United States Patent [19]

Lytle

[11] **3,764,122**

[45] **Oct. 9, 1973**

[54] **APPARATUS FOR SELECTIVELY SCARFING METAL BODIES**

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[73] Assignee: **Union Carbide Corporation**, New York, N.Y.

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[21] Appl. No.: **118,048**

[52] **U.S. Cl.** ..... **266/23 H**, 239/505

[51] **Int. Cl.** **B23k 7/06**

[58] **Field of Search** ..... 266/23 D, 23 E, 23 H, 266/23 HH, 23 K, 23 L, 23 M, 23 P, 23 R; 148/9.5; 239/103, 433, 558, 505, 506, 507

[56] **References Cited**

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Primary Examiner—J. Spencer Overholser
Assistant Examiner—John S. Brown
Attorney—Harrie M. Humphreys and Lawrence G. Kastriner

[57] **ABSTRACT**

A conventional continuous oxygen slot nozzle scarfing unit can be adapted for selectively scarfing the flanges of beam blanks without scarfing the web by inserting a removable flow restricting plug into the oxygen nozzle slot. The plug may vary in size and may be shaped to direct the flow of the oxygen. Auxiliary air streams may be used in conjunction with the plug to prevent molten metal from flowing over onto the web. The modified scarfing unit may be used in conventional four-sided self-sizing scarfing machines.

2 Claims, 5 Drawing Figures

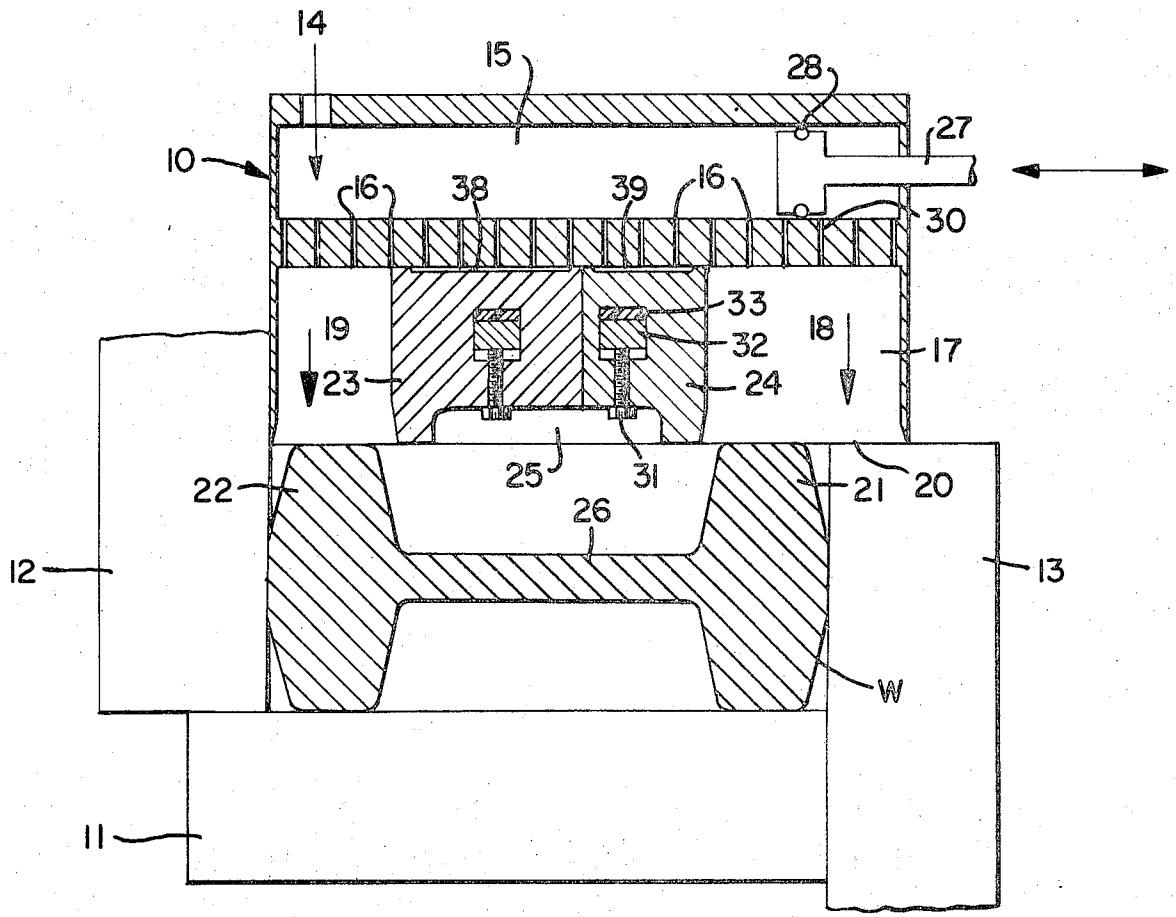
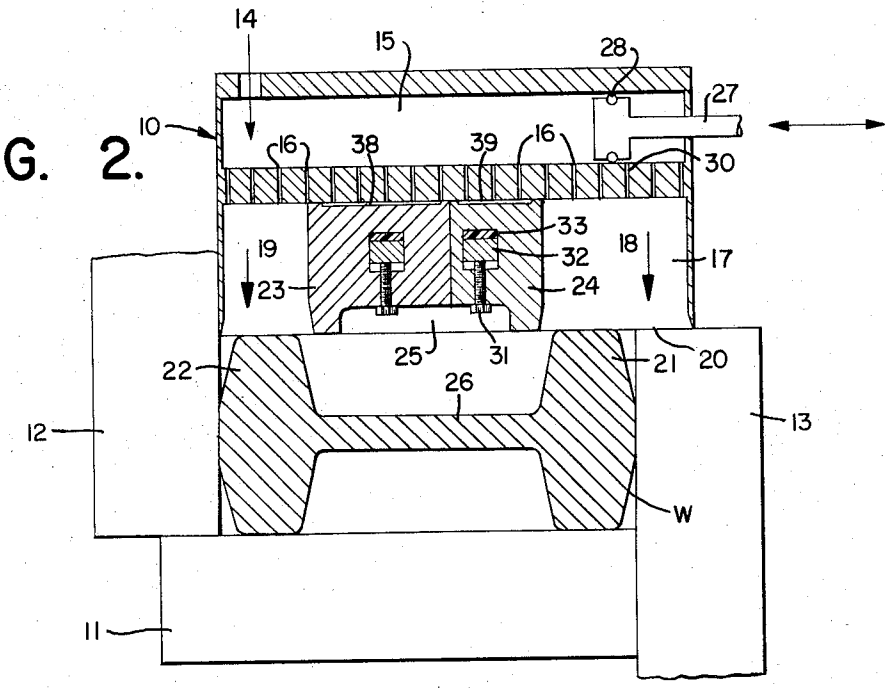


