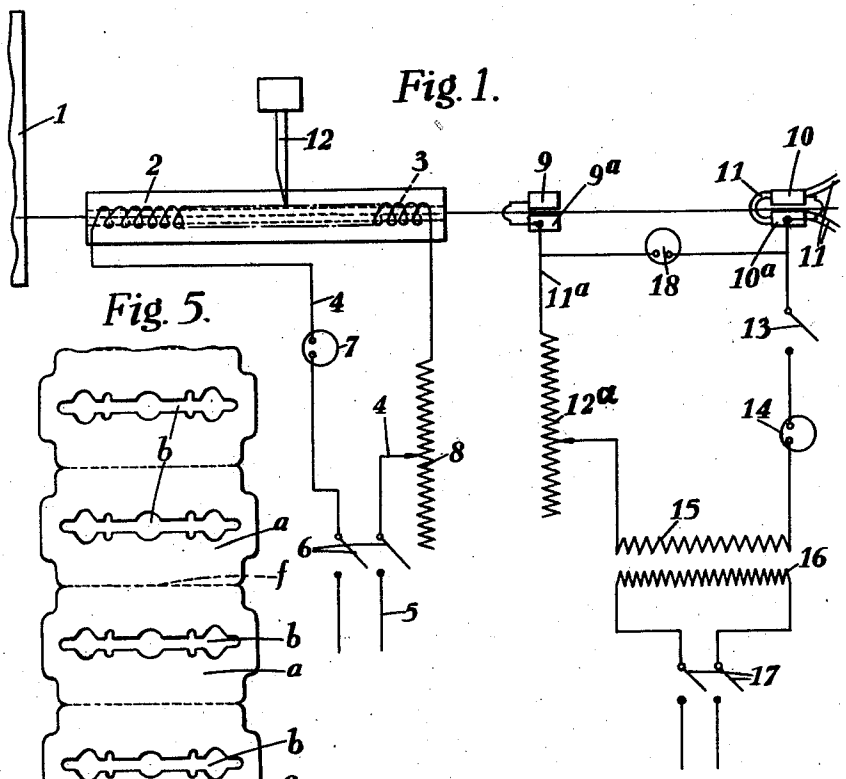



Fig. 5.




Fig. 2.

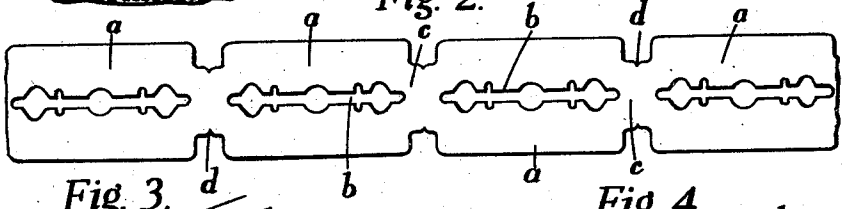



Fig. 3.

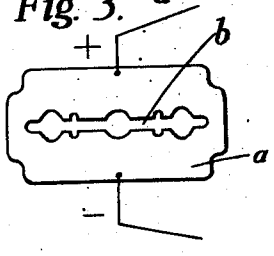
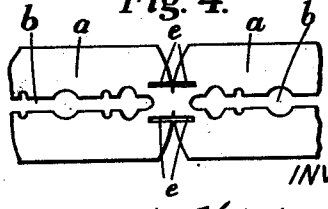



Fig. 4.




INVENTOR

Hubert L. Claisse.

BY

H. W. Conway.

ATTORNEY

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2,038,415

## MANUFACTURE OF SAFETY RAZOR BLADES

Herbert Lefevre Claisse, London, England, assignor to Gillette Safety Razor Company, Boston, Mass., a corporation of Delaware

Application April 21, 1933, Serial No. 667,208
In Great Britain May 13, 1932

9 Claims. (Cl. 148—10)

The present invention relates to the manufacture of safety razor blades of the thin flexible type having a continuous slot of substantial length, e. g., extending substantially over the whole length of the cutting edge of the blade, and having end portions which are intended to be bent transversely and maintained in a position of curvature during use, and whose medial parts are substantially softer than the cutting edges.

In one aspect the present invention consists in improvements upon the invention the subject of the copending application of Otto Roth, Serial No. 666,641, filed April 18, 1933, which issued as U. S. Patent No. 1,989,886, on Feb. 5, 1935.

