Oct. 28, 1941. E. P. JONES ET AL 2,260,322

DESEAMING AND DESURFACING APPARATUS AND PROCESS

Filed April 22, 1939

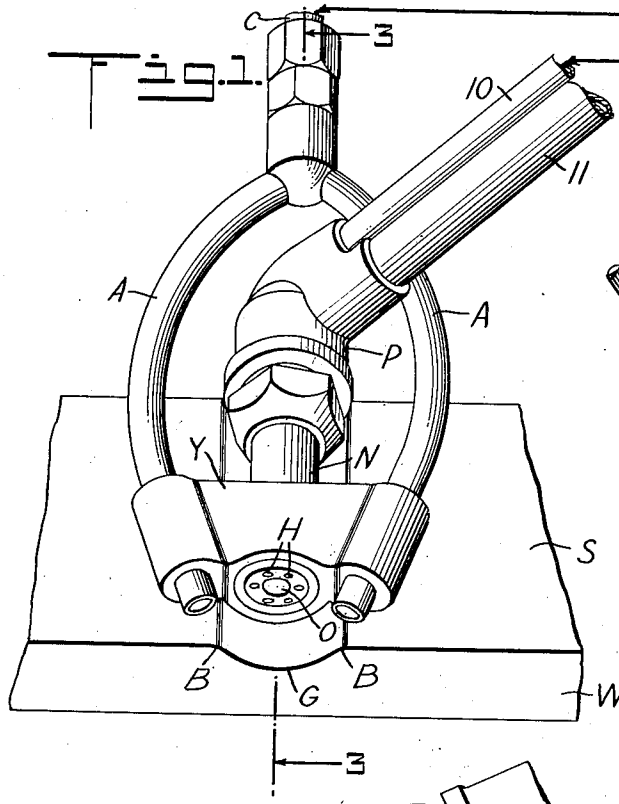


Fig. 1.



Fig. 2.

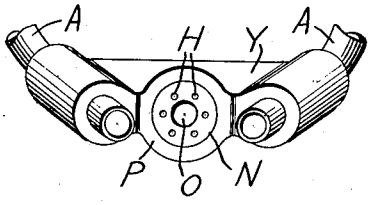
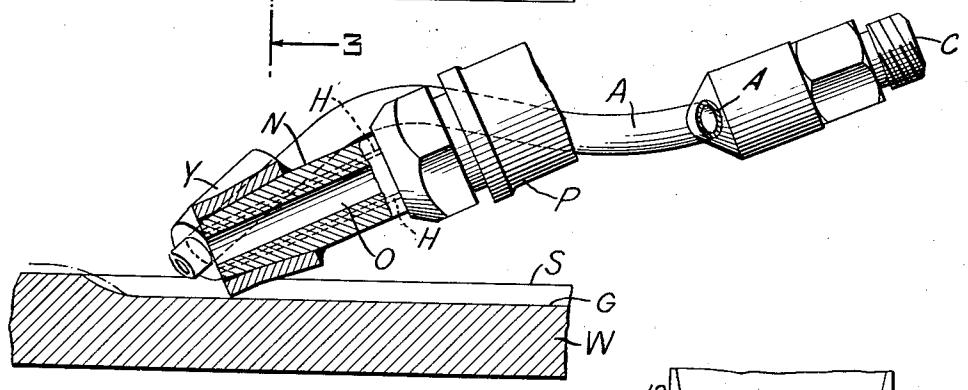


Fig. 3.



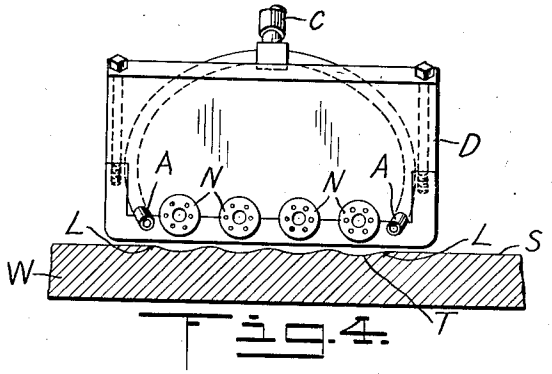


Fig. 4.

