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PROCESS AND APPARATUS FOR DESURFACING METAL BODIES

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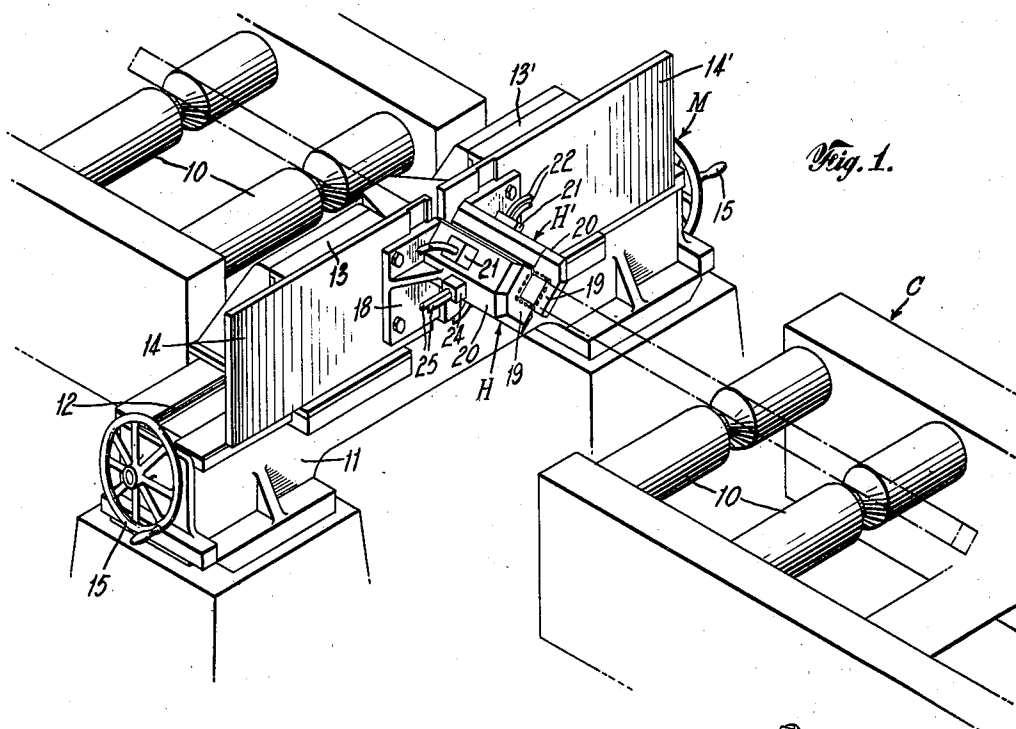
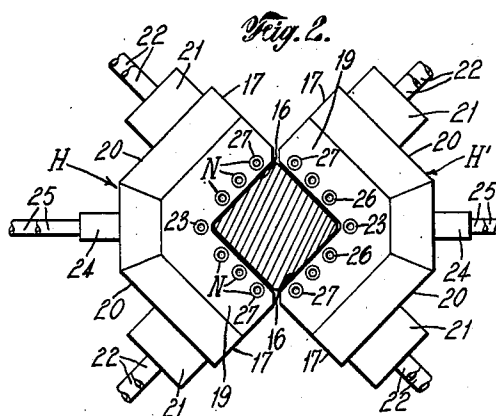
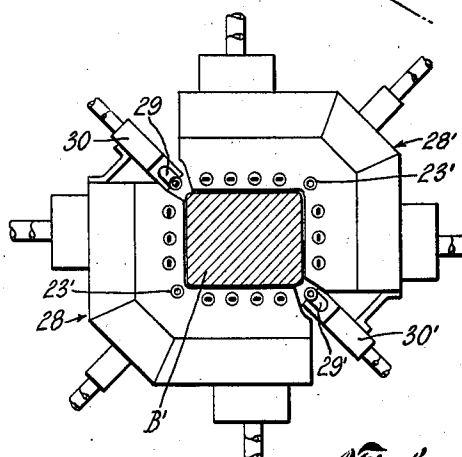
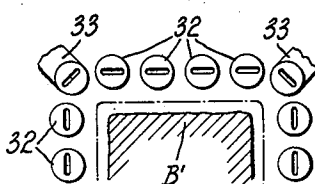
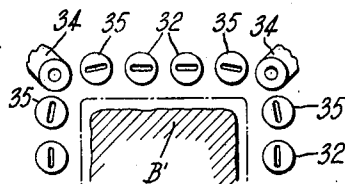


Fig. 4.