In another aspect the invention comprises improvements having general application to the production of thin flexible safety razor blades of differential hardness whereby certain portions of the blade are rendered substantially softer than the cutting edges.

With known methods of producing such blades it is difficult to obtain the desirable degree of hardness of the cutting edges, if the medial area is to be sufficiently soft to permit the blade to flex without risk of fracture. Moreover such prior methods are very liable to produce distortion of blades so as to render it commercially impracticable to produce finished blades with an even cutting edge by grinding in the strip.

The object of the present invention is to facilitate obtaining differential hardening, and to enable the manufacturer to obtain more easily such differing conditions of edge and medial hardness as he may desire.

What are the optimum conditions is to some extent a matter of opinion. It has been found that a blade with an edge hardness of about 850 on the Vickers Hardness Testing Machine and a hardness of 700 or less near the medial projections gives good results in practice, but it should be observed that with these blades it is a matter of great difficulty to obtain the exact degree of hardness represented by these figures for each and every blade.

To this end use is made of the process disclosed in the aforesaid co-pending application No. 666,641, this process being characterized by the employment of an electric current in connection with a hardened blade of such configuration and proportion that there is a substantial difference between the density of the current flow in different portions of the blade, the greatest density of such flow being in the end portions where the metal should be of the lowest degree of hardness, and least density at and near the cutting edge, the heating effect at each point being proportional to $I^2 R$, where I is the density of the current flow at such point and R the resistance.

To obtain this differential density the current is applied to a blade having a medial slot of substantial length, and end portions so shaped that the breadth of metal available for the passage of the current through such end portions is substantially less than that so available in the medial portion of the blade, e. g., in the cutting edge carrying portions thereof, whereby the density of the current flow in such end portions is increased beyond that near the cutting edges.

The length of the slot, its terminal form and the restriction of the breadth of metal in the end portions has an important effect in producing the differential density of the current flow through the blade.

With a slot of substantially even breadth and the current entering and leaving at the ends of the blade the density of the current flow near the medial line of the blade will also tend to be somewhat greater than at or near the cutting edge, since the path from electrode to electrode is less near such medial line.

The process is applicable to blades of known shape, e. g., such as those shown in U. S. Letters Patent Nos. 1,869,327, 1,850,902 and 1,858,316 since the end portions of such blades possess the requisite qualities above described.

The present invention is particularly suited for continuous operation in cases where the blades are hardened, tempered and sharpened in the strip, which after the punching operation consists as shown in Fig. 2 of the drawing hereinafter referred to, of a series of blade blanks (*a*) having continuous slots (*b*), the blade blanks being joined end to end by narrower portions or necks (*c*) which are finally severed to leave equal portions thereof on adjacent blades.

The method is applicable both to cases where blades are hardened and/or tempered and/or sharpened in the strip, and where individual blades are hardened and/or tempered and/or sharpened separately.

In so far as the present invention consists in improvements upon the invention the subject of Roth's co-pending application Serial No. 666,641, filed April 18, 1933, the present process is characterized by first hardening a blade of the kind referred to and then tempering the blade by any known or approved methods to a general degree of hardness substantially corresponding to, or slightly exceeding, the edge hardness which experience shows is desirable for good shaving, but which is too high to permit the blade to be strongly flexed without considerable risk of fracturing the end areas, and then interposing the blade in an electric circuit so that the current enters and leaves at the narrower end portions.

Thus according to the present invention intermediate methods may be used in which various degrees of softening are employed prior to the electrical treatment.

The present invention further provides for sharpening the blades while still on strip form.

Owing to the fact that the end portions of the blade at which the current enters and leaves are of less cross sectional area than the main portion of the blade the current density will be substantially greater at the end areas than along the main portion of the blade, whereby such a differential tempering is obtained between the end areas and the main portion of the blade as will give the blade the characteristics hereinbefore referred to.

In order that the invention may be the more readily understood reference is hereinafter made to the accompanying drawing in which:—

Fig. 1 is a diagrammatic view of one form of apparatus for carrying out the present process, and

Fig. 2 shows part of a strip of blade blanks adapted to be treated by the process.

Fig. 3 shows diagrammatically a variant way of applying the current.

Fig. 4 shows part of a strip of blade blanks of a modified form, and

Fig. 5 shows a part of a further modified form of strip.

