This invention relates to scarfing of billets or other metal bodies by means of oxygen streams directed at an angle against heated surface metal.

In its broadest aspects, it is an object of the invention to provide improved scarfing apparatus capable of following irregularities in the surface of the billet or other work piece.

The invention comprises apparatus in which the oxygen jets are maintained in a definite relation to the metal surfaces on which they operate, and are caused to shift automatically to maintain such relation on undulating surfaces caused by variations in the shape and thickness of the work piece, and on curving surfaces such as those of a crooked billet.

The invention also comprises an improved billet scarfing machine for efficiently scarfing all sides of a billet while the billet is moving along a conveyor, such as a mill table leading to a rolling mill. It is difficult to scarf a billet during its movement along a mill table because most billets are not straight and each surface upon which the scarfing jets are directed may shift toward, away from, or sideways to either the right or left, with respect to the scarfing jets, depending upon the direction, or combination of directions, in which the billet is crooked. This invention not only follows the billet automatically from side to side on the conveyor, and up and down over the conveyor, but will even follow a portion of the billet that extends below the top level of the conveyor rolls while passing between successive rolls of the conveyor or mill table.

In the preferred embodiment of the invention torch-positioning devices are supported on pivot connections with axes at right angles to one another affording a universal movement to the torch-positioning devices.

Another object of the invention is to provide improved apparatus for holding scarfing torches or suitable bearing members connected with the torches, in contact with the surfaces of the billet, or other metal body, on which the torches are operating. In accordance with another feature of the invention, the torches, or bearing members connected with the torches, are held in contact with the work by yielding pressure applied in two directions for causing the torches automatically to advance or recede, or shift sideways, to accommodate themselves to irregularities in the shape of the billet. Gas pressure, such as the pressure of a pneumatic motor, is used to hold the torches against the work, and the same means can be used for bringing the torches into position to contact the billet or for moving them away from the billet at the end of the scarfing operation, or holding the torches retracted while waiting for a new billet to move down the table or conveyor into position for the scarfing torches to operate upon it.

Other objects of the invention relates to simplified torch supporting apparatus for holding torches on a common support in contact with two sides of the billet at the same time with a yielding pressure.

Although this invention is described in connection with the surfacing of billets, it will be understood that it can be applied to other work pieces and that billets are merely illustrative of the kind of work pieces for which the invention is intended.

Other objects, features and advantages of the invention will appear or be pointed out as the specification proceeds.

In the accompanying drawings, forming part hereof:

Fig. 1 is a top plan view of a mill table or conveyor and scarfing apparatus embodying this invention.

Fig. 2 is a slightly enlarged side elevation of the apparatus shown in Fig. 1.

Fig. 3 is an enlarged end view with a portion of the structure broken away along the line 3—3 of Fig. 2.

Fig. 4 is an enlarged detail view of a part of the structure shown in Fig. 1.

Fig. 5 is a sectional view taken on the line 5—5 of Fig. 4.

Fig. 6 is an enlarged view of one of the torches.

Fig. 7 is a sectional view on the line 7—7 of Fig. 6.

A mill table or conveyor 10 comprises a fixed frame 11 that supports rollers 12 for rotation about substantially horizontal and parallel axes. Each of the rollers 12 has end shafts or axles 13 extending into pillow blocks 14 secured to the frame 11, and the shafts 13 at one side of the rollers 12 extend beyond the pillow blocks 14 and have bevel gears 16 secured to them for driving the rollers 12.

A drive shaft 18 turns in bearings in supports 19 that extend from the side of the frame 11. Bevel gears 20 on the shaft 18 mesh with and drive the gears 16 on the axles 13 of the conveyor rollers 12.

A billet 22 is shown in dot-and-dash lines passing down the center of the conveyor 10. Other billets are of different size and most billets are
crooked throughout at least a portion of their length. Provision is made for billets of different size by changing the size of the scarfing torch elements, but even when working on a single size of billet it is important to be able to follow the surface of a crooked billet and undulations caused by variation in its shape.