Fig. 5.

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PROCESS AND APPARATUS FOR
DESURFACING METAL BODIESEdward Meincke, Scotch Plains, N. J., assignor to
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Application July 27, 1940, Serial No. 347,950

7 Claims. (Cl. 148—9)

This invention relates to the art of conditioning the surfaces of metal bodies and more particularly to an improved process and apparatus for thermo-chemically desurfacing two or more longitudinal surfaces of elongated ferrous metal bodies.

During the production of semi-finished steel shapes, such as blooms, billets, and bars, in a steel mill, certain surface defects such as scabs, scale inclusions, cracks, seams, and the like, occur and it has been found desirable to eliminate such defects by conditioning or thermo-chemically removing a relatively shallow layer of surface metal from the longitudinal surfaces containing the defects. Thermo-chemical surface removal is effected by applying against and along the surfaces, high-temperature heat and surface metal-removing streams of oxygen. An apparatus has heretofore been proposed for desurfacing four sides of rectangular steel billets while they are moved longitudinally along a conveyor line. Such apparatus has included a separate row of desurfacing nozzles for each side of the billet. The nozzles in each row are spaced relatively close to each other so as to form in effect a sheet-like desurfacing gas stream. In such prior nozzle arrangements it has only been possible to obtain removal of surface metal from the longitudinal corner portions of the billet by arranging the width of the rows of nozzles so that both end nozzles of each row are sufficiently close to the corners.

The requirements for steel have become more exacting in recent years and it is desirable that all the defective surface metal of billets for high-quality products should be removed. The defective metal often extends to a greater depth along the corner portions of the steel shapes. Therefore, it is desirable to remove metal to a greater depth along the longitudinal corner portion. With the prior apparatus it has been difficult to obtain metal removal along the corner portions to a greater depth than along the sides of the billet. Also, the nozzle-to-nozzle spacing in each row of nozzles is determined for efficient surface removal from the sides of the body and it is very difficult to accurately space both ends of the row of nozzles with respect to the corners of the billets. This is especially true when the billets vary slightly in size as they generally do.

According to the present invention, these difficulties are overcome by providing desurfacing nozzle heads in a desurfacing machine which include at least two additional desurfacing nozzles arranged to project desurfacing gas streams

against and along at least two of the longitudinal corner portions of the billet. Such nozzles are positioned between adjacent rows of nozzles which project desurfacing gas streams against the sides of the body adjacent to such corner portions. By a suitable arrangement of the desurfacing head, it is possible to provide corner desurfacing nozzles for each of the four longitudinal corners of the billet. When, according to the invention, two diagonally opposite corner desurfacing nozzles are provided, the rows of nozzles can be spaced slightly away from the corners of the billet against which the corner nozzles act and the rows of nozzles can be readily positioned and accurately maintained sufficiently close to the remaining corner portions of the billets so that complete surface metal removal from all four corners is insured even though slight changes in dimensions of the billets may occur. It has been found that even though rows of nozzles have been carefully positioned with respect to the corner portions of the billet that undesirable fin formation tends to occur along certain of the corner portions. Such fin formation is entirely eliminated by the use of corner desurfacing nozzles, according to the present invention.

The principal objects of the present invention are therefore: to provide process and apparatus for removing surface metal to a desired depth from the longitudinal corner portion of a polygonal ferrous metal body when desurfacing at least two adjacent longitudinal surfaces of such body; to provide such apparatus for completely desurfacing the entire longitudinal surface of a rectangular metal body to a desired depth; to provide such apparatus for effectively removing surface metal from the longitudinal corner portions of rectangular metal bodies irrespective of small variations in the cross-sectional dimensions of said body; to provide such apparatus which will insure against the formation of undesirable fins along the corner portions of such body; and to provide a smoothly rounded corner formation on such body.

