Dec. 29, 1942. J. L. ANDERSON 2,306,370

SURFACING OF BLOOMS OR OTHER METAL MEMBERS

Filed April 15, 1939 5 Sheets-Sheet 1

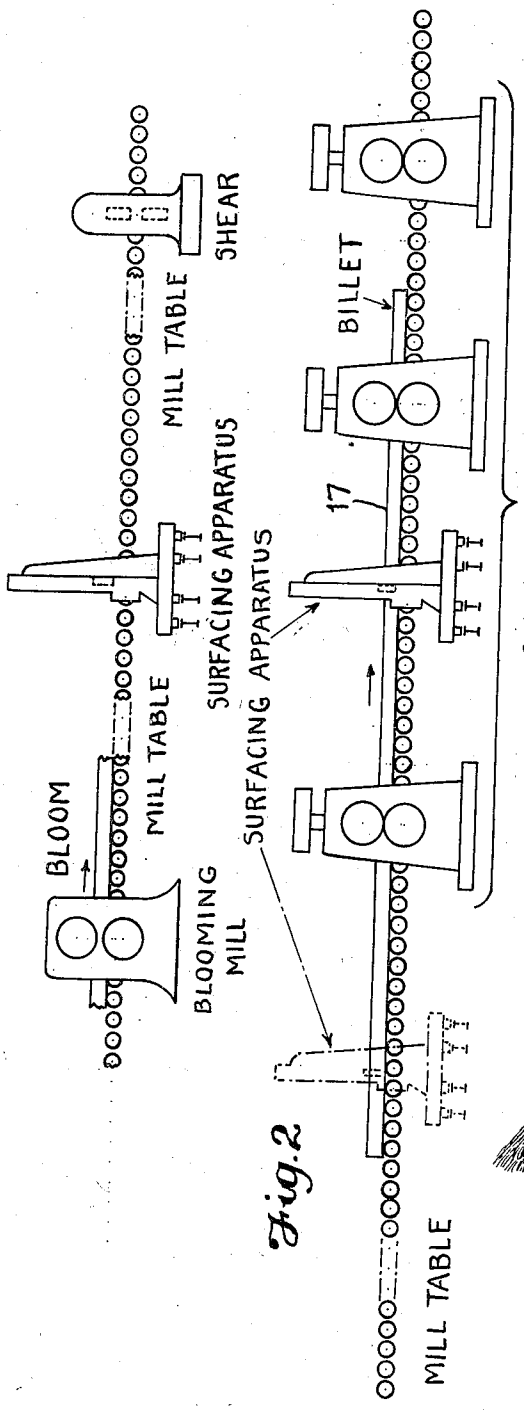


Fig. 1.

Fig. 2

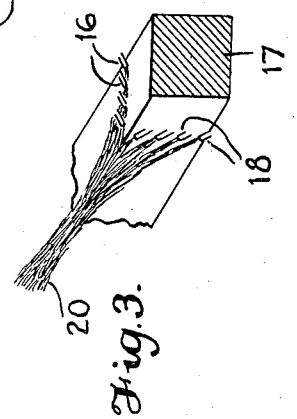


Fig. 3.

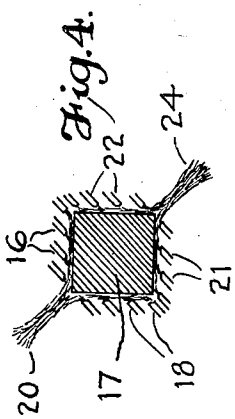


Fig. 4.

