Feb. 10, 1959 I. P. THOMPSON ET AL 2,873,224

PROCESS AND APPARATUS FOR DESURFACING A REFRACTORY METAL BODY

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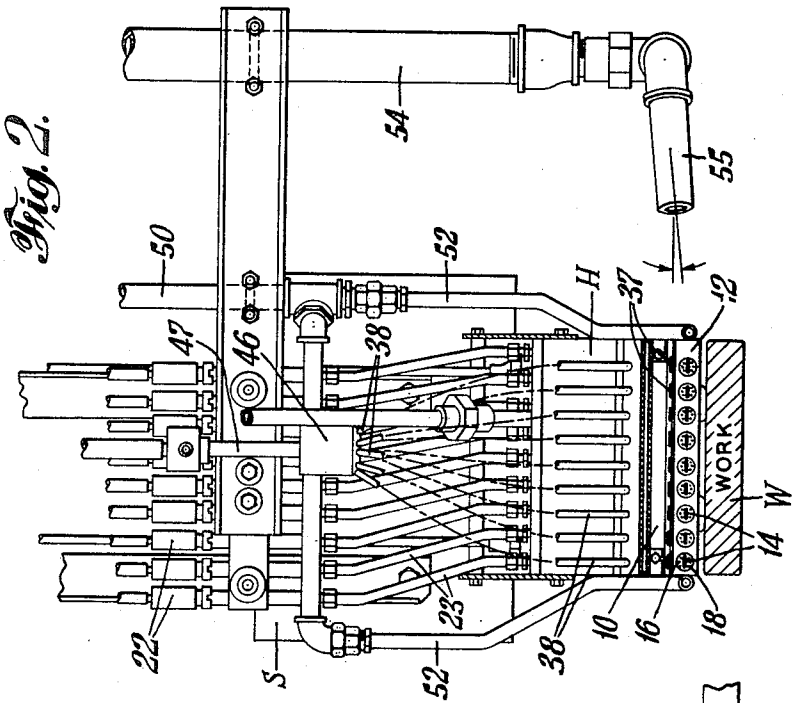


Fig. 2.

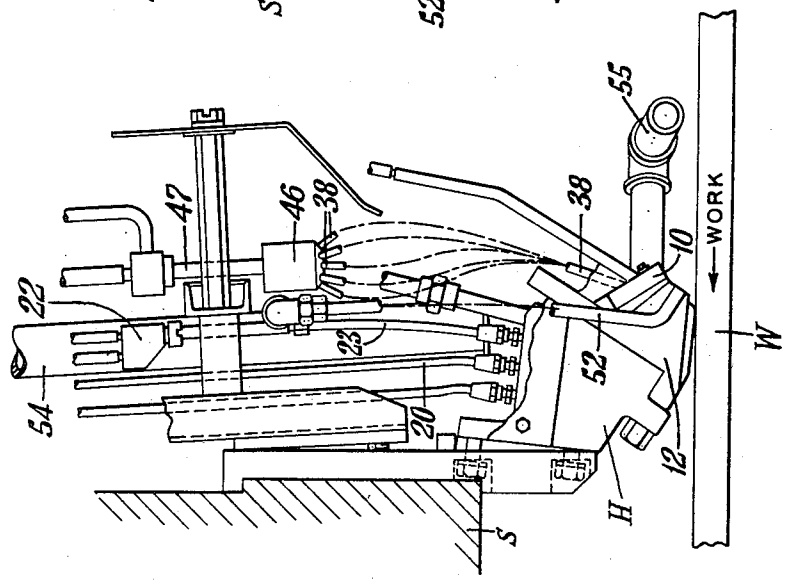


Fig. 1.

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Fig. 3.