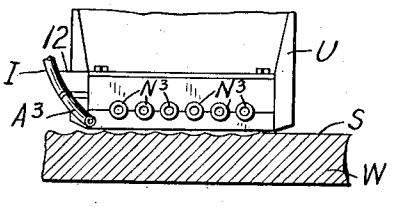


Fig. 5.

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Patented Oct. 28, 1941

2,260,322

UNITED STATES PATENT OFFICE

2,260,322

DESEAMING AND DESURFACING APPARATUS AND PROCESS

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Application April 22, 1939, Serial No. 269,440

5 Claims. (Cl. 148—9)

This invention relates to deseaming or desurfacing, and more particularly to a method of and means for inhibiting fin formation during a deseaming or desurfacing operation.

In the manufacture of ferrous metal bodies, ingots are generally rough rolled into pieces of smaller section and different form, such as blooms, billets, slabs and the like. The latter usually contain superficial flaws or defects, such as blowholes, blisters, cavities, scale and the like, which originate in the vicinity of the surface of the ingot, and rolling and forging, which decrease the cross section of the ingot, also reduce the depth of the defects. However, their length increases as a result of each successive rolling pass, and therefore they produce fissures, cracks, seams, crusts, snakes, laps, spongy areas and other undesirable flaws in the bloom, billet or slab.

To remove these and similar defects and flaws, increased use is being made of the deseaming blowpipe and desurfacing apparatus, because of the marked advantages and superiority of the latter over machine tools. A known deseaming blowpipe is adapted to produce oxy-acetylene flames at a series of openings in the blowpipe tip or nozzle, which surround a larger central orifice. This central orifice is connected with an oxygen supply and has a separate controlling valve, operated by a conveniently located lever on the blowpipe handle. The function of the oxy-acetylene flames is to preheat the surface metal that is to be removed. Above a red heat, iron combines with oxygen so rapidly that it burns with the generation of heat. Iron and oxygen combine to form iron oxide, a material that is solid at ordinary temperatures. Iron oxide, however, melts at a temperature somewhat below the melting point of iron or steel. The heat generated by the burning iron is sufficient to melt the iron oxide, so that it runs off as molten slag, exposing more ferrous surface metal to the action of the oxygen jet. The jet can thus be moved along, producing a clean groove in the surface of the work.

To start the deseaming operation, the preheating flames are used to heat a spot on the work surface to a red heat. Then, when the valve controlling the oxygen jet is opened, the deseaming operation is started. The blowpipe is then tilted and advanced to direct the oxygen jet along and obliquely against the work surface for thermochemical reaction with surface metal. The preheating flames remain burning while deseaming is in progress in order to make up for radiated heat. The operation is quite simple and proficiency is acquired readily by the average workman. By properly manipulating the deseaming blowpipe, a defect or flaw may be removed quickly and satisfactorily from the ferrous metal body, leaving a shallow trough free of all dross and very brilliant, which facilitates inspection to make sure that the defect has been removed.

However, when deseaming by hand with a deseaming blowpipe having a single nozzle, molten metal flows over the edges of the groove, and solidifies to form thin horizontal fins that are attached to the base metal only along the edges of the groove. The heat of the reaction is so great in the deseaming operation that a considerable proportion of the surface metal itself is melted and this molten metal becomes intimately mixed with the molten iron oxide so that the removed material is a mixture of iron oxide and slag, particularly when the efficiency of the reaction is high, that is, when the weight of metal removed per unit of oxygen consumed is high. The amount of metallic iron in the removed material may be as high as 40% or more. For convenience hereinafter, the mixture of molten metal and molten oxide will be termed a slag. Fully oxidized slag, when cooled, is very brittle, but when the slag contains considerable metal it tends to adhere firmly to the edges of the channel produced. Thus, by reducing the metal content of that portion of the slag which is at the edges of the groove, the adherence of the slag after cooling can be prevented.

