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S. SMITH

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FLAME HARDENING

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FIG. 1.

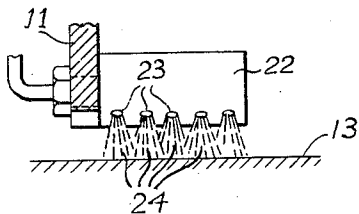
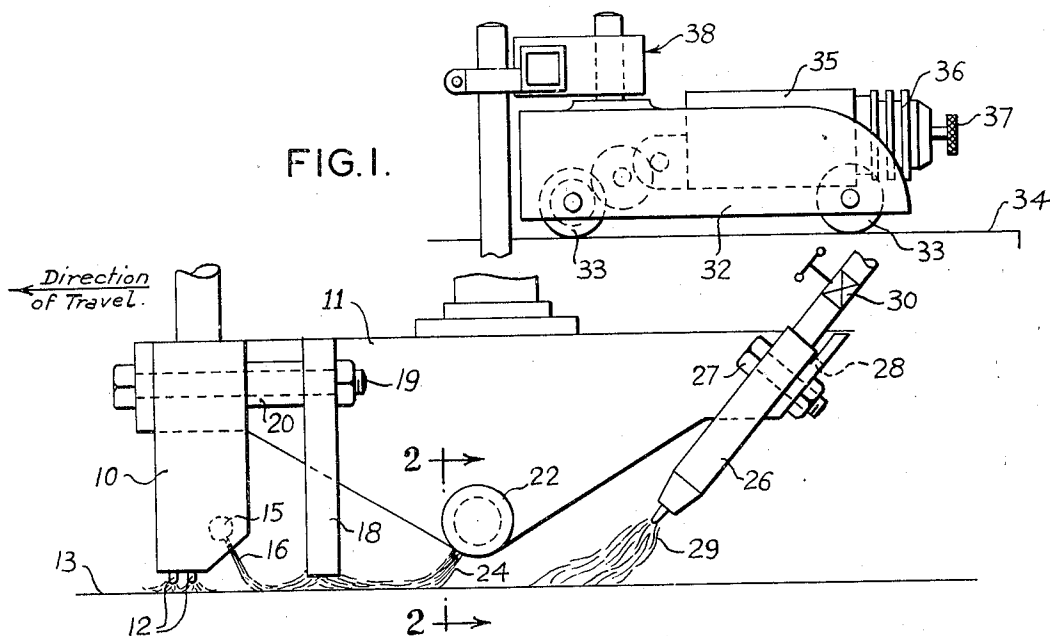


FIG. 2.

INVENTOR
STEPHEN SMITH
BY *J. J. Brandenburg*
ATTORNEY

UNITED STATES PATENT OFFICE

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FLAME HARDENING

Stephen Smith, Jersey City, N. J., assignor to
Air Reduction Company, Incorporated, New
York, N. Y., a corporation of New York

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2 Claims. (Cl. 148—21.55)

This invention relates to flame hardening by moving a heating torch progressively along a work-piece closely followed by a quenching spray.

It is an object of the invention to provide an improved method of flame hardening in which the degree of hardening can be effectively controlled. For many purposes it is not desirable to have the maximum hardness which is attained by quenching metal of the particular composition of the work-piece. With this invention no subsequent tempering operation is necessary where a less-than-maximum hardness is desired. This invention hardens and tempers in a single operation by following closely behind the progressive hardening quench with a tempering flame system, or other tempering means such as induction heating, and preventing the liquid of the quenching jets from affecting the metal in the region of the tempering flame system.

The invention is intended for heat treating ferrous metal, such as steel, but in its broadest aspects may be employed in the treatment of any work-piece constructed of material that can be hardened by heating above a critical temperature and then quenching.

Another object is to provide simple and efficient apparatus for flame hardening in accordance with this invention. The apparatus includes a heating torch, a quenching header, and a tempering torch connected with a common support and moved progressively along the work-piece at a controlled speed. The apparatus includes special elements for preventing the liquid from the quenching jets from reaching the metal under the tempering torch.

The assembly is moved by a common support at a speed that enables the heating torch to raise the surface metal of the work-piece above its critical temperature, and the heating effectiveness of the tempering torch is correlated with that of the heating torch so as to draw the temper when moved progressively along the work-piece at the speed of the common support.

Other objects, features and advantages of the invention will appear or be pointed out as the specification proceeds.

In the accompanying drawing, forming a part hereof:

Figure 1 is a side elevation, partly diagrammatic and on a reduced scale, showing apparatus for flame hardening in accordance with this invention.

Figure 2 is a detail sectional view taken on the line 2—2 of Figure 1.

A heating torch 10 is connected to a support 11

or bracket 11. The torch has orifices from which oxy-fuel gas flame jets 12 are projected against a work-piece 13. The torch 10 preferably has multiple rows of jet orifices extending across the width of the surface to be hardened, two rows being shown in Figure 1.