Torch elements 24 (Fig. 3) may comprise a plurality or group of torches disposed close together in position to project touching streams against a billet surface, but are here shown as looking tips with rows of surfaces for directing the touching streams of oxygen against a billet surface. Each of the torch elements includes a shoe on one side of the tip for contacting with the surface of the billet. This structure cannot be shown on the scale of Fig. 3 but will be described in connection with Figs. 6 and 7.

The torch elements 24 for scarfing the top and left side of the billet are connected to a torch-positioning device comprising a bracket 25, and the torch elements for scarfing the bottom and right side of the billet are connected to a similar device or bracket 26.

The bracket 26 is connected to the end of a tubular arm 28 (Fig. 1) which is supported by a frame 29. The arm 28 is connected to the frame 29 by a pivot 30 at the end of the arm 28 remote from the torch holder 25. This construction is best shown in Figs. 4 and 5. The frame 29 is of angular section, and overlies the top and one side of the tubular arm 28 throughout most of the length of the arm.

The frame 29 has a short box structure 31 that provides a bearing for the pivot 33. The end of the arm 28 through which the pivot 33 passes comprises an end casting 32 with a stud that extends into the tubular portion of the arm and is fastened in position by a pin 33. The axis of the pivot 33 is substantially horizontal and parallel to the axes of the conveyor rails in the illustrated embodiment of the invention.

The frame 25 is supported at its end remote from the bracket 26 by a pedestal 34, best shown in Fig. 2. The pedestal 34 is connected to the fixed frame 11 of the conveyor by bolts 35, and the frame 29 is connected to the pedestal 34 by a pivot 36 that extends at right angles to the pivot 33. This combination of pivots gives the torch-positioning device 26 movement upward and downward, and to the side of a billet, or any combination of movements for maintaining torch elements against the top and side surface of a travelling billet in spite of undulations of the surfaces.

The frame 29 is supported at its end remote from the pivot 36 by wheels 38 (Fig. 3) that roll on the top flanges of a cross beam 39 or other suitable supporting surface. A cylinder-and-piston motor 40 has a piston rod 41 connected with the frame 29 by a pivot connection 42. The cylinder of the motor 40 has pintles 43 that support the motor or from a bracket 44 bolted to the cross beam 39 which is in effect a part of the stationary or fixed frame 11 of the conveyor.

The axes of the pintles 43, pivot connection 42, and pivot 30 (Fig. 1) are parallel with one another.

The frame 29 has upwardly extending supports 45. A cylinder-and-piston motor 47 has pintles 48 extending into the supports 46. The motor 47 has a piston rod 49 connected by a pivot 50 with a clamp 51 that grips the tubular portion of the arm 28 and comprises a part of the arm 28. The axes of the pintles 48 and pivot 50 are parallel with the axis of the pivot that connects the arm 28 to the frame 29.

The torch-positioning device 25 is supported by structure similar to that already described for the torch holder 25 with the necessary reversals for the opposite side of the conveyor, and parts of the supporting structure for the torch compared with that described for the torch holder 25 that correspond to those of the torch holder 25 are indicated by the same reference characters.

When a scarfing operation is to be started on a billet, the torch elements 24 are vertically moved back out of the path of the billet by supplying compressed gas to the cylinders of the motors 43 to cause those motors to draw the frames 29 away from one another and from the center of the conveyor. At the same time the motor 47 on one side of the apparatus is operated to lower the bracket 26 and the corresponding motor 47 on the other side of the apparatus is operated to raise the bracket 25. The torch elements 24 are then out of the way where they cannot be struck by the end of the billet 22.

As soon as the end of the billet 22 has passed the brackets 25 and 26, compressed gas is supplied to the motors 43 and 47 to cause them to move in the reverse direction and bring all of the torch elements 24 into contact with the billet 22. The compressed gas holds the torch elements against the billet with a yielding pressure that causes the torch element that is against any surface of the billet to yield or advance in response to any horizontal change in the relative position of that surface with respect to the center line of the conveyor or any vertical change with respect to the level of the conveyor.

The bracket 25 has a clamp 53 at one end for securing it to the tubular arm 28. The bracket 26 is of similar construction but is partly broken away in Fig. 3, to expose the structure behind it. The torch elements 24 may be bolted to the brackets 25, 26.