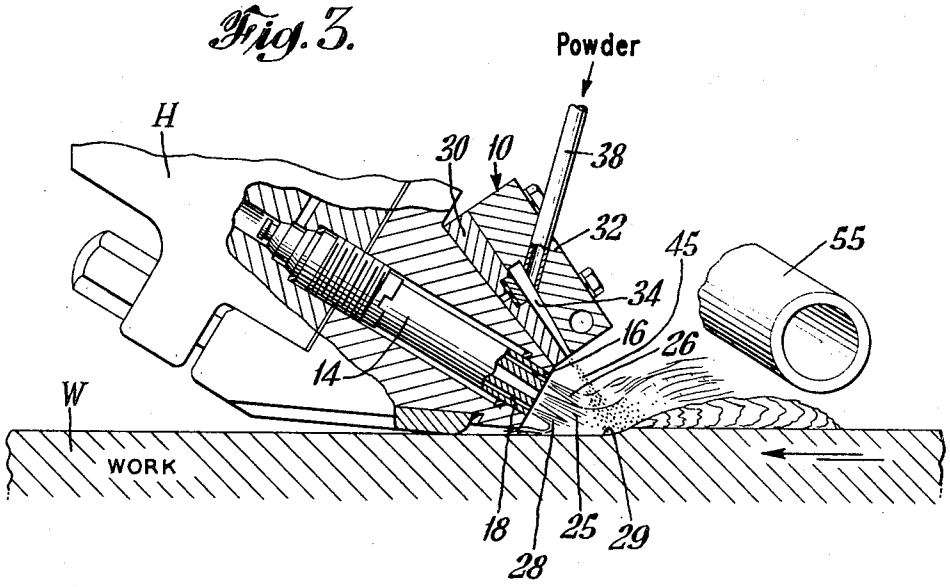
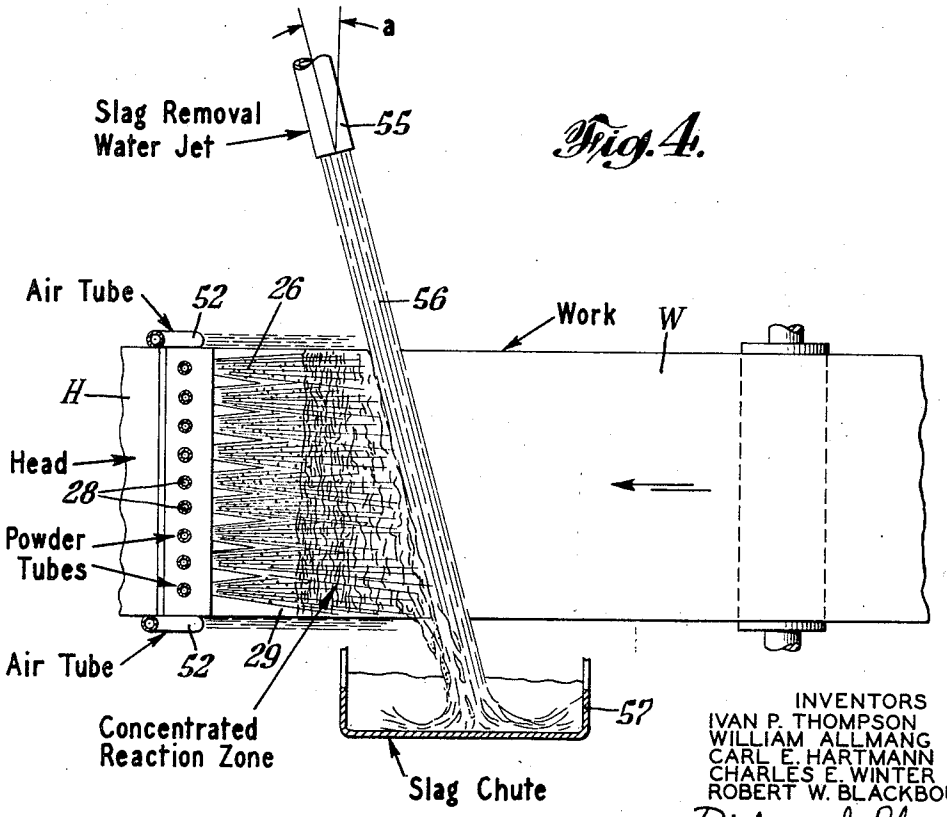


Fig. 4.



