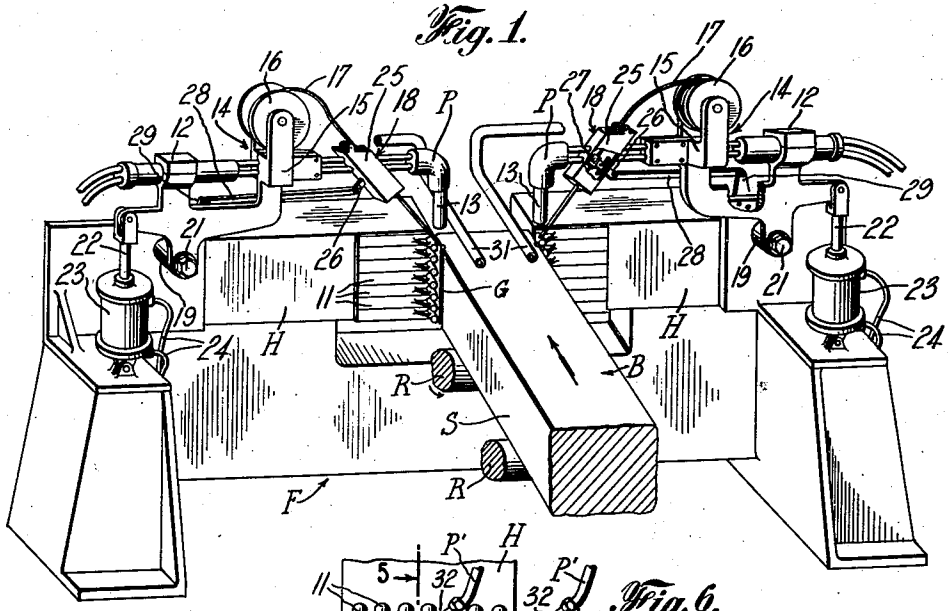
June 30, 1942. A. P. SCHELLER 2,288,027

METHOD OF AND APPARATUS FOR INITIATING A DESURFACING OPERATION

Filed May 31, 1940

Fig. 1.



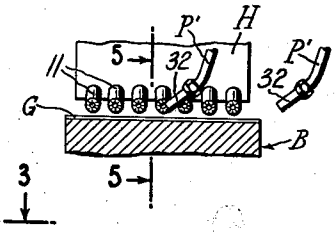


Fig. 6.

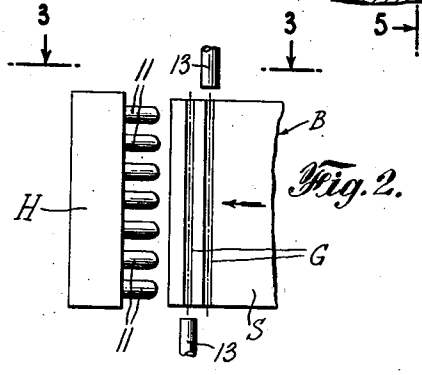


Fig. 2.

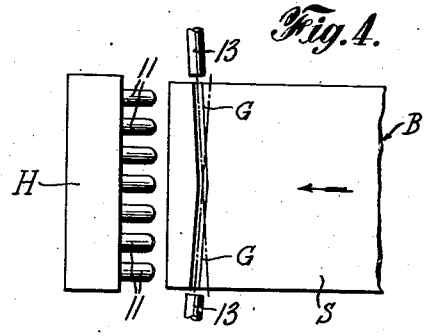


Fig. 4.

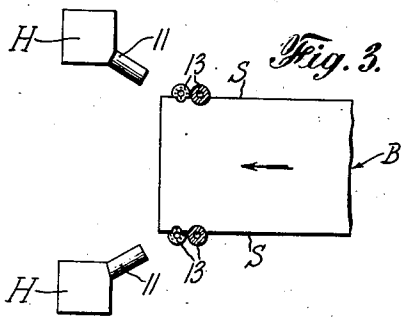


Fig. 3.

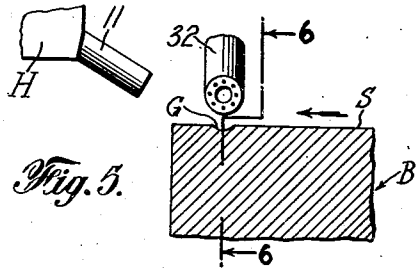


Fig. 5.