In order to prevent the torch elements 24 from striking one another if the torch-positioning devices are brought together with no billet between them, or with a billet too small for the torch elements 24, limit stops are provided. Screws 54 threaded through lugs on the pivot 30 strike against abutments 55 on the bracket 26.

The torch elements 24 are preferably set at a compound angle to the billet surfaces so that the oxygen streams from each of the torch elements are not only directed at an angle toward the billet surface, but the projections of the streams on the billet surfaces have a directional component toward a longitudinal edge of the billet. The torch elements are also correlated so that the oxygen streams from the torch elements that are directed against contiguous surfaces have components in the direction of, or away from, the longitudinal edge along which those surfaces meet. For example, the torch elements 24 carried by the bracket 25 are both canted so that their oxygen streams have components away from the upper left-hand corner of the billet 22 in Fig. 3. The other torch elements direct their streams at an angle away from the bottom right-hand corner of the billet. With their associated torch elements, the molten slag and oxide produced by the reaction of the scarfing against the surface metal of the billet are blown off the billet along the upper-right and lower-left longitudinal corners of the billet. In installations where upwardly directed slag streams
are objectionable, this feature may be used for the bottom and only one side face.

Figs. 6 and 7 show one of the torch elements comprising a block tip 57 with a row of oxygen jet orifices 58 in its bottom face, and each orifice 58 has a number of preheating jet orifices 59 above it. Fig. 7 shows an oxygen jet 59' and preheating jet 59". A shoe 60 is connected with the tip 57 by screws 61. The shoe 60 is preferably made of steel and may be hard-faced to reduce wear. The purpose of the shoe 60 is to keep the brass tip block 57 from touching the hot billet, because the brass would wear away very rapidly, and the torch might be heated excessively by contact with the billet.

The shoe 60 is cooled by jets of air that issue from orifices at spaced points along the length of a header 62. These jets of air are blown through the space between the tip and shoe in the direction indicated by arrows in Fig. 7 and the volume of air is insufficient to interfere with the operation of the preheating devices 59". A second header 64 supplies compressed air to aid the combustion of the preheating flames 59'.

The scarifying operation is made more efficient, that is, less oxygen is required to do the same scarifying as the preheating torches 59' above, and only above, the oxygen scarifying jets 59". Probably the products of combustion of preheat flames under the scarifying jets flow between the scarifying jets and the surface of the work piece so that the scavenging oxygen does not come into immediate contact with the work, or the dilution of the lower part of the oxygen streams with products of combustion of the preheating flames under the oxygen streams, reduces the effectiveness of the scavenging.

Certain features disclosed but not claimed herein are claimed in a divisional application Serial No. 505,986, filed October 12, 1943.

The preferred embodiment of the invention has been described, but changes and modifications can be made and some features of the invention can be used without others.

I claim:

1. A billet scarifying machine comprising a torch-positioning device with portions for holding torch elements in position to operate over two contiguous longitudinal surfaces of a billet, supporting means for said torch-positioning device including a bearing about which the supporting means is movable to shift the torch-positioning device toward and from the plane of one of said surfaces, and a separate bearing about which the supporting means is movable to shift the torch-positioning device toward and from the plane of the other of said surfaces, so that the torch elements can follow said surfaces on both straight and crooked billets.

2. A billet scarifying machine comprising a torch-positioning device with portions for holding torch elements in position to operate over two contiguous longitudinal surfaces of a billet, supporting means for said torch-positioning device including a bearing about which the supporting means is movable in one direction to shift one of the torch elements away from or into contact with the contiguous surface, and gas-operated motor means for imparting both movements to said supporting means for following both vertical and lateral undulations of a billet.

3. A billet scarifying machine including apparatus for causing scarifying torches to follow the surface of a billet, said apparatus comprising a torch-positioning and shifting device with portions for holding torch elements in position to operate over two contiguous longitudinal surfaces of a billet, supporting means for said torch-positioning device including a bearing about which the supporting means is movable in one direction to shift one of the torch elements away from or into contact with the billet surface over which that torch element operates, and a different bearing about which the supporting means is movable in another direction to shift the other torch element away from or into contact with the contiguous surface, a motor for moving the torch-positioning device in one direction, and a second motor for moving said device in the other direction.