These and other objects and novel features of this invention will become apparent from the following description and the accompanying drawing in which:

Fig. 1 is a perspective view of an exemplary desurfacing machine including nozzle heads arranged to desurface a rectangular billet when supported and moved longitudinally in the diamond position and embodying a nozzle arrangement in accordance with the present invention;

Fig. 2 is a fragmentary front elevational view

on an enlarged scale of the desurfacing heads of the machine shown in Fig. 1;

Fig. 3 is a similar view of an alternative arrangement of desurfacing heads having nozzles arranged according to the invention; and,

Figs. 4 and 5 are diagrammatic views showing specific arrangements of nozzles with respect to the corner portions of a rectangular billet according to the invention.

Referring now to the drawing, a portion of the customary billet conveyor line of a steel mill is indicated generally at C. In this instance a section of the conveyor has been removed and an exemplary desurfacing machine shown generally at M has been substituted therein. The conveyor C is provided with rollers 10 suitably shaped for supporting and longitudinally moving a billet in the diamond position, that is, with one of the diagonals of the billet cross section vertical. The rolls 10 of the conveyor are customarily power driven by suitable motor driven gearing, not shown. The desurfacing machine may have various forms and usually comprises mechanism for supporting rows of blowpipes, for producing suitable movement relative to the longitudinal surfaces of the billet, and for maintaining such rows of blowpipes in an efficient operating position adjacent to the respective surfaces during the longitudinal movement of the billet through the machine. In some cases, the machine M may be stationary, as shown in Fig. 1, while in other cases, particularly when only a part of the surfaces are treated in one operation, the billet may be stationarily supported and the machine suitably mounted on a carriage for movement with respect to the billet.

Referring to Fig. 1, the machine M may comprise a transverse bed or frame 11 having horizontal transversely extending ways 12 along its upper surface. A pair of slidable members 13 and 13' are mounted for movement toward and away from each other on the ways 12. Vertically arranged carrier plates 14 and 14' are secured respectively to each of the members 13 and 13'. Means for moving the members 13 and 13' toward and away from each other may be provided in the form of a long screw (not shown) rotated by a handwheel 15. Against the front face of each carrier plate and adjacent the inner ends of each there is mounted a nozzle head H and H', respectively. The nozzle heads H and H' may have various shapes according to the size and shape of the body to be operated upon. When all surfaces of the body are to be desurfaced, the heads are so formed as to completely surround the billets when the heads are moved together into the operating position.

When the billets are square in cross section and supported in the diamond position, the heads preferably will have the shape shown in Fig. 1 and Fig. 2. A form of such nozzle head is described in the copending application Serial No. 347,930, filed by James H. Bucknam. The desurfacing heads H and H' generally comprise a box shoe having billet contacting walls 16 adjacent to surfaces of the billet, such walls being angularly related according to the angular relation between the surfaces of the billet. The heads are also provided with upper and lower end walls 17, a back wall 18, a front wall 19 through which the desurfacing nozzles N project, and a top wall 20 through which the means for supplying gas to the nozzles is passed. In the head illustrated in Fig. 2 a row of three nozzles N is arranged to project gas obliquely against each of the two

side surfaces of the billet which are contacted by the wall 16. These nozzles are secured inside the shoe to a header block 21, part of which projects water tightly through the top wall 20 of the shoe. A fuel gas mixture and a desurfacing gas stream are supplied to the header block through conduits 22.