INVENTOR
James L. Anderson
BY J. F. Brandenburg
ATTORNEY

Dec. 29, 1942. J. L. ANDERSON 2,306,370

SURFACING OF BLOOMS OR OTHER METAL MEMBERS

Filed April 15, 1939 5 Sheets-Sheet 2

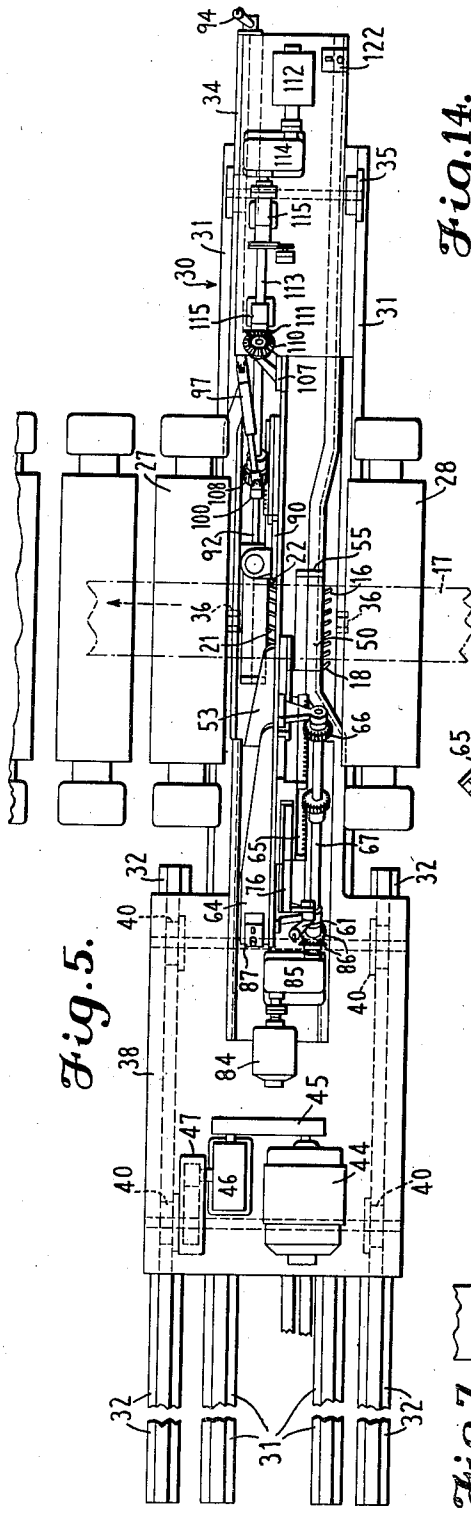


Fig. 5.

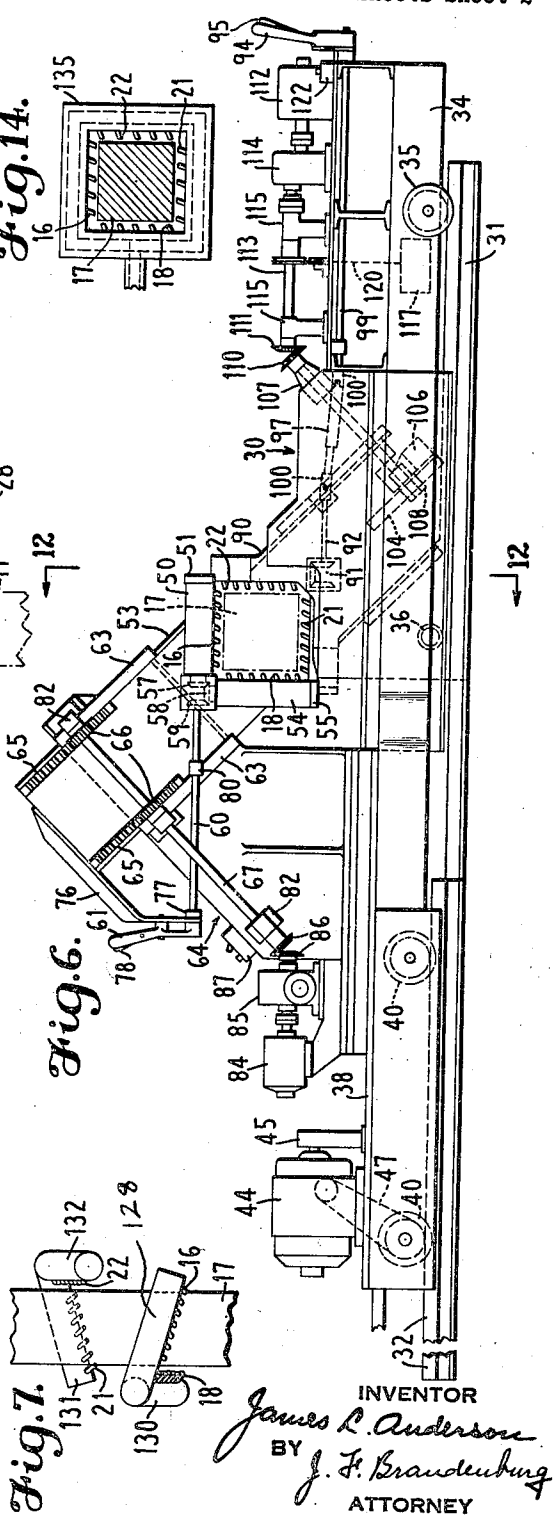


Fig. 6.