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METHOD OF AND APPARATUS FOR INITIATING DESURFACING OPERATIONS

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Application May 31, 1940, Serial No. 337,973

15 Claims. (Cl. 148—9)

This invention relates to the art of thermo-chemically conditioning ferrous metal bodies and more particularly to methods of and apparatus for facilitating the start of a desurfacing operation.

Flame-desurfacing is a process which has been developed within recent years for thermo-chemically skinning a layer from a surface of a ferrous metal body to remove surface defects and to expose undesirable seams beneath the surface. The process is especially adapted for removing defects appearing in the surfaces of semi-finished structural steel shapes, and the like, while they are being rolled at high temperatures, as the thermo-chemical action proceeds more rapidly when the desurfacing stream of oxidizing gas is applied to heated metal. Desurfacing has been applied equally well in removing a surface stratum from steel ingots, billets, and the like, which have partially or completely cooled from the rolling temperatures. Although the whole body may be raised to the ignition temperature for starting a desurfacing operation, it is preferable in either case to preheat a starting zone to or above the ignition temperature to initiate the desurfacing operation. Locally preheating metal bodies for the start of a desurfacing operation heretofore has extended the operating time unduly, and attempts to reduce the time required for preheating have required the use of unnecessarily elaborate and expensive auxiliary preheating equipment.

Heretofore, preheating a starting zone of steel bodies for initiating desurfacing operations has been accomplished by separately heating the zone in front of each desurfacing nozzle with individual preheating flames issuing from the respective nozzles. These preheating flames consume relatively large quantities of gases. The individual preheat flames customarily employed are usually provided for two purposes. Firstly, to preheat the starting zone to or above the ignition temperature so as to insure ignition across the full width of the surface layer to be removed, for which purpose relatively large preheat flames are desired in order that the time consumed for preheating may not be excessively long. Secondly, to accompany the surface-removing gas stream or streams during the surface-removing operation for which purpose relatively small flames only are usually necessary. Although the thermo-chemical reaction of the surface metal with the oxygen stream can be propagated solely due to the heat of combustion of the metal removed especially when the work is hot or at rolling temperatures, it has been found that the stability of operation and the speed and efficiency are improved by continuing the application of preheat flames. Thus, to reduce the starting time, it has been customary to employ larger preheat flames than would ordinarily be necessary during the actual desurfacing.

According to the present invention, the preheating of the starting zone is effected by auxiliary means, and the normal preheat flames may therefore be reduced to the size that provides optimum economy and efficiency during desurfacing under the particular conditions of operation. Although relatively long preheating time required by such flames has been shortened heretofore by adding individual starting rod mechanisms to each desurfacing nozzle, the saving in preheating time is offset by the complications and costs introduced by such added equipment.

By means of the present invention, a single flame-cutting blowpipe of conventional design, preferably provided with a starting rod feed device, may be used to preheat the starting zone for an entire gang of desurfacing nozzles in a small fraction of the time ordinarily required for the purpose, even when large preheat flames are employed.

Accordingly, the principal objects of the present invention are: to provide improved methods of and apparatus for initiating a flame-desurfacing or similar operation; to provide improved methods of and apparatus for rapidly heating to an ignition temperature the initial lateral starting zone of a desurfacing operation by flame-cutting a groove along such lateral zone; to provide preheating methods and apparatus for forming one or a plurality of shallow flame-cut grooves transversely along the surface of a billet or slab adjacent to a gang of desurfacing nozzles; to provide a method and apparatus for forming such grooves with flame-cutting jets projected in substantially opposite directions; and to still further reduce the preheating time by employing starting rods with the foregoing methods and apparatus. These and other objects of the invention will become apparent from the following description and from the accompanying drawing showing various modifications of the present invention. In the drawing:

Fig. 1 is a perspective view of one form of exemplary desurfacing machine incorporating the improved preheating means;

Fig. 2 is a side elevational view of one end of a billet or slab showing its relation to a desurfacing head and to a pair of oppositely disposed preheating blowpipes at the start of a desurfacing operation;

Fig. 3 is a sectional view taken on the line 3—3 of Fig. 2;

Fig. 4 is a side elevational view similar to Fig. 2, but wherein the preheating blowpipes are tilted slightly to produce intersecting starting grooves;

Fig. 5 is an enlarged sectional view of a modified arrangement taken on the line 5—5 of Fig. 6; and

Fig. 6 is a sectional view taken on the line 6—6 of Fig. 5.