FIG. 2.



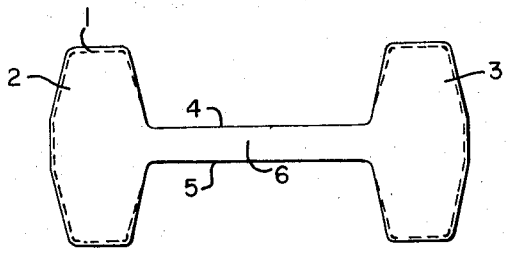


FIG. 1.

FIG. 3.

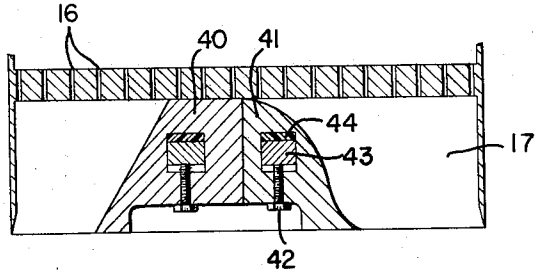


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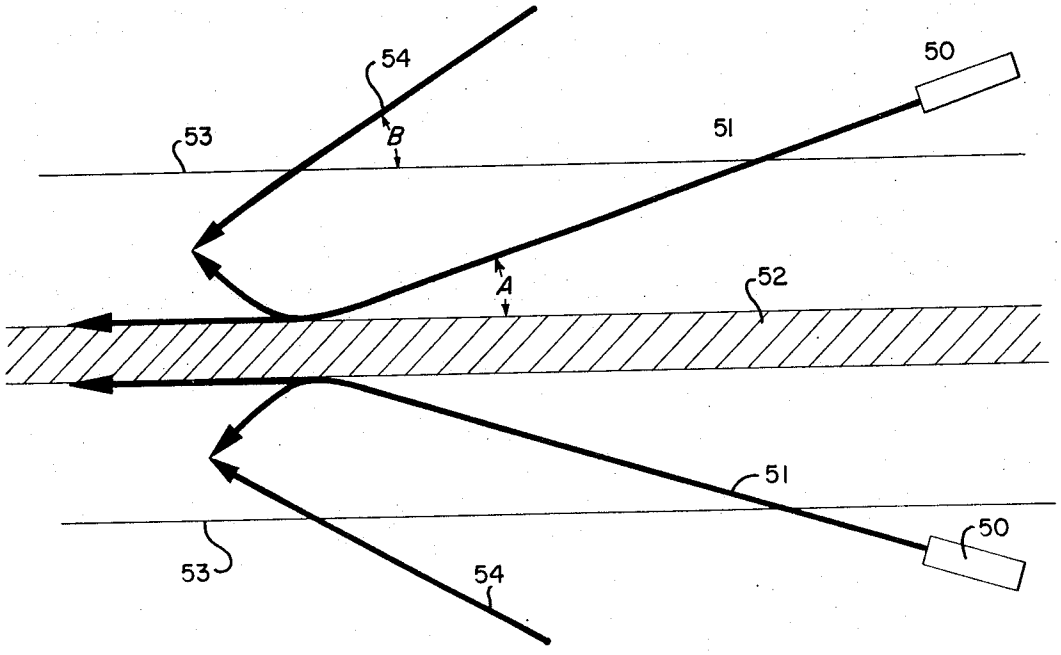
FIG. 4.



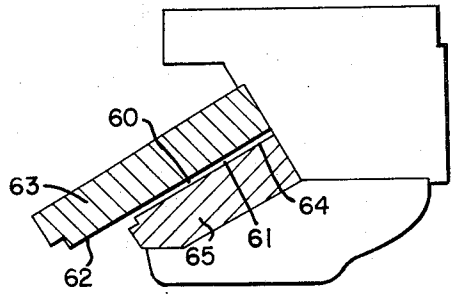


FIG. 5.

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APPARATUS FOR SELECTIVELY SCARFING METAL BODIES

BACKGROUND

This invention relates to apparatus for selectively scarfing the surface of ferrous metal bodies, particularly non-uniformly cross-sectioned bodies such as beam blanks.

Structural steel shapes such as I beams, channels and the like are commonly rolled from rectangular ingots by forming blanks, such as beam blanks, having a cross-sectional outline similar to the shape of the finished structural member. During the course of the rolling operation, the ingots are rolled into beam blanks which are then rolled further into the desired structural shape by being subjected to a series of successive changes in shape and reduction in thickness. Beam blanks are therefore an intermediate stage in the overall rolling operation of the finished product.

Surface metal defects such as cracks, seams and slag inclusions are commonly encountered in both the flange and web sections of beam blanks. Since the presence of such defects seriously affects the ultimate loading capability of the finished I beams, the beam blanks are commonly subjected to a thermo-chemical surfacing reaction referred to in the art as scarfing.

From the structural mechanics relating to I beam loadings, it is known that the most highly stressed portions of the beam are in the outer corners, i.e., the two flange sections of the beam. Defects in the web area are generally not critical since they do not affect the loading capability of the finished beam, and hence are more tolerable. Consequently, the most efficient method of scarfing beam blanks is to restrict the scarfing reaction solely to the flange sections while leaving the surface of the web portion unscarfed.

Beam blank scarfing has heretofore been carried out primarily on special type of apparatus, that is special purpose machines which are solely able to accomodate a particular size and shape of product. U.S. Pat. No. 3,398,943 illustrates a scarfing machine in which the scarfing heads are contoured to correspond to the particular shape of the metal workpiece to be scarfed. Although such machines are effective for scarfing a given beam blank size, the disadvantages of this type of apparatus are severe, because the inordinate amount of time required to assemble and disassemble the scarfing heads precludes the commercial use of such machines for anything other than a single size and shape of metal workpiece. As a result, such machines have only limited commercial value.