If the steel contains less than about 0.14% carbon, such fins are ductile and very hard to remove. When many separate grooves are made, each groove results in the formation of two fins. Attempts have been made to remove the fins by briskly rubbing the end of the blowpipe back and forth across the groove, but this greatly shortens the life of the blowpipe and does not fully accomplish the result sought. Some operators when hand deseaming, turn the blowpipe slightly so that the nozzle is at an oblique lateral angle to the direction of the cut so that one fin only is formed at each pass; but this movement requires a technique such that it can be done only by a skilled operator and there always results a fin from the last pass.

It is highly desirable that these fins be removed, because, if allowed to remain on the surface of the work, they will be rolled into the work and cause blemishes. To go over the surface of the work by hand to remove the fins requires

time and greatly increases the cost of deseaming.

Therefore, the primary objects of this invention are to provide: a deseaming apparatus and process wherein fin formation is inhibited; an improved deseaming blowpipe having auxiliary low velocity oxidizing means associated therewith for thermochemical reaction only with fin-forming material tending to overflow the groove as a result of the deseaming operation; an improved process of removing surface metal from a ferrous metal body; improved apapratus for desurfacing; and a fin-inhibiting deseaming blowpipe that is simple and economical in its parts, and very efficient and effective in operation.

The improvement in the process of thermochemically removing surface metal according to the present invention comprises the step of impinging a soft auxiliary oxidizing gas jet along and obliquely against incipient fin-formation while at a kindling temperature for thermochemical reaction with the molten metal which, when cool, would otherwise result in fin formation. The auxiliary oxidizing gas jet is directed so as to oppose the fin-forming tide of molten slag tending to overflow the base metal laterally of the groove following the main desurfacing or deseaming operation. At the same time the auxiliary oxidizing gas jet is maintained at such a low velocity that the metal content of the fin-forming slag is sufficiently reduced by thermochemical reaction to inhibit undesirable fin formation without burning or damaging the underlying base metal at the surface of the body.

The apparatus that is preferred in carrying out the process of this invention comprises a deseaming blowpipe having means for discharging a main oxidizing gas stream along and obliquely against a work surface, and means for discharging a soft fin-inhibiting oxidizing gas jet along and obliquely against said work surface and inwardly and downwardly relatively to said deseaming jet and simultaneously therewith. Compared to the main oxygen jet, the velocity of the auxiliary fin-inhibiting oxygen jet is preferably very low, so as not to interfere with the function of the former, and to inhibit undesirable fin formation without affecting the base metal.

Where a plurality of blowpipe nozzles are assembled in a bank or head for desurfacing a relatively wide surface area, the fin-inhibiting auxiliary oxidizing jets may be associated with one or both of the opposite sides of the blowpipe bank or head, so as to counteract both physically and chemically the tide of molten slag flowing laterally out of said area and over the opposite edges thereof as a result of the desurfacing operation.

Referring to the drawing:

Fig. 1 is a fragmentary perspective and partially diagrammatic view of a deseaming blowpipe embodying features of this invention, in operation;

Fig. 2 is a fragmentary view in front elevation of such blowpipe;

Fig. 3 is a fragmentary view mainly in section on line 3—3 of Fig. 1;

Fig. 4 is a fragmentary view in front elevation of a blowpipe assembly for desurfacing, embodying features of the invention, in operation; and

Fig. 5 is a similar view of a desurfacing unit having an auxiliary fin-formation inhibiting means associated with only one side thereof.

Referring to Figs. 1, 2 and 3, there is shown, by way of example, a preferred embodiment of the invention which comprises a hand deseaming blowpipe P having a main nozzle N provided with a central oxygen orifice O, and a concentric series of heating gas orifices H surrounding the same. The oxygen pipe 10 and heating gas pipe 11 are arranged in parallel relation and are provided with a conventional blowpipe handle or grip, not shown, the arrangement being such that oxygen alone is supplied to the oxygen pipe 10 and a mixture of combustion gas, such as oxygen, and fuel gas, such as acetylene, is supplied to the heating gas pipe 11.