The invention is specifically adapted for preheating a linear zone of a ferrous metal body to a temperature that will allow the heated portion to thermo-chemically react wth a voluminous sheet-like oxygen stream projected obliquely against the linear zone, to effect superficial combustion of a surface layer of the ferrous metal body. Generally speaking, the invention comprehends forming a shallow flame-cut groove G in the surface of a ferrous metal body B adjacent to the initial zone of application of the sheet-like desurfacing stream. A suitable frame F supports one or more desurfacing heads H in position to project a desurfacing stream against the desired surface S of a workpiece or body B, such as an ingot, billet, bloom, or slab. Ordinarily, the desurfacing stream is applied initially against the billet or slab B at one end thereof, and then progressively against successive transverse portions along the length of the billet B. Rollers R may be provided to move the billet lengthwise past the desurfacing heads H, or the heads H may be mounted upon a suitable carriage for motion along a stationary billet B. Preheating or starting means comprises a cutting blowpipe or a deseaming blowpipe P located adjacent to the heating heads H and being operable at the start of a desurfacing operation to form a shallow flame-cut groove across the billet B adjacent to the point of initial application of the desurfacing stream. Starting blowpipes P may be provided to form one or more starting grooves G in each surface S to be treated, and the respective grooves G may either intersect one another or extend in parallel relation.

The present invention is useful in initiating flame-cutting operations generally, but is particularly useful for initiating flame-desurfacing operations, wherein a relatively wide stream of oxidizing gas is projected obliquely against successive lateral portions of a ferrous metal body in a manner disclosed in Patent 2,125,177, dated July 26, 1938. The invention is herein disclosed in conjunction with a desurfacing machine of the type shown in Patent 2,168,581, dated August 8, 1939, adapted to treat simultaneously two vertical sides of a slab or billet. However, the present invention is equally well applicable to desurfacing apparatus adapted to operate on a single surface, as shown in Patent 2,125,176, dated July 26, 1938, or apparatus adapted to operate on the four sides of a billet or slab, as shown in Patent 2,125,174, dated July 26, 1938.

The apparatus disclosed in Fig. 1 comprises a base or supporting frame F, upon which are mounted a pair of spaced desurfacing heads H. A body of ferrous metal B, such as a billet or slab, is supported on rollers R so as to be moved progressively lengthwise between the heads H. A starting blowpipe P is located adjacent to each desurfacing head H so as to direct a flame-cutting jet along each surface S, to thereby form an incandescent groove G adjacent to the starting zone of the desurfacing operation. To simplify the description, only the apparatus employed to treat a single surface of the billet will be described, as such apparatus is similar to the apparatus employed to treat one or more of the remaining surfaces.

The desurfacing head H is provided with a plurality of deseaming type nozzles 11 arranged substantially close together and having central discharge orifices for projecting jets of oxidizing gas obliquely against aligned portions along a surface S of the body B. Each deseaming nozzle 11 may be also provided with one or more preheating passages from which a suitable combustible gas mixture is discharged. Ordinarily, the nozzles forming head H are located relatively close together, so that the jets from the nozzles 11 merge and form in effect a single sheet-like stream of oxidizing gas which is projected obliquely against the work surface along a linear zone extending substantially transversely of the surface. A similar but more uniform sheet-like stream of oxidizing gas may be projected from a modified desurfacing head having one or more slot-shaped orifices of the type shown in copending application Serial No. 107,334, filed October 24, 1936, issued Dec. 23, 1941 as U. S. Patent 2,267,405 to Jones et al., and the starting means is equally adapted for use with either form of head.

With the parts arranged as shown in Fig. 1, the desurfacing head H is adapted to protect a wide stream of oxidizing gas against an initial transverse portion forming a starting zone transversely along the surface adjacent one end of the body or billet B. By heating the starting zone to the ignition temperature and moving the body B in the direction indicated by the arrow, the desurfacing stream may be applied to progressively effect superficial combustion along successively adjoining transverse zones to remove a wide but shallow layer from the surface S. Heretofore, the preheating operation on metals considerably below ignition temperatures has been retarded appreciably by relying solely upon the heating effect of the preheating flames from the desurfacing nozzles 11. A considerable reduction in the starting time is effected by employing a separate starting blowpipe which is adapted to heat the starting zone to the ignition temperature by flame-cutting a shallow groove in the surface S substantially adjacent to the point of initial application of the desurfacing stream.