To project a desurfacing gas stream directly against the longitudinal corner portion of the billet, a nozzle 23 is provided midway between the rows of nozzles N. The nozzle 23 is disposed in the horizontal plane and directed at an acute angle to the longitudinal element of the corner portion. The nozzle 23 is supplied with oxidizing and fuel gases by a header block 24 extending to the left through the top wall of the shoe. Conduits 25 supply the oxidizing and fuel gases to the header block 24. The chamber formed by the walls of the shoe provides a water jacket permitting cooling water to surround the nozzles to keep them and the shoe properly cooled during operations. The right-hand head H' is substantially similar to the head just described except that it is opposite handed. When the heads are moved away from each other they separate along the vertical diagonal of the cross section of the billet. In Fig. 2 it will be seen that the end nozzles 26 of the rows of nozzles which are adjacent to the nozzle 23 are spaced at a slightly greater distance from the corner of the billet than the nozzles 27 which are adjacent the upper and lower portions of the billet. This spacing is desirable in order that the desurfacing gas stream issued by the nozzle 23 will blend efficiently with the gas streams issued by the two nozzles 26. The nozzles 27 must be relatively close together in order to insure that the gas streams produced by them will meet sufficiently to remove surface metal from the upper and lower corners. The nozzle 23 is positioned so that the longitudinal axis of the gas stream issuing therefrom is disposed in a plane passing through the corner of the billet and extending intermediately between the planes of the longitudinal surfaces forming such corner.

In some cases, it may be desirable to support the billet on one of its sides instead of in the diamond position. Such flat positioning of the billet is more desirable when the cross section is not square, as shown in Fig. 3. The billet B' is supported on one of its wider sides by conveyor rolls which are cylindrical. The nozzle heads 28 and 28' are similar in construction to the nozzle heads H and H' with the exception that one row of nozzles in each head is longer than the other row of nozzles. The heads 28 and 28' may be mounted on a machine similar to the machine M of Fig. 1 with the exception that the heads 28 and 28' are rotated a quarter turn counterclockwise relatively to the heads H and H'. The heads 28 and 28' may be secured to the carrier plates 14 and 14' in the position shown in Fig. 3. In the embodiment shown in Fig. 3, four corner desurfacing nozzles are provided. The nozzles 23' are similar to the nozzles 23 of the heads H and H' and are adjacent to the lower left-hand corner and upper right-hand corner of the billet B', respectively. For desurfacing the upper left-hand and lower right-hand corners, there is provided a pair of nozzles 29 and 29' which are positioned substantially in the plane of the diagonal of the billet B' and which are secured to separate water-cooled header blocks 30 and 30'. The header block 30 may be secured against the side wall of the shoe of the head 28

so that it will move in unison therewith. The header block 30' may be secured to the lower end wall of the head 28' to be moved in unison with the right-hand head. If desired, however, both header blocks 30 and 30' may be secured to move in unison with one of the heads 28 or 28'. For example, it may be advisable under certain conditions to have the head 28 supported substantially stationarily and the header blocks 30 and 30' may then be secured thereto, while the head 28' is supported for movement independently of the head 28, and preferably in a direction substantially along the diagonal of the billet B' that extends from the lower left-hand corner to the upper right-hand corner.

The nozzle arrangements described herein may be employed with any form of surface removing nozzle. For example, instead of a row of nozzles having circular orifices for projecting gas on a zone completely across one side of a billet, there may be employed a single nozzle having a single wide slot-like oxidizing gas orifice that produces a sheet-like oxidizing gas stream. With such slot-like nozzles, which, for example, might be of the construction shown and claimed in the copending application Serial No. 107,334, now Patent No. 2,267,405, filed jointly by H. W. Jones, H. W. Cowan, and W. J. Jacobsson, it will become particularly advantageous to employ corner desurfacing nozzles according to the present invention because the sheet-like streams produced by such nozzle would be too thin to remove sufficient surface metal from the corner portions of the billet. While rows of nozzles with round orifices may be employed provided they are properly spaced in the row, it has been found particularly advantageous to employ rows of nozzles with oval or laterally elongated oxidizing gas orifices which are aligned to form substantially sheet-like oxidizing gas streams. Such nozzles 32 are indicated in Fig. 4.