Fig. 14.

Fig. 7.

INVENTOR
James L. Anderson
BY J. F. Brandenburg
ATTORNEY

Dec. 29, 1942. J. L. ANDERSON 2,306,370

SURFACING OF BLOOMS OR OTHER METAL MEMBERS

Filed April 15, 1939 5 Sheets-Sheet 3

Fig. 8.

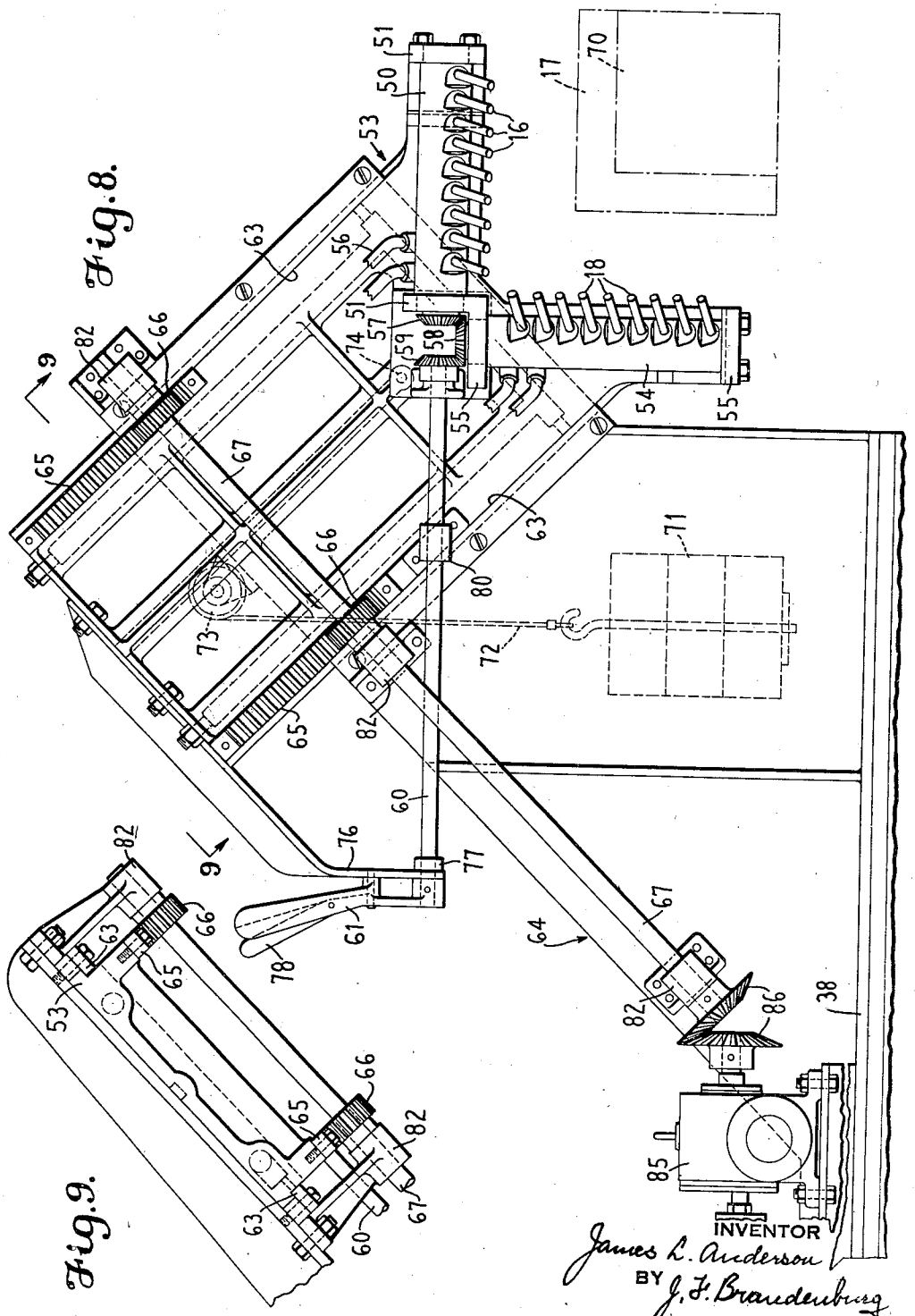