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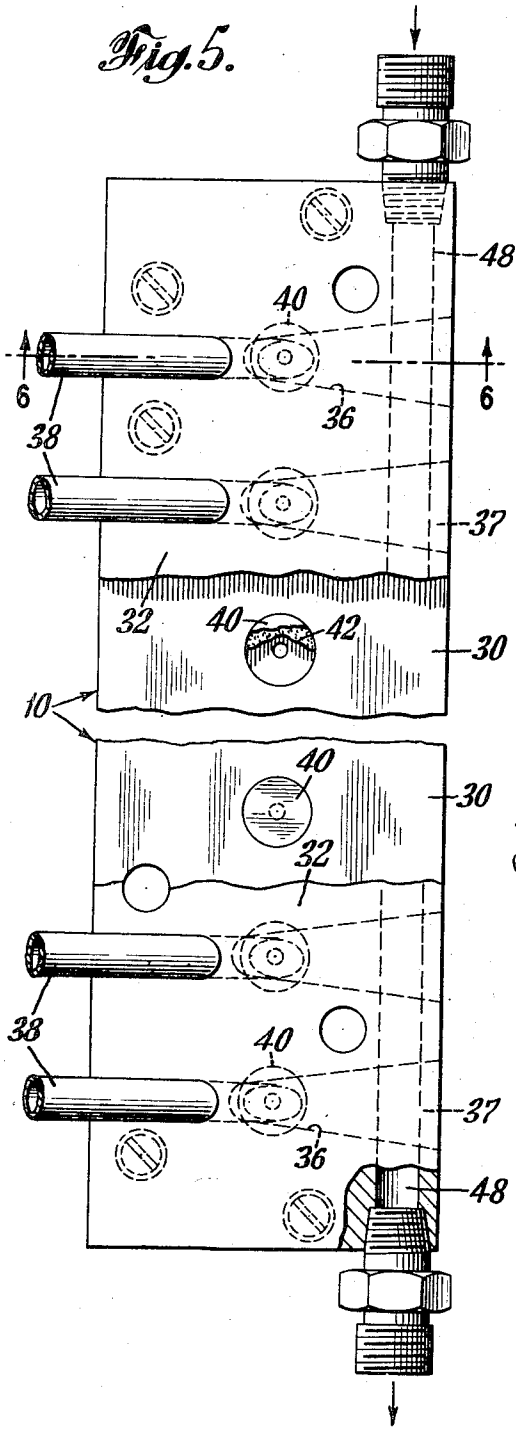
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Fig. 5.



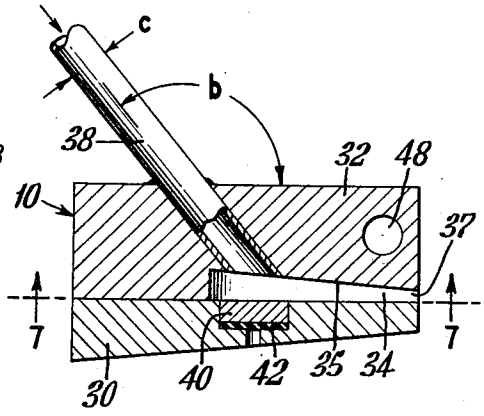


Fig. 6.

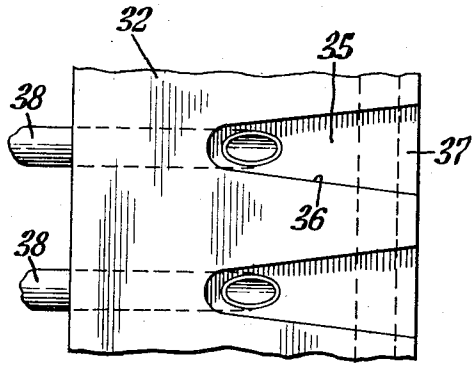


Fig. 7.

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PROCESS AND APPARATUS FOR DESURFACING A REFRACTORY METAL BODY

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Application May 6, 1955, Serial No. 506,532

4 Claims. (Cl. 148—9.5)

The invention relates to thermochemical metal removal, and more particularly to method and apparatus for machine scarfing of cold stainless steel with externally fed powdered solid fuel.

The success of the operation of cold desurfacing of stainless steel with manually operated powder fed blowpipes depends largely on the flexibility of the hand operation and the skill of the operator. These features are lost in the mechanization of the process for operation by machine, which accordingly presents new problems. The angle of inclination of the desurfacing nozzle cannot be adjusted as the surface quality of the steel section changes. The speed at which the mechanized desurfacing pass is made cannot be changed to suit the conditions, and the nozzle height must be kept constant. Another problem is to accomplish blending of the cuts made by the individual nozzles.

The objects of the present invention are to provide a quality surface regardless of the condition of the steel section prior to desurfacing, to maintain uniformly good stability when desurfacing at varying depths of cut, to provide and supply an even distribution of the powder down and into the reaction zone in the quantities found best for desurfacting, and to provide uniform depth to cut across the work surface under the gap between adjacent nozzles as well as under the centers of the nozzles, and to concentrate and stabilize the reaction zone to facilitate carrying long cuts.