In Fig. 4 there is employed for desurfacing the corner portion of the billet, a single slotted orifice nozzle 33. When a slotted orifice nozzle is used at the corner, the depth of surface metal removed is about the same as on the sides so that in general the radius of curvature at the corner of the billet will not be changed. In most instances, however, it will be desirable to remove surface metal from the corner portion of the billet to a greater depth and thereby produce a more rounded corner having a greater corner radius than the original corner radius and for such purposes there is substituted for the nozzle 33 a round orifice nozzle 34 as shown in Fig. 5. The corner nozzle 34 may have an oxygen orifice having a cross-sectional area equal to the cross-sectional area of the orifices of the nozzles 32, and in such case the depth of surface removal at the corner will be relatively great. In practice it has been found preferable to provide the corner nozzle 34 with an outlet orifice having a slightly smaller cross-sectional area than that of a nozzle 32 and to position the corner nozzle 34 with its outlet orifice at a slightly greater distance above the original surface of the corner of the billet than the spacing of the orifices of the side nozzles 32 above the side surfaces of the billet. Each of the nozzles 33 and 34 is positioned so that the longitudinal axis of the gas stream issuing from the nozzle is disposed in a plane passing through the corresponding corner of the billet and between the planes of the surfaces extending along each side of and forming such corner.

Generally the slot-like orifices of the side

nozzles 32 are maintained with their longer dimensions all parallel to the adjacent surface of the billet. In some cases, however, it may be desirable to slightly tilt the orifices of the end nozzles 35 of each row of side nozzles so that these end orifices are inclined toward the corner portions, as shown in Fig. 5. Such positioning is particularly desirable when removing surface metal from the complete surface of relatively small rectangular bars such as high-carbon bar stock. When manufacturing high-carbon bar stock it has been found that heating of the billets and bars in a furnace prior to rolling, decarburizes a layer of the surface metal and if this layer of surface metal is not removed, the finished article has insufficient strength. The heating process tends to decarburize the corner portions of the bars to a substantially greater depth than the side faces. Therefore, it is particularly desirable to desurface the corner portions to a greater depth, which may be accomplished by the apparatus of the present invention. With the corner nozzles suitably positioned, the oxidizing gas streams produced by the corner nozzles and the adjacent side nozzles will blend smoothly to produce a smoothly rounded corner formation entirely free of fins.

Although particular embodiments of the invention have been described in detail, it will be obvious that various changes could be made by one skilled in the art without departing from the principles of the invention.

I claim:

1. In a desurfacing machine for removing surface metal from adjoining surfaces of a ferrous metal body having a longitudinal corner portion between said surfaces, desurfacing apparatus comprising nozzle means arranged to project desurfacing gas streams obliquely against and along each of said surfaces adjacent to said corner portion, said nozzle means being substantially equi-distant from the middle of said corner portion; and additional nozzle means having a slot-like desurfacing gas orifice and constructed and arranged to simultaneously project a ribbon-like desurfacing gas stream directly against and along said corner portion to remove metal therefrom and provide a smoothly rounded corner formation having a predetermined substantially uniform contour, said additional nozzle means being so positioned between and relatively to such first-mentioned nozzle means that the gas streams projected by all of said nozzle means will blend uniformly about said corner portion, and said additional nozzle means being maintained substantially in that plane including the middle of said corner portion and having equi-angular relation to said surfaces.

2. In a desurfacing machine for removing surface metal from adjoining surfaces of a ferrous metal body having a longitudinal corner portion between said surfaces, desurfacing apparatus comprising nozzle means arranged to project desurfacing gas streams obliquely against and along each of said surfaces adjacent to said corner portion; and nozzle means constructed and arranged to simultaneously project a desurfacing gas stream directly against and along said corner portion to remove metal therefrom and provide a smoothly rounded corner formation having a predetermined substantially uniform contour, the position of said last-mentioned corner nozzle means being correlated with the spacing of said first-mentioned surface treating nozzle means from said corner portion so that the streams pro-

duced blend uniformly about said corner portion, said corner nozzle means being maintained spaced from the surface of said corner portion at a greater distance than said surface treating nozzle means are spaced from their respective surfaces.