4. Apparatus for maintaining a scarifying torch in position to scar the side of a billet as the billet travels along a conveyor made up of a fixed frame and successive rollers supported by said frame for rotation about parallel horizontal axes, said apparatus comprising a torch-positioning device, an arm by which the torch-positioning device is carried, a frame to which the arm is connected at a region remote from said device, a pivot connecting the arm to said frame and about which the arm is freely movable with respect to the frame, and another pivot connecting the frame with a support that is in a fixed relation to the conveyor frame, the axes of the pivots being at right angles to one another so that the torch has a universal movement during a scarifying operation for following the surface of a crooked billet.

5. A billet surfaceing machine including in combination a torch-positioning device, an arm by which the torch-positioning device is carried, a frame, a pivot supported by the frame and about which the arm swings to move said device in one plane during a surfaceing operation, and a second pivot holding the frame and extending in such a direction that the movement of the frame about said second pivot shifts the torch-positioning device in a plane at right angles to the plane of movement of the arm.

6. Apparatus for a billet comprising a torch-positioning device in position for scarifying the side of either a straight or crooked billet as the billet travels along a conveyor made up of a fixed frame and successive rollers supported by said frame for rotation about parallel horizontal axes, said apparatus comprising a bracket that extends across two intersecting longitudinal surfaces of a billet moving along said conveyor, a tubular arm extending lengthwise of the conveyor and on one end of which the bracket is carried, an angle frame overlying the top and side of the arm for most of the length of the arm remote from the bracket, a pivot connecting the end of the arm remote from the bracket with the frame for oscillating movement in a vertical plane, a cylinder-and-piston motor, means carried by the frame for supporting the motor and on which the motor has oscillating movements about a substantially horizontal axis in a connection between the piston rod of the motor and said arm for moving the arm in said vertical plane, a pivot connecting the end of the frame furthest from the bracket with the fixed frame of the conveyor, this latter pivot having a substantially vertical axis, a second cylinder-and-piston motor, a motor support connected with the fixed frame and supporting the second motor for oscill-
lation about a substantially vertical axis, and a connection between the frame and the piston rod of the second motor for swinging the frame horizontally toward and from the billet.

7. In metal scarfing apparatus in which a conveyor has successive horizontal rolls rotatable about parallel horizontal axes, the combination with said conveyor of frames pivotally connected to fixed supports on opposite sides of the center line of the conveyor, and an arm freely pivoted to each of said frames with the axis of the arm pivot extending substantially at right angles to the axis of the pivot by which the frame is connected to its fixed support so that a torch holder carried by the arm has universal movement in an ellipsoidal surface extending generally transverse of the direction of movement of a work-piece along the conveyor.

8. In combination with a conveyor having successive rollers over which a billet or other work piece passes, torch supporting means on opposite sides of the center line of said conveyor for holding torch elements in position to scarf the surfaces of a work piece traveling along the conveyor, each of said supporting means comprising a frame pivotally connected to a support that is fixed with respect to the conveyor, and an arm freely pivoted to the frame for swinging movement during a scarfing operation and about an axis extending at an angle to the axis of the pivot connection of the frame to its fixed support, and a torch holder connected to one end of each arm remote from the pivot connection between the arm and frame.

9. Billet surfacing apparatus comprising two carriages on opposite sides of a course along which a billet travels, each of said carriages including a frame pivotally connected to a fixed support for oscillation about a substantially vertical axis, wheels supporting the carriage at some distance from the pivot connection with the fixed support, a bearing surface on which the wheels run, an arm pivotally connected with each frame for oscillation about a substantially horizontal axis, and a torch holder carried by the arm.

10. Billet scarfing apparatus including an arm that supports a torch bracket, a pivot bearing on which said arm is movable in a plane normal to the plane of one face of the billet on which the apparatus operates, a frame by which the pivot bearing is supported, another pivot bearing on which said frame is movable in a plane at right angles to the plane of movement of the arm about its pivot bearing, and a fixed frame supporting the pivot bearing on which the first frame moves.

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