In an effort to accomodate the wide variety of product sizes and shapes encountered in steel mill operations, conventional four-sided scarfing machines, such as for example, the self-sizing machine described in U.S. Pat. No. 3,462,135, have been employed for scarfing beam blanks. However, the use of such machines for scarfing beam blanks presents serious operating problems. Specifically, if uniform oxygen flow issues from the four sides surrounding the beam blanks, metal removal is uneven because the desurfacing reaction along the edges and sides of the flanges is much more effective than the reaction at the web surface. This results in a poorly controlled scarfing reaction and consequently a poorly scarfed product.

More important, however, is the fact that heretofore, the scarfing of beam blanks with a four-sided scarfing machine has precluded the scarfing of such sections in the generally preferred pattern. That is, selectively scarfing only the flange portion of the beam blank surface. This problem is attributable to the nature of the continuous oxygen slot nozzle with which the scarfing heads are provided. Such nozzles provide a continuous and uniform sheet-like stream of oxygen gas across the work surface of the metal body. Since in the majority of instances, only the flanges of the beam blank require desurfacing, removal of metal from the web surface represents a wasteful operation, rendering the entire scarfing operation inefficient. This is particularly true for beam blanks where the web surface represents the major portion of the metal work surface.

OBJECTS

It is an object of this invention to provide scarfing apparatus capable of selectively scarfing only preselected portions of a metal workpiece, while leaving the remaining portion of said workpiece unscarfed. It is another object of this invention to provide scarfing apparatus capable of selectively scarfing only the flange sections of beam blanks. It is another object of this invention to provide a scarfing unit which may be quickly and easily adjusted to accomodate a range of sizes and shapes of metal workpieces to be scarfed. It is a further object of this invention to provide a scarfing unit capable of selectively scarfing a metal work surface while preventing molten metal from running over into the unscarfed portions of the workpiece. It a still further object of this invention to provide a scarfing machine, such as a four-sided, self-sizing scarfing machine, capable of scarfing only the selected portions of a non-uniformly cross-section metal workpiece.

SUMMARY OF INVENTION

These and other objects, which will become apparent from the detailed disclosure and claims to follow are achieved by the present invention, which comprises in a scarfing unit comprising flat upper and lower surfaces defining therebetween a wide continuous slot nozzle adapted to discharge a sheet-like stream of oxygen gas through the front end of said nozzle at a zone extending across the metal body to be scarfed, said scarfing unit containing a multiplicity of orifices through which oxygen gas is directed into the back end of said nozzle, the improvement comprising: means for restricting the flow of said oxygen gas through a section of said nozzle, said means being disposed within said nozzle in such manner as to be substantially contiguous with the upper and lower surfaces of said nozzle and being narrower in width than the width of said nozzle, whereby said scarfing unit is rendered capable of selectively scarfing a pre-selected portion of said metal body narrower than the width of said nozzle, while leaving the remaining width of said metal body corresponding to the width of said flow restricting means unscarfed.

Although the present invention is most advantageously used to scarf beam blanks, the term "metal body" as used throughout the specification and claims is not intended to be restricted to such metal shapes, but rather is meant to include any metal sections requiring scarfing wherein a portion of the workpiece is sought to be scarfed while leaving a remaining portion unscarfed. Thus, the present invention is particularly useful for scarfing non-uniformly cross-section metal bodies.

It is to be noted that the term flow restricting means is not intended to be limited to completely restricting the flow of oxygen but may be used only to direct the flow. On the other hand, the restricting means may entirely plug up the orifices at the back end of the slotted nozzle so that complete restriction is obtained. Furthermore, the flow restricting means may have edges parallel to the edges of the scarfing unit thereby directing the flow of oxygen in a straight path, or may be angularly shaped thereby creating a change in the direction of the oxygen flow through the nozzle such that the oxygen stream passing through the nozzles strikes the section of the workpiece to be scarfed with a force and direction so as to prevent molten metal from running over into the portion of the workpiece which is not to be scarfed.