There is a header 15 comprising a conduit in the tip of the torch 10, extending transversely of the area to be hardened, and having orifices from which liquid cooling jets 16 are projected, under pressure, downwardly and at an angle rearwardly against the surface of the work-piece 13. A baffle 18 is connected to the torch 10 by a bolt 19 and held at a spaced distance behind the header 15 by a spacer 20 surrounding the bolt. The baffle 18 extends close to the top surface of the work-piece and acts both as a spray shield and a dam to prevent water, or other quenching liquid, that is discharged from the header 15 from covering the surface of the work-piece beyond the baffle 18.

The clearance between the bottom edge of the baffle 18 and the surface of the work-piece 13 is preferably of the order of one-sixteenth of an inch or less. A blast pipe 22 attached at one end to the support or bracket 11 has a row of orifices 23 from which compressed air jets 24 are blown against the work-piece at an angle toward the back of the baffle 18. The jets 24 are closely spaced so as to form in effect a curtain behind the baffle and to maintain a gas pressure at the bottom edge of the baffle to prevent quenching liquid from flowing rearwardly through the clearance between the bottom of the baffle and the surface of the work-piece.

The air jets 24 also blow away any quenching liquid that may remain on the surface of the work-piece after the heating jets 12, quenching jets 16, and baffle 18 have passed over the surface. By limiting the rearward influence of the quenching jets 16, the mass of metal below the surface is not so completely cooled and some residual heat builds up in the metal prior to the application of the tempering flames.

A reheating and tempering torch 26 is connected to the support 11 by a clamping bolt 27. This bolt preferably extends through a slot 28 so that the torch 26 can be adjusted toward or from the work-piece to change the heating effectiveness of the torch.

There is a row of jet orifices in the face of the torch 26 from which flame jets 29 are directed against the work-piece. These flames are preferably oxy-fuel gas flames, and in addition to the adjustment of the heating effectiveness of the

torch 26 by moving it closer to or further from the work-piece, the supply of gas to the torch 26 can be adjusted by means of a valve 30 to change the volume of the tempering flames and thus control the temperature to which the hardened metal is reheated and the amount of tempering effected by the flame jets 29.

The bracket 11 and the assembly of elements carried by this common support are moved progressively along the length of the work-piece, in the direction indicated by the arrow, by a self-propelled carriage 32. This carriage 32, shown diagrammatically and on a reduced scale, has four wheels 33 that run on a track 34. The front wheels are driven by a motor 35, and the motor is under the control of a centrifugal governor 36 that can be adjusted, to hold the carriage to a different speed, by a knob 37. The support 11 is connected with the carriage 32 by a bracket assembly 38.

This invention can be employed for hardening curved surfaces, or surfaces of irregular contour, as well as plane surfaces. Moving the work-piece instead of the torch support is, of course, a mechanical equivalent of the support movement illustrated in the drawing.

Other modifications and changes can be made and some features of the invention can be used without others.

I claim:

1. The method of hardening a ferrous work piece which comprises causing relative movement between the work piece and a heating flame, the intensity of the flame and the rate of relative movement being such that the flame heats the work piece to a temperature above its critical temperature, progressively quenching the work piece close behind the region of heating by flowing a cooling liquid thereon, substantially restricting the contact of the cooling liquid to a limited area of the work piece behind the heating flame by restricting the free space above the work piece adjacent and behind the place where the cooling liquid is flowed onto the work piece and by causing a superatmospheric pressure to be formed

in said restricted space by directing a blast of compressed air along the surface of the work piece close to and towards such restricted space from the side thereof opposite that where the cooling liquid is flowed onto the work piece, applying a tempering flame to the surface of the work piece close behind and in alignment with the place where the air blast strikes it, and progressively along the surface of the work piece, and correlating the heating effect of the tempering flame with the rate of relative movement between the work piece and the heating flame to draw the temper of the hardened surface and to produce a lower degree of hardness.

2. Flame hardening apparatus comprising a torch for heating the surface of a metal work piece to a temperature above its critical temperature, a quenching header positioned behind and in alignment with said torch for applying quenching liquid to the work piece close behind the region of the work piece heated by the torch, a common support for the torch and the quenching header, a baffle carried by said support and extending therefrom, in alignment with and behind the quenching header, to a position to pass close over the work piece, means carried by said support in alignment with and behind said baffle for directing a blast of air along the surface of the work piece over which the support is moved, adjacent the baffle and towards the baffle from the side thereof opposite the quenching header, to cause a superatmospheric pressure to be built up between the baffle and the work piece to impede the flow of the quenching liquid along the work piece under the baffle, a tempering torch carried by said support in alignment with and behind the air blast means and positioned to apply a tempering flame to the surface of the work piece close behind the place where the air blast strikes it, and means for producing movement of said common support at a controlled speed and progressively over the surface of the work piece to be hardened.

STEPHEN SMITH.