A yoke Y is mounted on the nozzle N and on the yoke Y are mounted, at opposite sides of the main nozzle, a pair of auxiliary nozzles A, A. The auxiliary nozzles A, A are connected to a separate and compartively low pressure source of oxidizing gas, such as oxygen, through a common oxygen supply conduit C. The auxiliary nozzles A, A are conformed and associated with the main nozzle N so as to direct soft jets of oxygen inwardly and downwardly relatively to the deseaming oxygen jet discharged by said main nozzle N. As shown, the front face of the yoke Y is contiguous with the front end face of the nozzle N, the front end faces of the nozzles A, A project beyond the front face of the yoke Y, and the yoke Y is conformed to ride in groove G and along edges B, B thereof.

Since the hand deseaming blowpipe requires a source of oxygen maintained at a pressure of between 50 and 70 pounds per square inch, and since the auxiliary nozzles of the hand deseaming blowpipe operate best when supplied with oxygen from a source maintained at a pressure of between 3 and 5 pounds per square inch, a separate oxygen supply source is preferably used for the auxiliary nozzles. The velocity of the auxiliary oxygen jet is preferably between 50 and 150 feet per second at its point of exit from the nozzle. If desired, this may be accomplished by connecting a throttling valve 13 to the main deseaming oxygen supply line 14, ahead or downstream of the control valve 15, to supply oxygen at a reduced pressure to the auxiliary jets only during deseaming. It will be understood that the foregoing specific velocity and pressure ranges of the oxygen supply sources are given merely by way of example, since they will vary over a much wider range for different types of hand deseaming blowpipes and machine desurfacing blowpipes and for steels of different analyses.

In operation, the blowpipe P may be held so that the main nozzle N directs the preheating oxy-acetylene jets against a selected point on surface S of work W, such as a ferrous metal body, to be deseamed. As soon as the preheating jets raise the selected spot on the work surface to a red heat, the main oxygen orifice O is supplied with oxygen at any suitable deseaming velocity, preferably between 500 and 1000 feet per second according to present efficient practice, and the nozzle N is tilted to impinge the main oxygen jet, as well as the preheating jets along and obliquely against the surface S of the body for thermochemical reaction with surface metal to form a shallow groove G therein, and the blowpipe is advanced. At the same time, the auxiliary nozzles A, A impinge low velocity oxygen jets along and obliquely against said surface S at the lateral borders B, B of the groove G, in such manner that the oxygen

reacts thermochemically with the hot material discharged therefrom as a result of the deseaming operation. The auxiliary oxygen jets also act generally to oppose the tide of molten fin-forming material flowing laterally out of the groove G and over the opposite edges B, B thereof onto said surface S. Undesirable fin formation on the surface S adjacent the groove G is thus inhibited. While the fin-forming molten metal in the slag is sufficiently oxidized to prevent adherence of the slag to the work, the exit velocity of the soft auxiliary oxidizing jets is so low, preferably about 75.6 feet per second, that the base metal is not affected by oxidation. A considerable saving in oxygen is thus effected while at the same time the full oxidizing power of the auxiliary jets is utilized by properly directing them against the molten tide of fin-forming slag flowing laterally out of the groove G.

The fin-inhibiting jets should be directed both downwardly and inwardly relatively to the main deseaming jet for most satisfactory results. Oxygen is supplied to the auxiliary fin-inhibiting jets at such a low pressure and rate relatively to the main jet that the increase in the cost of operation of the blowpipe is slight.

In actual practice it has been found that a relatively unskilled operator can operate the blowpipe of the present invention easily and successfully, because he has not been trained to tilt the blowpipe laterally and, therefore, naturally holds the blowpipe in proper position for best results in eliminating fin formation. If desired, however, the yoke Y may be made free to turn on the nozzle N, so that even though the blowpipe P should be inaccurately positioned, the auxiliary oxidizing jets issuing from the nozzles A, A will be held in proper position for fin elimination by the automatic movement of the yoke Y to the correct position in parallel relation to the work surface S by virtue of the mere resting of the yoke Y on such surface S.