Fig. 9.

INVENTOR
James L. Anderson
BY J. F. Brandenburg
ATTORNEY

Dec. 29, 1942. J. L. ANDERSON 2,306,370

SURFACING OF BLOOMS OR OTHER METAL MEMBERS

Filed April 15, 1939 5 Sheets-Sheet 4

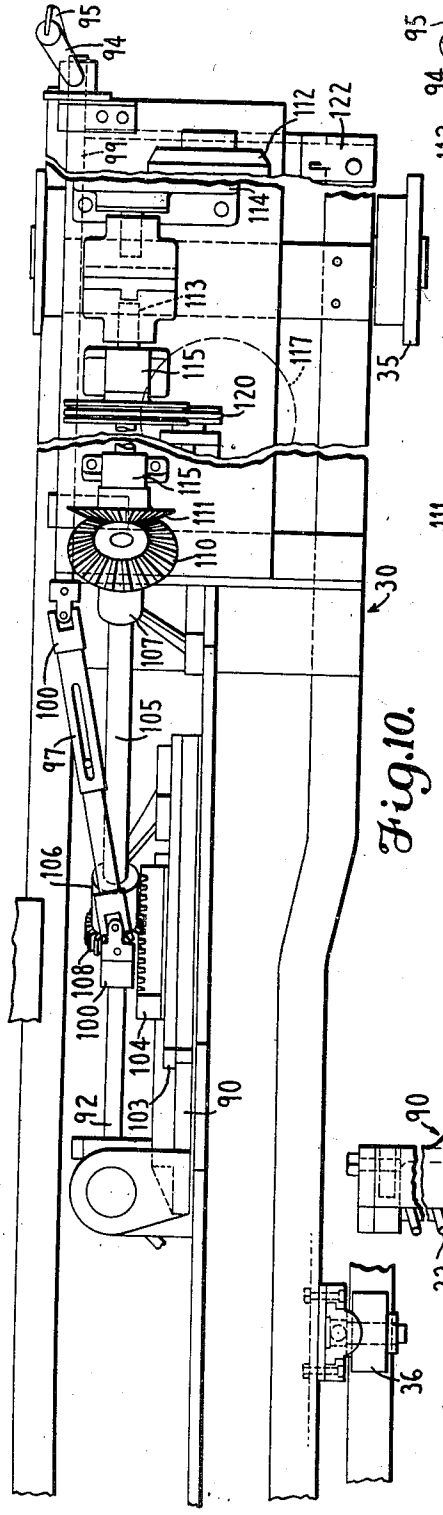


Fig. 10.