In a preferred embodiment of the present invention, the scarfing unit is used in combination with a four-sided, selfsizing machine such as described in U.S. Pat. No. 3,462,135. According to this embodiment of the invention, the scarfing machine comprises upper, lower, first side and second side scarfing units adapted to scarf, respectively, the corresponding side of the metal body to be scarfed. It will be apparent to those skilled in the art that each side may be made up of several scarfing units butted up against each other in accordance with conventional practice.

THE DRAWINGS

FIG. 1 depicts a beam blank upon which the preferred pattern of metal removal is indicated by the dotted lines.

FIG. 2 is a schematic in partially foreshortened sectional representation of a scarfing unit in combination with a four-sided scarfing machine in accordance with a preferred embodiment of the present invention.

FIG. 3 is an illustration of two angularly shaped flow restricting members according to the present invention.

FIG. 4 is a schematic view of a beam blank upon which the flow profiles of the scarfing oxygen streams are indicated relative to pressurized air streams used in accordance with the present invention.

FIG. 5 is a diagramatic elevation in partial cross-section of a scarfing unit provided with flow restricting means in the oxygen nozzle in accordance with the present invention.

DETAILED DESCRIPTION

Referring to FIG. 1, the preferred pattern of beam blank scarfing in accordance with the present invention is shown by dotted line 1 indicating that metal removal is only effected along the surface of the beam blank flanges 2 and 3, leaving the upper and lower surfaces 4 and 5 respectively of web 6 untreated.

FIG. 2 shows scarfing unit 10 used as the upper scarfing unit in combination with a four-sided scarfing machine (not shown in its entirety) including lower scarfing unit 11, first side unit 12 and second side unit 13, all schematically represented. Scarfing oxygen indicated by arrow 14 is fed through oxygen supply manifold 15 and passes therefrom through a multiplicity of orifices 16 into the back end of continuous slot nozzle 17. The oxygen passes through nozzle 17 in the direction shown by arrows 18 and 19 and out through the front end 20 of nozzle 17 being thereby directed at the flanges 21 and 22 at the workpiece W, which in the present case is shown as an I beam. Flow restricting members 23 and 24 are contiguous with the upper and lower surfaces of the preheat blocks (not visible in this view) and extend forwardly from the back end of slotted nozzle 17 being in contact so as to shut off certain of the orifices 16 and extending to the front end 25 of oxygen slot 17, thereby completely filling a section of said nozzle 17. Flow restricting members 23 and 24 are positioned within nozzle 17 so as to prevent oxygen gas from impinging upon the web surface 26 of the workpiece W, thereby preventing scarfing oxygen reaction from taking place thereon. The beam blank 20 is thus selectively scarfed only along the flange surfaces 21 and 22.

Size adjusting piston 27 is positioned within the oxygen supply manifold 15 in accordance with the size of the particular metal body to be scarfed in accordance with the conventional manner. It serves to prevent the oxygen gas 14 from filling the oxygen manifold 15 beyond the limits of the O-ring 28 and thus illustrates the number of orifices 16 which are operative during the scarfing reaction. In the embodiment shown orifices to the right of orifice 30 would be inoperative and oxygen would be supplied only to those orifices to the left of said orifice 30.

Flow restricting members 23 and 24 are removably inserted within oxygen slot nozzle 17 by means of a screw 31 which forces anvil 32 to press against compressible pad 33 which may be made for example of Teflon, causing it to expand in a direction normal to screw 31 thereby locking it in place against a surface to the preheat block (not shown in FIG. 2 since such planes are parallel to the plane of the drawing).

In FIG. 3 flow restricting members 40 and 41 illustrate the angular shapes which the size of such members can assume in applications where it is desirable to create a change in the scarfing oxygen stream which passes through nozzles 17. By properly shaping the side of the flow restricting means 40 and 41, for a given workpiece to be scarfed, it is possible to create an oxygen flow pattern such that the oxygen strikes the section of the work surface to be scarfed in a manner which prevents molten metal from running over into the section of the workpiece which is not to be scarfed. Members 40 and 41 are removably inserted into the oxygen slot nozzle 17 in like manner as previously described by means of screws 42, anvils 43 and compression pads 44.