According to the present invention, the process of desurfacing a refractory metal body comprises applying preheat to a local surface portion of such a body, discharging a relatively flat stream of oxidizing gas at an acute angle against such heated portion, supplying a row of streams of powdered solid fuel-laden gas at an acute angle against coplanar surfaces of hard-facing erosion resistant material, discharging the resultant separate flat stream of gas containing uniformly transversely distributed powdered solid fuel at an acute angle toward such oxidizing gas stream, so that the central planes of such streams in the direction of flow thereof form dihedral angles with one another and with such surface portion of the body, and relatively moving such streams with respect to the body so that successive surface portions thereof are progressively removed thermochemically by the scarfing action of the combined powdered solid fuel and oxidizing gas stream.

In the drawings:

Fig. 1 is a side elevation of a desurfacing machine according to, and for carrying out the method of the present invention;

Fig. 2 is a front elevation of the same;

Fig. 3 is a vertical cross section through the desurfacing head;

Fig. 4 is a plan view of the work surface showing the reaction zone;

Fig. 5 is a plan view of the powder nozzle plate;

Fig. 6 is a section taken along the line 6—6 of Fig. 5; and

Fig. 7 is a section taken along the line 7—7 of Fig. 6.

As shown in the drawings, the invention is illustrated as applied to a desurfacing machine comprising a head H mounted on a suitable support S above the path of the work W, such as a cold slab of stainless steel. The head H comprises a nozzle block 12 provided with a plurality of flat slotted nozzles 14 for discharging a relatively flat stream of cutting oxygen against the work W, as well as upper and lower rows of ports 16 and 18 for discharging preheat gas flames adjacent such scarfing oxygen stream. The cutting oxygen is supplied to the slotted nozzles 14 by tubes 20, and the preheat mixture of oxygen and acetylene is supplied by mixers 22 and tubes 23 to the ports 16 and 18.

According to the present invention a relatively flat powder nozzle 10 is mounted on the nozzle block 12, and is shown in detail in Fig. 3. The flat slotted nozzles 14 discharge a relatively flat stream 25 of cutting oxygen against the work W, and the rows of ports 16 and 18 discharge preheat gas flames 26 and 28 adjacent such scarfing oxygen stream. The preheating gas flames extend above and below the oxygen stream 25, forming dihedral angles with the work surface 29.

The powder nozzle 10 comprises a metal base plate 30 and a metal cover 32 suitably bolted together. The cover 32 is recessed to form relatively long uniformly spaced channels 34, each of which, as shown in Fig. 6, has a top wall 35 converging in the direction of flow with the upper surface of the base 30. The channels 34 have side walls 36 diverging in the direction of flow as shown in Fig. 7 and leading to uniformly closely spaced flat slots 37.

Powder-laden gas is supplied to each channel 34 by a tube 38 mounted in the cover 32 at an angle *b*, which is an optimum of 140°. A change of 5° either side of this optimum angle causes a noticeable change in the powder flow as it exits from the nozzle. Too shallow an angle causes the powder to become concentrated in the middle of the slot, while too steep an angle causes the powder to run down the side edges of the powder slot.

The tube 38 terminates at the top wall 35, and directs the stream of powder-laden gas against the top of the base plate 30 therebelow. A disk 40 of hard-facing material such as tungsten carbide is inserted in a socket in the base plate flush with the upper surface thereof. A rubber disk 42 is used as a shim to provide for top surface alignment. As compared to a chromium plated wear plate life of two hours continuous powder flow, a soft rubber disk increased this to eight hours, and with the rubber backed sintered tungsten carbide disks shown, no sign of wear was evident after thirty hours of continuous service.

The powder-laden streams of carrier gas such as air, nitrogen or oxygen, for example, coming from the tubes 38 as round streams are flattened by impact at an angle of between 35° and 45° against the carbide disks 40 and passes along the channels 34 and out the flat orifices 37. The discharge face of the powder nozzle 10 is positioned on the blowpipe nozzle 12 so that the channels 34 discharge the separate powder-laden carrier gas streams from the flat orifices 37 located above the front upper edge of the nozzle 12. These streams combine to form the transversely continuous powder-laden gas stream 45 which forms a dihedral angle with the oxygen stream 25 and the work surface 29. The individual branch tube 38 in connection with each channel 34 is one of a battery of such tubes leading from a distributor 46 shown in Fig. 1, which in turn is connected to a powder-laden gas supply line 47.

Originally the powder nozzle 10 itself was found to warp or buckle because of the extreme heat of the desurfacing reaction. The powder nozzle had to be water cooled to eliminate this warping. Accordingly, the powder nozzle cover 32 above the channels 34 is provided

with a transverse bore 48, as shown in Figs. 5 and 6, for the circulation of cooling water therethrough.

In order to blow away any slag adhering to the sides of the work, compressed air from a suitable source is supplied by a pipe 50 to air tubes 52 on each side of the nozzle head H, to project jets of air against the sides of the work W.