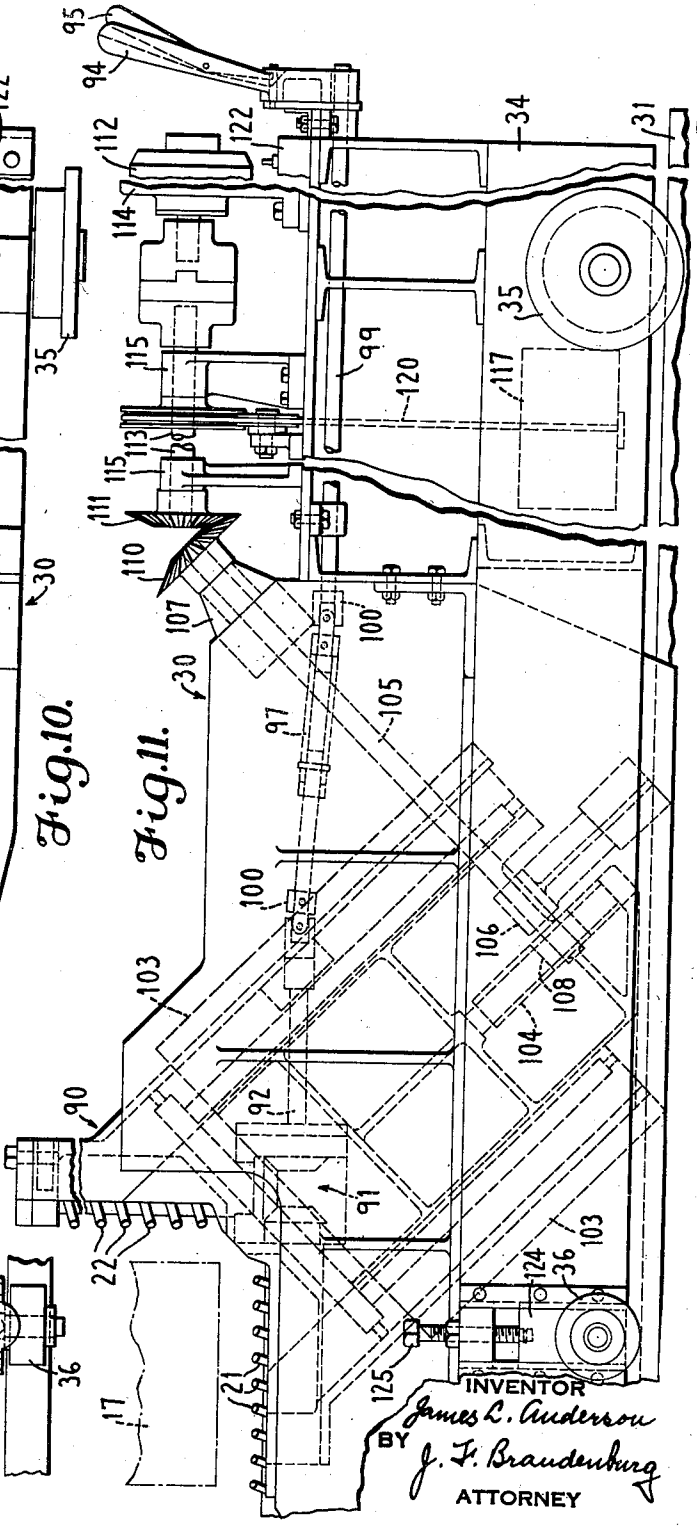


Fig. 11.

INVENTOR
James L. Anderson
BY J. F. Brandenburg
ATTORNEY

Dec. 29, 1942. J. L. ANDERSON 2,306,370

SURFACING OF BLOOMS OR OTHER METAL MEMBERS

Filed April 15, 1939 5 Sheets-Sheet 5

Fig.12.