Referring to Fig. 4, there is shown a modification of the invention for desurfacing a relatively wide area of the surface S of the work W, comprising an assembly or bank of a plurality of main nozzles N mounted in a supporting and protecting head D. The nozzles N are adapted to impinge heating jets and desurfacing oxygen jets along and obliquely against the surface S of the ferrous metal body W for thermochemical reaction with surface metal over a predetermined area T thereof, as the head D or body W is moved relatively to the other. Mounted in the head D and laterally thereof, are auxiliary nozzles A, A adapted to impinge low velocity oxygen jets along and obliquely against the surface S at the lateral borders L of the desurfaced area T, for thermochemical reaction exclusively with hot material discharged therefrom as a result of the desurfacing operation. The auxiliary nozzles A are positioned to direct their low velocity or soft jets of oxidizing gas downwardly and inwardly relative to the desurfacing jets so as to counteract the tendency of the latter to blow said hot material out of said area T and over the opposite edges L thereof onto said surface S after the desurfacing operation. As a result, the formation of fins along the lateral edges of the desurfaced area is very effectively and economically inhibited without burning or otherwise affecting the base metal.

If desired, only one fin-inhibiting oxidizing jet may be used in deseaming or desurfacing, particularly when making overlapping successive grooves or passes, as shown by Fig. 5, but the use of two fin-inhibiting jets automatically eliminates the formation of both fins, and thereby, especially in hand deseaming, leaves the operator free to give his attention to other important elements of the technique. This results in improving the character of the work and increasng the efficiency of the operation.

Referring to Fig. 5, the desurfacing unit U of a desurfacing machine is used generally to desurface the surface S of cold work W, such as a ferrous metal body, but, of course, may be used to desurface hot work. When making a desurfacing pass, the desurfacing nozzles N^3 are positioned so as to direct oxidizing jets downwardly and obliquely against the work surface S as the work W and unit U are moved relatively to each other. A relatively large pool of molten slag, actually a mixture of molten slag and metal, flows ahead of the nozzles N^3 because of the reaction, and the large portion of such slag may flow over one edge of the desurfaced area depending upon the relative position of the nozzles N^3 and the direction of the pass; or equal portions of such slag may flow over each edge of the desurfaced area. In all cases, a fin is formed along each edge of the desurfaced area, although such fins may be of unequal magnitude.

The desurfacing machine of Fig. 5 usually desurfaces only a portion of the work surface S at each pass and, therefore, a number of passes are progressively made across the work to desurface the entire surface S. While each pass causes the formation of two fins, one of these fins is removed by the next pass, so that when the work W has been desurfaced there will result a fin on the surface S for each pass plus an extra fin. These fins, as pointed out above, are liable to cause blemishes if rolled into the work W by later operations and also are liable to hide underlying defects. Therefore, it is important that such fins be removed, but, because they contain a high percentage of iron, it is very difficult to remove them by scraping or similar operations, especially when the steel is of low carbon content.

According to the present invention, a relatively flexible tube I is connected to a relatively low pressure oxygen source, and to the outlet end of the tube I a nozzle A^3 is connected and held positioned by a bracket 12 on the unit U, so as to direct a low velocity stream or jet of oxidizing gas downwardly and inwardly along the edge of the pass to burn the molten metal and thus prevent the formation of a fin along that edge which is not desurfaced by the next pass of the desurfacing unit U. Oxygen is supplied to the nozzle A^3 by a separate source, or from the oxygen supply conduit to the unit U provided a throttling valve is provided to reduce the pressure and velocity of the auxiliary jet issuing from the nozzle A^3.