Water from a suitable supply passes through a pipe 54 to a slag removal water jet 55 which projects a high pressure stream of water 56 at an angle *a* across the work surface just ahead of the nozzles to wash away the slag into the chute 57. When scarfing stainless steel, the slag removal is particularly important, because the chrome oxide tends to fuse to the work surface, and must be removed before it hardens. Furthermore, this stream of water 56 accomplishes another purpose in that it forms a heat dam which concentrates the puddle of molten metal running in advance of the cutting nozzles, and greatly strengthens the reaction zone.

The powder distribution is greatly improved by the construction of the powder nozzle and the inlet tubing. The internal diameter of the tubes 38 is decreased from one quarter to three sixteenths of an inch. The taper or flare of the powder channel 34 is important in determining the type of intersection or blend of the individual powder streams from the orifices 37 into a transversely continuous flat stream of uniform thickness. A slot thickness of one sixteenth inch although giving a satisfactory powder flow, was subject to powder plugging at the exit due to external spray water. This problem was eliminated by reducing the slot thickness to approximately one thirty-second of an inch and maintaining the same air flow, thus increasing the powder air velocity.

In the mechanization of powder scarfing, one standard cutting nozzle angle had to be determined that could be used for both shallow and heavy cuts, and such that up to a 5° change in the normal horizontal position of the slab, as would result from slab camber, would not materially affect the surface quality obtained. A 30° cutting angle between the oxygen stream 25 and the work surface 29 was found to give the best to obtain these results, whereas the normal hand desurfacing angle is about 45°.

We claim:

1. Process of desurfacing a refractory metal body, which comprises applying preheat to a local surface portion of such body, discharging a relatively flat stream of oxidizing gas at an acute angle against such heated portion, projecting a row of streams of powdered solid fuel-laden gas at an acute angle against coplanar surfaces of hard erosion resistant carbide material, discharging the resultant separate flat stream of gas containing uniformly transversely distributed powdered solid fuel at an acute angle toward such oxidizing gas stream, so that the central planes of such streams in the direction of flow thereof form dihedral angles with one another and with such surface portion of the body, and relatively moving such streams and the body so that successive surface portions thereof are progressively removed thermochemically by the scarfing action of the combined powdered solid fuel and oxidizing gas stream.

2. Process of desurfacing a refractory metal body, which comprises applying preheat to a local surface portion of such body, discharging a relatively flat stream of oxidizing gas at an acute angle against such heated portion, projecting a row of streams of powdered solid fuel-laden gas at an acute angle against rubber backed coplanar surfaces of hard erosion resistant material, discharging the resultant separate flat stream of gas containing uniformly transversely distributed powdered solid fuel at an acute angle toward such oxidizing gas stream, so that the central planes of such streams in the direction of flow thereof form dihedral angles with one another and with such surface portion of the body, and relatively moving such streams and the body so that successive surface portions thereof are progressively removed thermochemically by the scarfing action of the combined powdered solid fuel and oxidizing gas stream.

3. Apparatus for desurfacing a refractory metal body, which comprises means for applying preheat to a local surface portion of such body, means for discharging a relatively flat stream of oxidizing gas at an acute angle against such heated portion, means for projecting a row of streams of powdered solid fuel-laden gas at an acute angle against coplanar surfaces of hard erosion resistant carbide material, means for discharging the resultant separate flat stream of gas containing uniformly transversely distributed powdered solid fuel at an acute angle toward such oxidizing gas stream, so that the central planes of such streams in the direction of flow thereof form dihedral angles with one another and with such surface portion of the body, and means for relatively moving such streams and the body so that successive surface portions thereof are progressively removed thermochemically by the combined scarfing action of the powdered solid fuel and oxidizing gas stream.

4. Apparatus for desurfacing a refractory metal body, which comprises means for applying preheat to a local surface portion of such body, means for discharging a relatively flat stream of oxidizing gas at an acute angle against such heated portion, means for projecting a row of streams of powdered solid fuel-laden gas at an acute angle against rubber backed coplanar surfaces of hard erosion resistant material, means for discharging the resultant separate flat stream of gas containing uniformly transversely distributed powdered solid fuel at an acute angle toward such oxidizing gas stream, so that the central planes of such streams in the direction of flow thereof form dihedral angles with one another and with such surface portion of the body, and means for relatively moving such streams and the body so that successive surface portions thereof are progressively removed thermochemically by the combined scarfing action of the powdered solid fuel and oxidizing gas stream.

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