3. In a desurfacing machine for removing surface metal from adjoining surfaces of a ferrous metal body having a longitudinal corner portion between said surfaces, desurfacing apparatus comprising a row of relatively closely spaced nozzles adjacent to each of said surfaces, each of said nozzles being adapted to apply a desurfacing gas stream obliquely against and along the adjacent surface and having a discharge orifice elongated in the direction transversely of said surface for forming merging substantially ribbon-like streams, said rows extending transversely of each respective surface and said nozzles of each row being fixedly spaced with respect to each other so that the ribbon-like gas streams produced therefrom merge sufficiently to form a substantially sheet-like stream; and a nozzle having a circular discharge orifice disposed between said rows and constructed and arranged for applying a desurfacing gas stream obliquely against and along said corner portion, the position of said last-mentioned corner nozzle being correlated with the spacing of said first-mentioned nozzles from said corner portion so that the streams produced blend uniformly about said corner portion, said last-mentioned corner nozzle being maintained substantially in equi-angular relation to both said surfaces and being spaced at a greater distance from the surface of said corner portion than the corresponding spacing of said first-mentioned nozzles from their respective surfaces.

4. In a desurfacing machine for removing surface metal from adjoining surfaces of ferrous metal bodies having a longitudinal corner portion between said surfaces, desurfacing apparatus comprising a row of relatively closely spaced nozzles adjacent to each of said surfaces, each of said nozzles being adapted to apply a desurfacing gas stream obliquely against and along the adjacent surface and having a discharge orifice elongated transversely of the adjacent surface of the body, the wide sides of said orifices except those nearest the said corner portion being positioned substantially parallel to the adjacent surface and the wide sides of the orifices of those nozzles nearest said corner portion being inclined toward said corner portion, and said rows extending transversely of each respective surface, said nozzles of each row being fixedly spaced with respect to each other so that the gas streams produced thereby merge sufficiently to form a substantially sheet-like stream; and a nozzle disposed between said rows constructed and arranged for applying a desurfacing gas stream obliquely against and along said corner portion, said last-mentioned nozzle having a circular discharge orifice.

5. In a desurfacing machine for removing sur-

face metal from the four longitudinal sides of a rectangular ferrous metal body, desurfacing means comprising two unitary nozzle heads; means supporting said nozzle heads for movement toward and away from each other; nozzle means in each of said heads adapted to project desurfacing gas streams against two of the four longitudinal surfaces of said body, said heads when moved toward each other forming an opening therebetween of substantially the same size and shape as the cross section of said body and said heads being separable substantially along a diagonal of said body; said nozzle means in each head comprising two rows of relatively closely spaced nozzles having slot-like oxidizing gas orifices, each row being arranged substantially parallel to a respective surface of said body and said orifices being spaced at a substantially uniform distance from said respective surfaces; and a corner nozzle carried by each of said heads and positioned between said rows to apply streams of oxidizing gas obliquely against and along the corner portions of said body which are on the diagonal of said body other than that along which said heads separate, said corner nozzles having circular oxidizing gas orifices which are spaced at a slightly greater distance from the surfaces of the respective corner portions of said body than the spacing of said slot-like orifices from the surfaces of said body adjacent thereto.

6. A process of thermochemically conditioning an elongated polygonal ferrous metal body having a corner extending lengthwise of said body and two longitudinal surfaces, one of such surfaces extending along each side of said corner, said process comprising progressively applying an oxidizing gas stream obliquely against successive heated portions of said corner, said stream having its longitudinal axis disposed in a plane passing through said corner and extending between the planes of said surfaces; and simultaneously progressively applying oxidizing gas streams obliquely against successive heated areas on both of said surfaces, the point of discharge of said corner stream being maintained slightly farther from the surface of said corner than the points of discharge of said other streams are maintained from the respective surfaces whereby the lateral portions of the several oxidizing streams merge substantially uniformly with one another to provide a continuous oxidizing gas stream extending around said corner.

7. A process as claimed in claim 6 in which said oxidizing gas stream applied to said corner is of substantially circular cross section before impingement against said corner, and said oxidizing gas streams applied against and along the surfaces forming said corner comprise ribbon-like streams spaced with respect to said corner to merge substantially uniformly with said stream applied to said corner at the zone of impingement.

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