The starting blowpipe P is mounted on a support 12 so that the nozzle 13 is located adjacent to one side of the head H. The starting blowpipe P comprises metal-removing blowpipe such as a conventional flame-cutting blowpipe, or a deseaming blowpipe of the type shown in Patent 1,957,351, dated May 1, 1934. In either case, the nozzle 13 is located so as to project preheating flames and a jet of oxygen against an edge of the body B and transversely across the surface S. The flame-cutting jet from the nozzle 13 forms a shallow groove G adjacent to the starting zone, thereby raising the adjoining portions to above the ignition temperature of the body B, so that the portions may react with the desurfacing stream. The sheet-like desurfacing stream is directed substantially perpendicularly to the starting groove G, so that the portions in front

of all nozzles 11 are heated to the ignition temperature at the same time. The preheating action is effected almost exclusively by the flame-cutting jet from the starting blowpipe P, though the action is assisted somewhat by the preheating flames from the nozzles 11, which flames are according to this invention, adapted more particularly for assisting the desurfacing operation after it has once been initiated.

The preheating action of the starting blowpipe may further be accelerated by the use of a starting rod mechanism 14 as shown in Fig. 1. A yoke 15 on the support 12 swivelly receives a spool 16 containing a coil of combustible metal wire 17 such as steel or iron starting rod. The wire 17 is fed to a point directly beneath the nozzle 13 by wire feeding mechanism 18, the operation of which will be more fully explained.

The entire support 12 is pivotally mounted to the frame F by means of a post 19 and pivot pin 21. A piston rod 22 pivotally extends from the support 12 to a fluid-operated cylinder 23. Tubes 24 extend from opposite ends of the cylinder 23 and communicate with a controlled source of fluid such as oil or air under pressure. As fluid is forced into the top or rod end of the cylinder 23, the piston rod 22 is forced in a downward direction, causing the bracket or support 12 to rock or pivot about pin 21, thereby retracting the starting blowpipe P and the starting rod mechanism 14 upwardly from the operating position shown in Fig. 1. To move the parts back to the operating position at the start of a desurfacing operation, fluid is admitted under pressure to the lower or head end of the cylinder 23, while releasing the fluid contained within the rod end of the cylinder. The flow of fluid to the cylinder 23 may be controlled by the operator of the machine at a central point, in conjunction with the operation of valves controlling the flow of oxidizing and preheating gases, control means for the rollers R, and the like.

The wire-feeding mechanism 18 may be actuated to advance a predetermined length of wire each time the retractible support 12 is operated. The wire feeding mechanism 18 comprises a housing 25 through which the wire 17 passes. A pivotal finger 26 is provided at its inner end with a clutching member 27 adapted to grip the wire 17 and advance it towards the blowpipe nozzle 13. A rod 28 connects the outer end of the pivotal finger 26 with a stud 29 on the frame F. As the starting blowpipe P is retracted from its operating position, the finger 26 pivots causing the member 27 to slide a predetermined distance up and along the wire 17. During the return movement of the support 12, the clutching member 27 forces the wire 17 downwardly a predetermined distance so as to advance a small quantity of combustible metal into operating position beneath the nozzle 13.

One or more tubes or manifolds 31 having a series of aligned apertures may be adjustably positioned adjacent to the operating zone so as to project slag-deflecting jets of air, oxygen or a mixture of the two, against the edges of the surface S so as to counteract the accumulation thereon of slag and other molten products of the thermo-chemical reaction. The rollers R effect continuous motion of the ferrous metal body relatively to the desurfacing head in a direction lengthwise of the surface, but the invention operates equally well if the body B is maintained stationary and each desurfacing head moves relatively thereto.

Under certain circumstances, as where the surface S is relatively wide, it may be desirable to employ more than one starting blowpipe P. As shown in Figs. 2 and 3, a pair of starting blowpipes may be located at opposite ends of the initial transverse portion, that is, with the nozzles 13 positioned at opposite sides of the desurfacing head H so as to project flame-cutting jets in substantially opposite directions. As shown in Figs. 2 and 3, the nozzles 13 are located adjacent to the starting zone and project substantially parallel flame-cutting jets from opposite sides of the body B. The sheet-like stream of oxidizing gas from the desurfacing head H is projected obliquely against the surface S in a direction substantially perpendicular to and latterally against the grooves G formed by the nozzles 13. By using a plurality of starting nozzles 13, as shown in Fig. 2, more certain and uniform initiation of the desurfacing operation may be effected. The thermo-chemical desurfacing reaction when once started at the initial transverse portion, may be continued with respect to successively adjoining portions along the length of the surface S, by providing relative motion between the parts. As soon as the operation has been initiated, the starting blowpipe P may be shut off, and retracted from the zone of operation, as described in connection with Fig. 1, since the starting jet is used only momentarily at the start of the desurfacing operation.