Referring to Fig. 1 of the accompanying drawing, the strip of blades, after being hardened and tempered by passing through a hardening apparatus **1** and then subsequently through a general tempering apparatus **2**, is caused to bridge a gap in an electric circuit, so that with a blade with a longitudinal slot the current will divide into two parts between the successive necks.

A general tempering apparatus **2** which serves well comprises a tube in which is a coil **3** in a circuit **4** which is connected to the electric mains **5** by a double pole switch **6**. In the circuit **4** is an ammeter **7** and a variable resistance **8**. An inert gas may be passed through the tube to avoid oxidation. **12** is a pyrometer.

The strip leaves this apparatus **2** with an all over even temper substantially at or slightly exceeding working edge hardness.

The strip now passes to the electrical treatment apparatus comprising spaced apart pairs of contact blocks **9**, **9***a* and **10**, **10***a*. The blocks are held to the strip by light spring pressure so that they form yielding clamp contacts. The blocks **9**, **9***a* and **10**, **10***a* are water cooled, a part of the water cooling system being indicated by **11**. The water in the blocks **9**, **9***a* is preferably insulated from the contacts. This water cooling of the blocks prevents heat from the centre of the strip spreading over the blocks and thus being transmitted to the edge of the strip.

The blocks **9**, **9***a* and **10**, **10***a* are units in an open circuit **11***a*, having therein a variable resistance **12***a*, a single pole switch **13**, an ammeter **14**, and the secondary winding **15** of a transformer, the primary winding **16** being connected to the mains by a double pole switch **17**. **18** is a voltmeter connected across the circuit **11**. The circuit **11** is closed by that part of the strip which for the time being bridges the gap between the contact blocks **9**, **9***a* and **10**, **10***a*.

To avoid or minimize oxidation during the differential heating it is convenient to arrange for the part of the strip under treatment to be surrounded by an inert gas.

A working example of voltage and amperage for a strip in which the blades are proportioned as shown each blade being about 43 mm. long is 4½ volts, 60 amps, with 12 blades between the contacts, the speed of strip going through being 145 blades a minute.

The strength of the current is so chosen with respect to the rate of feed of the strip, and the distance the contacts are spaced apart, that in the time that the blade is subject to the heating effect of the current the necks are softened the desired amount, without reducing or substantially reducing the edge hardness of the strip. In other words, the hardening and tempering of the blades may be carried out with all desired accuracy in separate operations and then the end-softening operation may be separately carried out on the previously tempered blades without being complicated by any considerations affecting the tempering of the cutting edge carrying portions of the blades.

Figure 3 shows, applied to a single blade, another way of carrying out the present process and applicable also to the process according to Roth's co-pending application Serial No. 666,641, filed April 18, 1933, in which the current enters and leaves by way of the cutting edges. In this method long contacts can be employed for example extending substantially over the length of the cutting edges.

Fig. 4 illustrates a modified form of blade strip in which the end areas of the blade blanks are perforated with slits or slots *e* to facilitate the localization of the high current density to the medial end portions of the blades both according to the present process and according to that the subject of Roth's co-pending application No. 666,641, filed April 18, 1933.

By the present invention the following factors are under the manufacturers' control; the hardness of the blade before treatment, the strength of the current, the time during which it is applied, the width of the end portions through which the current enters and leaves the minimum breadth of metal available for the path of the current near the ends compared to that of other portions of the blade, and by experiment or calculation these features can be so varied as to obtain a great variety of differences of temper.

Further, where the current is applied to a strip containing a number of blades, the differentiation of current density may be increased by nicking or the like, so that the breadth of the parts by which the current enters or through which it leaves is decreased. Nicks *d* at the necks between the blades are shown in Fig. 2.

In some cases it may be advantageous both in the case of strips and also of single blades to have nicks or slots parallel to the medial line to further control the current flow. In some cases curved or inclined nicks or slots may be used for this purpose.

The present invention also embraces a variant method wherein instead of joining the blades end-to-end in strip form, they are joined side-to-side as shown in Fig. 5 so that the medial longitudinal slots in the blades lie transverse to the direction of length of the strip and parallel to each other. The electric current then enters and leaves by way of the blade portions, which are to contain the cutting edges, at each side of the longitudinal slot as in the arrangement according to Fig. 3 and travels in a general direction transverse to the slots *b*. The blade blanks are subsequently severed along the lines *f* and sharpened.

Apart from the specific advantages above described the use of the electric current avoids many

of the difficulties attached to other methods of tempering.