In FIG. 4 air jets 50 are shown as they would be used in combination with the present invention. Pressurized air streams 51 shown above and below the web 52 are directed at said web and are deflected therefrom along flanges 53 to prevent molten metal from the scarfed flanges 53 from running over on to the surface of web 52. The angle of deflection of air stream 51 will be governed by its angle of impingement upon web 52, the particular shape of the work surface which it strikes and the motion of the work surface relative to the air stream. The flow of oxygen stream 54 is also shown impinging upon flanges 53. It should be noted that angle A, the angle of impingement between air stream 51 and the surface of web 52 should always be somewhat less than angle B, the angle of impingement between oxygen stream 54 and flange edge 53.

FIG. 5 illustrates the relative orientation of the flow restricting member 60 which fills the oxygen nozzle 61 formed between the lower surface 62 of upper preheat

block 63 and the upper surface 64 of lower preheat block 65.

It is preferred that the flow restricting members 23 and 24 not be flush or contiguous with the upper and lower surfaces defining the nozzle slot 17, but rather that they be substantially contiguous, that is leaving a clearance therebetween for the flow of a small amount of oxygen. This is illustrated in FIG. 2 wherein recesses 38 and 39 are provided between the upper surfaces of flow restricting members 23 and 24, respectively and the lower surface of the upper preheat block to enable a small flow of oxygen gas eminating from the orifices in back of members 23 and 24 to pass through said recesses. The purpose of this small oxygen flow is to keep the exposed front end surface of the upper block clear of slag flow-back which would otherwise accumulate during the scarfing operation.

I claim:

1. In a scarfing unit comprising flat upper and lower surfaces defining therebetween a wide continuous slot nozzle adapted to discharge a sheet-like stream of oxygen gas through the front end of said nozzle at a zone extending across the metal body to be scarfed, said scarfing unit containing a multiplicity of orifices through which oxygen gas is directed into the back end of said nozzle, the improvement comprising means for rendering the scarfing unit capable of selectively scarfing a preselected portion of said metal body narrower than the width of said nozzle while leaving the remaining portion of said metal body unscarfed, comprising: means for restricting the flow of said oxygen gas through a section of said nozzle, said flow restricting means being disposed within said nozzle in such manner as to be substantially contiguous with the upper and lower surfaces of said nozzle and being narrower in width than the width of said nozzle, and said means having sides angularly shaped so as to create a change in the direction of a portion of the oxygen stream passing through the oxygen slot such that the oxygen stream impinging upon the preselected portion of the metal body prevents molten metal from running over on to the remaining unscarfed portion of the metal body corresponding to the width of said flow restricting means.

2. In a scarfing unit comprising flat upper and lower surfaces defining therebetween a wide continuous slot nozzle adapted to discharge a sheet-like stream of oxygen gas through the front end of said nozzle at a zone extending across the metal body to be scarfed, said scarfing unit containing a multiplicity of orifices through which oxygen gas is directed into the back end of said nozzle, the improvement comprising means for rendering the scarfing unit capable of selectively scarfing the flange surface of a beam blank while leaving the web surface unscarfed, comprising: means for restricting the flow of said oxygen gas through a section of said nozzle corresponding to the web surface of the beam blank to be scarfed, said flow restricting means being disposed within said nozzle in such manner as to be substantially contiguous with the upper and lower surfaces of said nozzle, and nozzle means for directing a pressurized air stream at the web, such that said air stream is deflected therefrom upward along the flange to prevent molten metal from the scarfed flange from running over on to the surface of the unscarfed web.

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UNITED STATES PATENT OFFICE
CERTIFICATE OF CORRECTION

Patent No. 3,764,122 **Issue Date** October 9, 1973

Inventor(s) T. J. Lytle

It is certified that error appears in the above-identified patent and that said Letters Patent are hereby corrected as shown below:

In claim 2, line 28, before the words "and nozzle means" insert -- and being narrower in width than the width of said nozzle --.

Signed and sealed this 17th day of June 1975.

(SEAL)
Attest:

RUTH C. MASON
Attesting Officer

C. MARSHALL DANN
Commissioner of Patents
and Trademarks