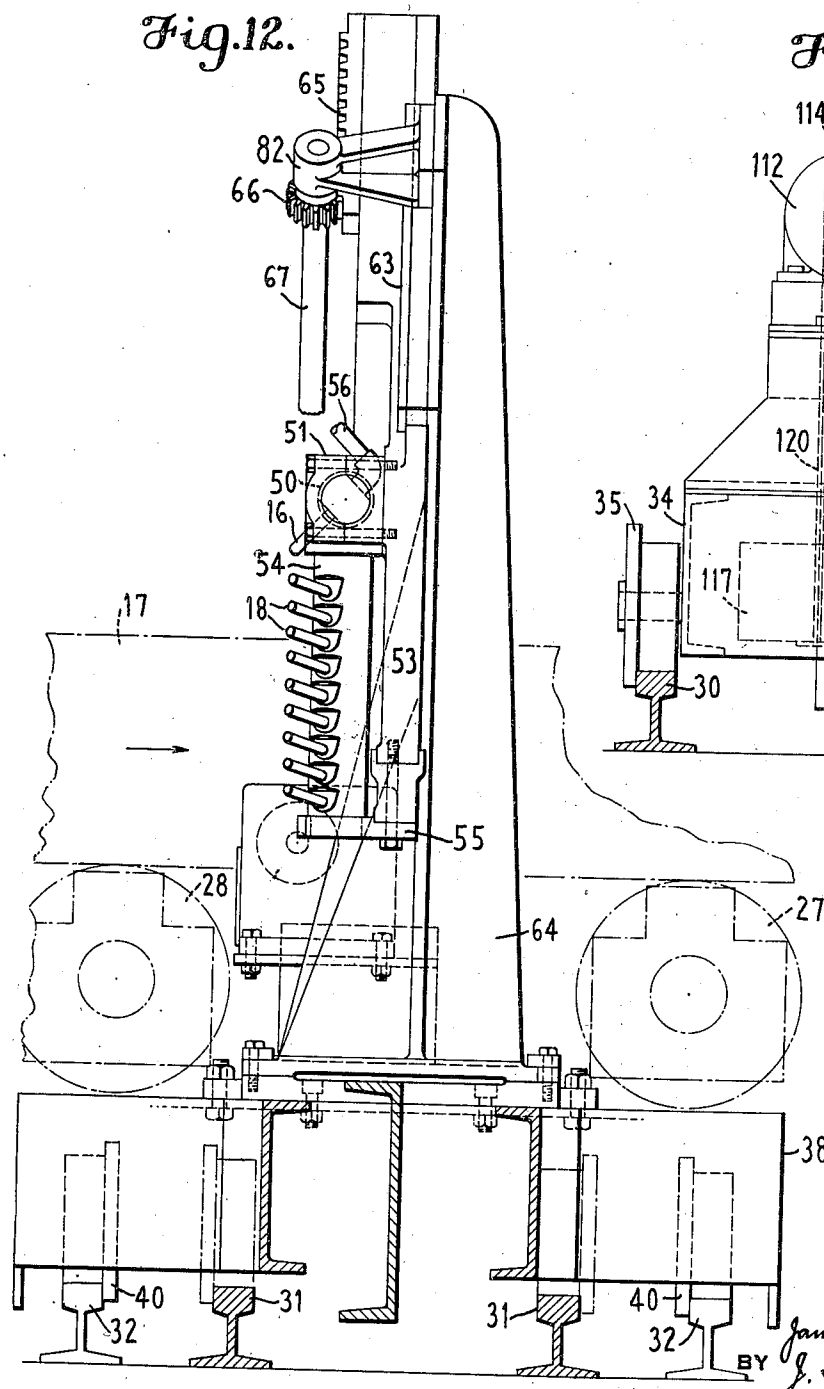


Fig.13.

INVENTOR
James L Anderson
BY J. F. Brandenburg
ATTORNEY

Patented Dec. 29, 1942 2,306,370

UNITED STATES PATENT OFFICE

2,306,370

SURFACING OF BLOOMS OR OTHER METAL MEMBERS

James L. Anuerson, Closter, N. J., assignor to Air Reduction Company, Incorporated, New York, N. Y., a corporation of New York

Application April 15, 1939, Serial No. 268,006

9 Claims. (Cl. 148—9)

This invention relates to method and apparatus for removing metal from the surfaces of blooms, billets or other metal members.

Blooms and billets, as they come from the rolling mills, have surface imperfections, such as surface cracks, pockmarks, and scale that has been rolled into the surface. In order to roll the highest grade plates or sheets, it is necessary to remove these imperfections from the metal work-piece at some stage before the final rolling operations. It has been proposed to eliminate these imperfections by removing the entire surface of the work-piece with a row of oxygen streams directed against the surface of the metal while said surface is at an ignition temperature. Such surfacing operations performed on ferrous metal bodies are well understood in the steel-making art.

It is an object of this invention to provide improved method and apparatus for removing the surface metal from a work-piece which is to be rolled into billets, bars, plates or sheets. In accordance with one feature of the invention the surface is removed from the work-piece while it is a bloom. One advantage of this feature is that the surface area of a given mass of metal is smaller when the mass is in the bloom stage. Another advantage of surfacing the bloom is that some imperfections roll in deeper and others form slivers as the result of further rolling.

Another object of the invention is to effect the surfacing of a metal member as a simultaneous operation with the rolling of the member.

