March 9, 1937. A. R. STARGARDTER 2,073,502

SAFETY RAZOR BLADE AND BLADE STRIP

Filed April 8, 1936

Fig. 1

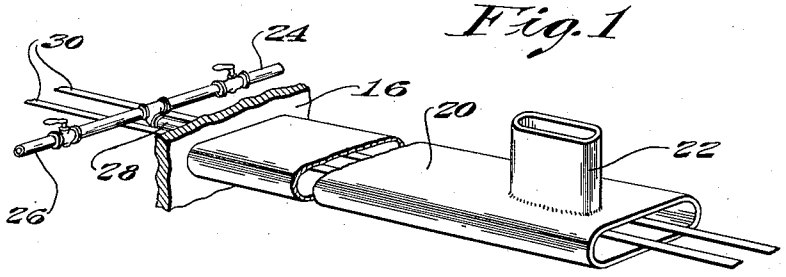


Fig. 2

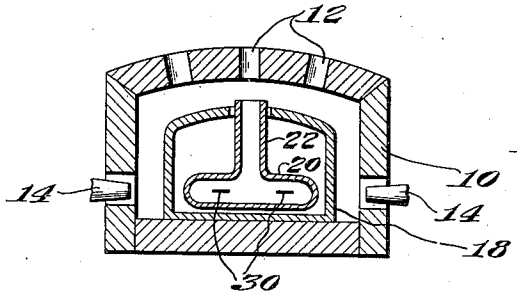


Fig. 3

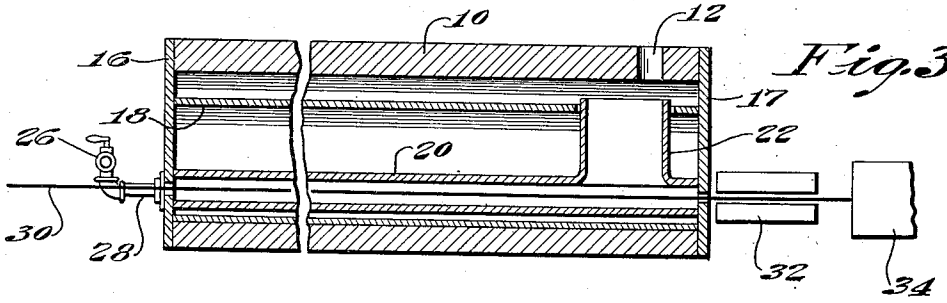
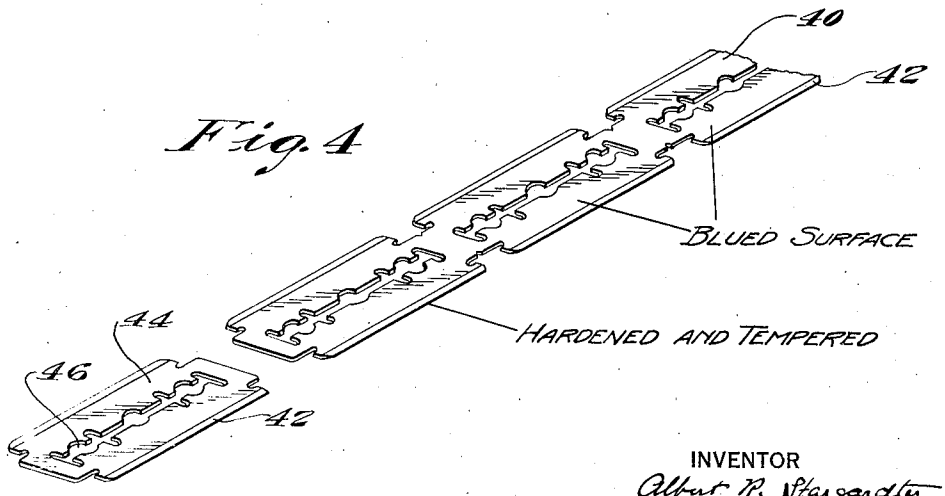


Fig. 4



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UNITED STATES PATENT OFFICE

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SAFETY RAZOR BLADE AND BLADE STRIP

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Application April 8, 1936, Serial No. 73,311

4 Claims. (Cl. 30—91)

This invention relates to safety razor blades, blade strips and flexible cutting blades in general. It consists in a novel product comprising a flexible blade of tempered steel having a blued surface finish of iron oxide and a hardness exceeding that of blue tempered steel. The present application is a continuation in part of my prior application, Ser. No. 711,207, filed February 14, 1934.