A slightly different arrangement embodying the use of two starting blowpipes is disclosed in Fig. 4. The nozzles 13 are disposed on opposite sides of the body B so as to project flame-cutting jets toward one another in opposite directions along the surface S. The nozzles 13 are tilted slightly so that the incandescent starting grooves G intersect at a point on the surface S substantially midway between both nozzles. Each groove G therefore extends about half-way across the surface S, thus permitting the use of starting blowpipes of lower capacity than would be required if a single groove were extended entirely across the surface S. Each of the grooves G formed by the blowpipe nozzles 13 disclosed in Fig. 4 extends substantially parallel with the starting zone along the end of the body B, and the desurfacing stream engages the surface in a direction substantially perpendicular to the grooves G.

In the arrangement disclosed in Figs. 5 and 6, the preheating means comprises metal-removing starting blowpipes P' spaced across the initial transverse portion on the surface S, with substantially aligned nozzles arranged to project flame-cutting jets in the same general direction along the linear starting zone. The starting blowpipes P' preferably are provided with nozzles 32, generally similar to the nozzles 11 on the desurfacing head H. The nozzles 32 are aligned in a plane extending transversely of the surface S, and are disposed so that the oxidizing jets from the nozzles 32 are directed obliquely against and in the same direction generally along the starting zone. The oxidizing gas jet from each nozzle 32 preferably is of relatively low velocity, and the jets from the respective nozzles 32 run together and merge to form a single groove extending completely across the body B.

Various other arrangements of the herein disclosed apparatus may be made without departing from the scope of the invention or sacrificing its advantages.

I claim:

1. A method of initiating the thermo-chemical removal of a portion of metal from the surface of a ferrous metal body, comprising flame-cutting a groove in said surface adjacent to the starting zone of such metal removal to preheat said zone to the ignition temperature; and applying a metal-removing stream of oxidizing gas obliquely along said surface and against said zone in a direction substantially perpendicular to said groove.

2. A method of initiating the thermo-chemical reaction between a ferrous metal body and a sheet-like stream of oxidizing gas applied obliquely against successive portions of a path along a surface of said body beginning with a transverse linear zone extending across said surface of said body, said method comprising flame-cutting a groove in said surface substantially parallel with and adjacent to said linear zone from an adjoining edge of said body, thereby quickly preheating said zone to thermo-chemically react with said stream.

3. A method of preheating the surface of an elongated ferrous metal body for thermo-chemical reaction with a plurality of desurfacing streams of oxidizing gas initially projected against substantially aligned portions extending transversely of said surface, said method comprising projecting a flame-cutting starting jet from a side edge across said surface adjacent to said aligned portions to react exothermally with said surface and thereby heat said portions to the ignition temperature.

4. A method of initiating the thermo-chemical reaction between a ferrous metal body and a sheet-like stream of oxidizing gas applied against a linear zone on a surface of said body, said method comprising flame-cutting a plurality of grooves in said surface adjacent to and substantially parallel with said linear zone from at least one adjoining edge of said body, to thereby preheat said zone to the ignition temperature.

5. A method as claimed in claim 4 wherein said grooves are formed by projecting intersecting flame-cutting jets in substantially opposite directions along said surface.

6. A method of initiating the thermo-chemical removal of a shallow layer of metal from the surface of a ferrous metal body wherein a sheet-like metal-removing stream of oxidizing gas extending laterally across said surface between the edges of said body is applied obliquely to initial and successive lateral portions of said surface, said method comprising locally preheating at least one of said edges adjacent to said initial lateral portion; and applying an oxidizing starting jet momentarily against such locally preheated edge and laterally across said surface adjacent to said initial lateral portion to form a shallow incandescent flame-cut groove in said surface to thereby preheat said initial lateral portion to react with said sheet-like metal-removing stream.

7. A method of initiating the thermo-chemical removal of a wide shallow layer of metal from a surface of a ferrous metal body wherein metal-removing oxidizing gas is applied first to an initial lateral zone of said surface extending transversely of said body and then to successively adjoining lateral zones, said method comprising heating a small quantity of combustible metal to substantially a molten condition; depositing particles of such molten metal on said body adjacent to one end of said initial lateral zone; applying a flame-cutting jet against said end and against said particles to produce an oxidation reaction; directing said flame-cutting jet laterally across said surface to produce a flame-cut groove in said surface adjacent to said initial lateral zone, to thereby preheat said zone for thermo-chemical reaction with said oxidizing gas; and thereupon discontinuing said flame-cutting jet.