What I claim is:—

1. A process of producing thin flexible razor blades with high edge hardness and relatively softer medial end areas, which consists in applying an electric current to a hardened blade having a medial longitudinal slot of substantial length and having the combined sectional area of the portions at each end of the slot substantially less than the longitudinal sectional area through the cutting-edge containing portions of the blade at opposite sides of the slot, and causing the current to flow in a general direction transverse to said slots and from one cutting-edge containing portion to the other through such end portions so that the density of the current is substantially greater over the medial end portions than at the cutting edges.

2. Process for the production of thin flexible razor blades with a high edge hardness and relatively softer medial end areas, comprising subjecting a plurality of blades which are provided with a longitudinal slot of substantial length to hardening and general tempering operations to produce in the edge substantially the hardness required for shaving purposes, and then applying an electric current to such blades, the said blades being connected longitudinally in strip form by necks of substantially less cross-sectional area than the main portion of the blade so that the density of the current will be substantially greater over the medial portions of the blades than at or near the cutting edges.

3. Process for the production of thin flexible razor blades with high edge hardness and relatively softer medial end areas, comprising applying an electric current to a plurality of hardened blades which are provided with a longitudinal slot of substantial length and are connected longitudinally in strip form, the cross-sectional area of the strip between the slots being considerably less than that of the main part of the strip so that the density of the current will be substantially greater over the medial end portions of the blade than at or near the cutting edges, said strip having longitudinally extending nicks or slots at the junctions of adjacent blades to control the current flow at said junctions.

4. Process for the production of thin flexible razor blades with high edge hardness and relatively softer medial end areas, which consists in applying an electric current to a plurality of blades having a medial longitudinal slot of substantial length, said blades being joined in strip form with the slots lying transversely of the strip, the combined cross-sectional area of the portions of the strip at the ends of each slot being substantially less than that of the portions between the slots so that the density of the current is substantially greater in the portions at the ends of the slots than in the portions between the slots, and then severing the blades between the slots and sharpening the edges thus produced to form cutting edges.

5. The step in the production of thin flexible razor blades with high edge hardness and relatively softer medial end areas, which consists in applying an electric current to a plurality of blades having a medial longitudinal slot of substantial length, said blades being joined in strip form with the slots lying parallel to each other, the combined cross-sectional area of the portions of the strip at the ends of each slot being substantially less than that of the portions between the slots so that the density of the current is substantially greater in the portions at the ends of the slots than in the portions between the slots.

6. Process for the production of thin flexible blades with high edge hardness and relatively soft medial end areas, which comprises subjecting a blade having a medial slot of substantial length to hardening and general tempering operations and subsequently end-softening the tempered blade, while maintaining the edge hardness previously imparted thereto, by applying an electric current to the blade, the cross-sectional area of each end portion of said blade being substantially less than that of the main portion so that the intensity of the current is substantially greater over the medial end portions than at or near its cutting edges.

7. A process for producing thin flexible razor blades with high edge hardness and relatively softer medial end areas, which comprises subjecting a blade having a medial slot of substantial length to hardening and general tempering operations to impart to the edge substantially the hardness required for shaving purposes, and then end-softening the tempered blade by applying an electric current to such blade, while maintaining the edge temper previously imparted to the blade, the sectional areas of the material available for the passage of the current through the end portions of the blade being substantially less than that available for the passage of the current through the main portion so that the density of the current is substantially greater over the medial end portions than at or near the cutting edges.

8. Process for the production of thin flexible blades with high edge hardness and relatively softer medial end areas, which comprises subjecting a blade having a medial slot of substantial length to hardening and general tempering operations to produce the hardness of the edge that is required for shaving purposes, and subsequently end-softening the blade, while maintaining the edge temper previously imparted thereto, by applying an electric current to such blade, the cross-sectional area of each end portion of the blade being substantially less than the combined cross-sectional area of the edge-bearing portions, so that the density of the current is substantially greater over each medial end portion than at or near the cutting edges.

9. A process of producing thin flexible razor blades in strip form with high edge hardness and relatively softer end areas, which consists in slotting the blade blanks in a strip to define separated edge-carrying portions, perforating the end areas with spaced open-ended slits to reduce locally their cross-sectional area, hardening the strip and then causing an electric current to flow through the strip of intensity sufficient to reduce the hardness of said perforated end areas more than the edge-carrying portions of the blades.

HERBERT LEFEVRE CLAISSE.