It is well known that a blued finish may be imparted to steel by hardening it and then drawing its temper to a point at which the steel is substantially softened and at which it naturally acquires a blue color. However, when so tempered steel is far too soft to serve as a satisfactory cutting blade for most uses. Also soft and untempered steel may be blued by heating it under atmospheric conditions to a definite temperature which is considerably below its critical point, and such steel of course is unsuited for cutting purposes.

I have discovered that it is possible to produce a steel blade or blade strip of the proper hardness for cutting, having at the same time a blue oxide surface finish and it is such a product that is the subject matter of the present invention.

One way of producing the desired result is by subjecting the steel under certain conditions to the action of an atmosphere having a controlled oxidizing effect. Preferably the coloring or bluing step may be combined with the heating of the steel preparatory to the hardening and tempering step, that is to say, the steel may be heated to a temperature above its critical point and simultaneously subjected to the action of an atmosphere having a controlled oxidizing effect and producing the desired blued finish, and then the blued steel may be immediately hardened by chilling it. Preferably the steel is dry-chilled between cooled plates since the appearance of the blued finish of the steel treated in this manner is superior to that of steel quenched in water or oil.

In my prior Letters Patent No. 1,948,192, issued February 20, 1934, I have disclosed in detail one manner of carrying out my invention and producing the desired product. The method therein disclosed consists in enveloping strip steel in a current of oxidizing gas which is heated above its ignition point, and in so controlling and handling the gas current that after it has passed along the heated strip it is conducted or directed away from it and preferably allowed to burn at a point remote therefrom. It will be understood that this procedure merely exemplifies one which is satisfactory in producing the novel product of the present invention and one which is herein shown for illustrative purposes.

These and other features of the invention will be best understood and appreciated from the following description of an illustrative method of producing hardened cutting blades having a blue ferrous oxide coating and examples thereof. In the accompanying drawing,—

Fig. 1 is a view in perspective of a muffle and its connections, showing two steel strips in passage therethrough;

Fig. 2 is a view in cross-section to the furnace chamber containing the muffle;

Fig. 3 is a view in longitudinal section through the furnace chamber, showing also the relation to the chilling and tempering devices to the furnace; and

Fig. 4 is a view in perspective of a blade strip and a single blade embodying the invention.

It will be understood that the illustrated apparatus represents one satisfactory form of manufacturing equipment only and that the product of my invention may be manufactured by employing various other forms of specific apparatus.

As shown in the drawing, an elongated furnace is formed by walls 10 of refractory material and the furnace is provided with vents 12 in its upper wall near the discharge end thereof. Gas burners 14 are arranged at points along the sides of the furnace and by these the interior of the furnace is heated to the desired temperature. Preferably the burners are arranged so that the furnace presents to the strip steel passing through it, progressively hotter zones increasing in temperature toward its delivery end. The left-hand or inlet end of the furnace is closed by a plate 16 and the right-hand or delivery end by a corresponding plate 17.

Within the furnace chamber is enclosed an auxiliary muffle 18. This is closed at either end by the plates 16 and 17 of the furnace chamber and provided in its upper wall with an aperture for a purpose presently to be described. The auxiliary muffle 18 is spaced at its sides and top from the corresponding walls of the furnace chamber and, in the example shown, is heated by gas flames from the burners 14 which maintain the interior thereof at a high temperature diffused throughout the muffle without abrupt variations. Within the auxiliary muffle 18 is mounted an elongated muffle 20, also closed at either end by the plates 16 and 17 and having adjacent to the delivery end of the furnace an upwardly-extending outlet duct 22 which passes through the aperture in the

upper wall of the auxiliary muffle **18**. The muffle **20** is constructed of a heat-resistant alloy, such as nichrome, and its body is relatively shallow and flat with curved walls, being adapted to receive a strip of steel, or several strips arranged in horizontal position. Within the muffle **20**, the plates **16** and **17** are provided with inlet and outlet slots through which pass the strips being treated. As herein shown, two strips **30** are guided in parallel paths, side by side, through the muffle.