The pressure used for the auxiliary jet preferably is between 10 and 20 pounds per square inch gauge pressure, so that the nozzle pressure is comparatively low compared to the pressure of the desurfacing jets; and, in any case, the velocity of the auxiliary jet should be low enough so as not to affect the base metal of the work W.

A considerable saving in oxygen is effected by the practice of the present invention, because of the new angle at which the auxiliary fin-inhibiting jet of oxidizing gas is directed against

the laterally overflowing tide of molten slag in the desurfacing or deseaming operation. Because of this angle, a soft auxiliary oxidizing jet is sufficient to burn and so reduce the molten metal in such slag that fin formation is inhibited more by thermochemical reaction than by physical reaction of the jet with the fin-forming material. Thus, less oxygen is lost or wasted by so properly directing the auxiliary jet for most efficient thermochemical reaction with the molten metal in the fin-forming tide, and also there is less liability of the auxiliary jet affecting the base metal.

What is claimed is:

1. Blowpipe apparatus comprising the combination with a first nozzle having an orifice adapted to discharge a stream of oxidizing gas at a predetermined velocity along and obliquely against the heated area of a ferrous metal work surface, means for maintaining said velocity of the order of 500 to 1,000 feet per second to effect a thermochemical reaction, thereby removing metal from said area and incidentally forming an undesirable fin along at least one lateral edge of said area, said fin consisting of a thin solid member firmly connected to said work surface along said edge and overlapping said work surface; of means for entirely preventing the formation of said fin during the metal removing operation comprising an auxiliary nozzle having an orifice adapted to discharge a soft fin-inhibiting jet of oxidizing gas, such as oxygen, exclusively against the fin-forming material as it emerges, at its kindling temperature, laterally from said area, means for maintaining the velocity of said soft jet at a very much lower value than the velocity of said oxidizing gas stream and of the order of 50 to 150 feet per second; and means so connecting sad two nozzles that said soft jet is directed downwardly and inwardly with respect to said oxidizing gas stream, with the orifice, from which said soft jet is discharged, in relatively close proximity to the edge of said area.

2. Blowpipe apparatus as claimed in claim 1, wherein the means connecting said two nozzles comprises a yoke mounted on said first nozzle, said auxiliary nozzle being mounted on said yoke at one side of said first nozzle, the front face of said yoke being substantially contiguous with the front end face of said first nozzle, the front end face of said auxiliary nozzle projecting beyond the front face of said yoke, and said yoke being conformed to ride in said area and along said edge.

3. Blowpipe apparatus as claimed in claim 1, wherein the oxidizing gas stream discharged by said first nozzle is accompanied by the incidental formation of an undesirable fin along each edge of said area, and the means for entirely preventing the formation of each fin during the metal removing operation comprises an auxiliary nozzle mounted on said connecting means at each side of said first nozzle.

4. In the process of removing metal from a ferrous metal body by directing heating and oxidizing gas stream along and obliquely against a surface area of said body for thermochemical reaction with heated surface metal wherein a tide of molten material flows laterally over the adjacent surface to form an undesirable longitudinal fin along at least one edge of said area; the method of inhibiting the formation of said fin which comprises impinging a soft auxiliary oxidizing gas jet along and obliquely against said tide of molten material as it flows laterally over said edge for thermochemical reaction exclusively with the molten metal therein, said soft auxiliary oxidizing gas jet being directed downwardly and inwardly with respect to said streams so as to oppose the fin-forming tide of molten material tending to overflow the adjacent surface, and maintaining said soft auxiliary oxidizing gas jet at a velocity substantially lower than a deseaming or desurfacing velocity and of the order of 50 to 150 feet per second, whereby the force of impingement of said soft auxiliary oxidizing gas jet against said tide is only such that the metal content of said molten material is thermochemically sufficiently reduced, in flowing over said edge, to prevent adherence of said material to said edge.

5. In a process of removing metal from a ferrous metal body as set forth in claim 4, the method claimed thereby wherein said soft auxiliary oxidizing gas jet is discharged from an orifice positioned in relatively close proximity to said edge.

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