8. Apparatus for preheating portions of a surface of a ferrous metal body for thermo-chemical reaction with a plurality of desurfacing streams of oxidizing gas projected against substantially aligned portions of said surface, said apparatus comprising flame-cutting means; and a support adapted to hold said flame-cutting means adjacent to said body in position to project a flame-cutting jet along said surface substantially perpendicularly to said streams to form a groove therein adjacent to said aligned portions.

9. In an apparatus for thermo-chemically removing a shallow layer of metal from a surface of a metal body, such as a steel slab or billet, having a desurfacing head for delivering a voluminous sheet-like oxygen stream obliquely against said surface to effect superficial combustion along a transverse zone of said surface, and means for effecting continuous relative motion of said head and said body lengthwise of said surface; the combination of preheating means comprising a cutting blowpipe; and a support adapted to position said blowpipe adjacent to said transverse zone; said cutting blowpipe having a cutting nozzle directed so as to project a flame-cutting jet against an edge of said surface and along said transverse zone substantially at right angles to said stream, to thereby form a starting groove in said surface adjacent to the wide transverse zone of application of said voluminous oxygen stream.

10. An apparatus for thermo-chemically removing a shallow layer of metal from a surface of a metal body such as a steel slab or billet, comprising a desurfacing head for delivering a voluminous sheet-like oxygen stream against said surface to effect superficial combustion along a transverse zone of said surface; preheating means comprising at least one starting blowpipe; means for supporting said starting blowpipe adjacent to said head; said starting blowpipe being provided with a nozzle adapted to project preheating flames and a jet of cutting oxygen against said surface and along said transverse zone, to thereby form an incandescent starting groove in said surface along the zone of application of said voluminous oxygen stream; and means for effecting continuous relative motion of said head and said body lengthwise of said surface.

11. Apparatus as claimed in claim 10 wherein said preheating means comprises a pair of starting blowpipes held by such supporting means at opposite ends of said transverse zone, and wherein said starting blowpipes are provided with nozzles disposed to project preheating flames and cutting oxygen jets toward one another in paths substantially perpendicular to the path of said sheet-like oxygen stream.

12. Apparatus as claimed in claim 10 wherein said means for supporting said starting blowpipe is retractible to permit said starting blowpipe to be moved away from said head during the thermo-chemical layer-removing operation; and including starting-rod mechanism, said

mechanism including means operable by such retractible supporting means to feed a predetermined quantity of combustible metal into the path of said preheating flames and jet of cutting oxygen.

13. An apparatus for thermo-chemically removing a shallow layer of metal from a surface of a metal body such as a steel slab or billet, comprising a desurfacing head for delivering a voluminous sheet-like oxygen stream against said surface to effect superficial combustion along a transverse zone of said surface; preheating means comprising at least one starting blowpipe; means for supporting said starting blowpipe adjacent to said head; said blowpipe being provided with a nozzle adapted to project preheating flames and a jet of cutting oxygen against said surface; starting rod mechanism secured adjacent to said nozzle and adapted to project a small quantity of combustible metal into the path of said preheating flames and said jet of cutting oxygen at a point between said nozzle and said surface, said small quantity being held by said mechanism so that particles thereof, rendered in a molten condition by said flames and jet, fall on said surface adjacent to one end of said transverse zone to preheat said end, said nozzle being positioned so as to direct said jet of cutting oxygen against said heated end of said transverse zone and along said surface adjacent to said transverse zone, to form a starting groove in said surface at the zone of application of said voluminous sheet-like oxygen stream; and means for effecting continuous relative motion of said head and said body lengthwise of said surface.

14. Desurfacing apparatus comprising a desurfacing head adapted to project a sheet-like stream of oxidizing gas against a linear zone extending across a surface of a ferrous metal body; and preheating means comprising at least one metal-removing blowpipe having a nozzle adjacent to said head adapted to project a flame-cutting jet along said linear zone to form a groove in said surface.

15. Apparatus as claimed in claim 14 wherein said preheating means comprises a plurality of metal-removing blowpipes having substantially aligned nozzles spaced respectively across said linear zone and arranged to project flame-cutting jets in the same general direction along said linear zone.

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