At the inlet end of the muffle **20** is provided a supply pipe **28** and to this are led an air inlet pipe **24** and a gas inlet pipe **26** each controlled by an independent valve. The purpose of the supply pipe **28** is to conduct continuously to the muffle **20** gas of controllable oxidizing effect. Ordinary illuminating gas which, as is well known, is reducing in its effect, diluted with air has been found entirely satisfactory in practice. The addition of atmospheric oxygen to the reducing illuminating gas results in a mixture which is no longer reducing but slightly oxidizing in its effect at the temperature used. The mixture thus formed is admitted to the muffle **20** through the supply pipe **28** and may be adjusted as to its composition by properly setting the valves in the air and the gas pipes and by thus adjusting the mixture the tint of the blued finish may be varied and made lighter or darker. The gas so delivered to the muffle **20** envelops the steel strips and flows lengthwise along them until it reaches the upwardly-directed outlet duct **22** near the discharge end of the muffle. The gas current is at this point deflected upwardly away from the strip steel and passes out through the top of the auxiliary muffle **18**. It will be understood that the muffle **20** is maintained at a temperature above the lower critical point of the steel being treated, for example, above 1400° F., and consequently the gas contained within the muffle is raised to a temperature considerably above its ignition point. Any substantial amount of the mixture is, however, prevented from burning within the muffle **20**, partly on account of its velocity of flow and partly on account of the restricted area of the muffle and of its discharge duct. The behavior of the oxidizing mixture within the muffle **20** is not entirely understood and it may be that its oxidizing effect is caused in part by conversion of reducing CO of the illuminating gas to oxidizing CO_2 in the mixture surrounding the steel strips. After leaving the duct **22**, the oxidizing gas mixture is free to ignite and burn either within the furnace chamber or after it has passed upwardly through the duct **12** in the upper wall of the furnace chamber. In any case, the complete combustion of the gas takes place at a point remote from the strip steel being treated so that the latter is kept from contact with the products of this combustion.

The effect of subjecting the steel strip to heat and the oxidizing effect of the gas mixture in the manner above explained is to produce upon its surface a thin, smooth, uniform coating of blue ferrous oxide. On passing out of the muffle **20** through the plate **17**, the heated and blue coated strips **30** are guided at once between chilled plates **32** whereby the heated strips are hardened while the blued finish previously imparted to them is preserved.

Upon leaving the chilling plates **32**, the hardened and blued strips are at once guided to and between heated plates **34** by which the hardened strips may be drawn to any desired degree of temper and this step also is carried out without affecting the blued finish of the strips.

In Fig. 4 is shown one example of a blade strip **40** which may be advantageously produced by the processes above outlined. The blade strip **40** is sharpened along its longitudinal edges **42**, internally perforated at **46** and notched at its edges to define individual blades therein. After being hardened and blued, as above explained, it may be broken into separate blades, one of which **44** is shown in the drawing.

In manufacturing such articles as safety razor blades the blued finish is highly prized, and has been acquired heretofore only by methods involving the use of lacquer or the like. The usual blued finish obtained by drawing the temper of hardened steel corresponds to a hardness which has unsatisfactory edge-holding properties.

By the process above explained, however, I am able to provide blades or blade strips with an excellent blue finish which greatly improves the appearance of the product and serves to distinguish it from other blades. By my invention, moreover, I provide a blue coating of substantially pure ferrous oxide which, unlike magnetic oxide, is not resistant to acids and may therefore be readily etched or printed with weak acid in applying trade-marks or other insignia to the product. Another advantage of great commercial importance incident to my invention is that it eliminates an entire operation heretofore necessary in blade manufacture, namely, the blade polishing operation. This results in a large saving in the cost of manufacture.

Having thus described my invention, what I claim as new and desire to secure by Letters Patent of the United States is:—

1. A thin flexible safety razor blade hardened and tempered for cutting, having a blued surface finish of iron oxide and a hardness greater than that of blue tempered steel.

2. A thin flexible blade strip of tempered steel having a blued surface finish of iron oxide and a hardness exceeding that of blue tempered steel.

3. A thin flexible safety razor blade hardened and tempered for cutting, having a blue surface finish of substantially pure ferrous oxide and a hardness greater than that of the blue tempered steel.

4. A thin flexible blade strip of tempered steel having a blue surface finish of substantially pure ferrous oxide and a hardness exceeding that of blue tempered steel.

ALBERT R. STARGARDTER.