Another feature of the invention relates to the removal of the surface metal from contiguous longitudinal faces and preferably from all of the longitudinal faces of the work-piece at the same time. In accordance with this feature of the invention, the oxygen streams are directed transversely of the faces to be surfaced and the angle of the streams for one face is so related to the angle of the streams that impinge against an adjacent face that the masses of gas, metal, oxide and molten slag blown from the two faces meet in a single stream at the corner of the work-piece. For example, the metal removed from the top and one side of a bloom can be discharged in one stream from one of the upper corners of the bloom, and the metal from the other side and bottom face of the bloom can be made to meet in a common stream at the diagonally opposite bottom corner. This directing of the gas stream, oxide, metal and molten slag from adjacent faces to a common edge of the metal member cleans the corners perfectly, and the combining of the slag streams facilitates the control of the flying slag.

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 diagrammatic view showing apparatus embodying this invention and its relation to other equipment in a steel mill.

Fig. 2 is a diagrammatic view showing the manner in which a metal member can be surfaced in accordance with this invention at the same time that the member is being rolled.

Fig. 3 is a diagrammatic perspective view illustrating the way in which the molten mixture of slag and oxide is removed from adjacent faces of a metal member in accordance with this invention.

Fig. 4 is a right sectional view through the metal member of Fig. 3, but illustrating diagrammatically the discharge of molten slag and oxide from all four sides of the metal member.

Fig. 5 is a plan view showing surfacing apparatus embodying the invention, and the relation of that apparatus to a conveyer or mill table.

Fig. 6 is a front elevation of the apparatus shown in Fig. 5.

Fig. 7 is a detail view illustrating a different form of torch apparatus.

Fig. 8 is an enlarged detail view of the left-hand torch apparatus and control means shown in Fig. 6.

Fig. 9 is a top view taken on the line 9—9 of Fig. 8.

Figs. 10 and 11 are enlarged detail views of the right-hand portion of the apparatus shown in Figs. 5 and 6, respectively.

Fig. 12 is an enlarged sectional view taken on the line 12—12 of Fig. 6.

Fig. 13 is an enlarged view of the right-hand end of the apparatus shown in Fig. 6, the scale being the same as that of Fig. 11.

Fig. 14 illustrates a modified form of torch structure.

Fig. 1 shows a blooming mill with the conventional mill tables which serve as conveyers for the work-piece. At some place in the mill table on the delivery side of the blooming mill, one of the rollers of the mill table is omitted, leaving a short gap in the table, and the surfacing apparatus of this invention extends into that gap when in operative position.

The surfacing apparatus is preferably at such a distance from the blooming mill that the rearward end of the bloom is out of the mill before the forward end passes through the surfacing apparatus. The bloom is conveyed along the mill table to a shear, in which the ends of the bloom are cropped off and the rest of it cut up into shorter lengths if desired.

Fig. 2 shows the surfacing apparatus of this invention combined with a continuous mill. The surfacing apparatus may be located between two of the mill stands, as shown in solid lines, or it

may be located ahead of the first stand, as indicated in dotted lines. If the surfacing apparatus is located between stands of a continuous mill, it is preferably located between the first and second stand because the speed of travel of the billet or work-piece is less at that end of the mill.

Before describing the structure of the surfacing apparatus, the method of removing the surface metal from the faces of a bloom, billet, or other metal member will be explained with the diagrammatic illustrations of Figs. 3 and 4. Torch tips 16 have jet orifices through which streams of oxygen are directed against the top surface of the metal member 17. Other torch tips 18 direct oxygen streams against one side of the metal member. It is a feature of the invention that the gas streams from both of the groups of tips 16 and 18 are directed at a transverse angle toward the same edge of the metal member 17 so that the stream of molten slag and burning oxide blown from the top face by the tips 16 meets the molten stream that is blown from the side face by the tips 18. These two streams merge into a common stream 20 of molten slag and oxide which discharges from the upper lefthand corner of the metal member 17. The transverse angle of the gas streams with respect to the surfaces on which they operate is preferably of the order of 30°–35°.

Fig. 4 shows groups of tips 21 and 22 disposed in positions to remove metal from the bottom and right side faces, respectively, in the same manner as the groups of tips 16 and 18 remove metal from the top and left side faces. The molten masses from the bottom and right side faces meet in a common stream 24 at the lower right-hand corner of the metal member 17.

This method of removing the metal from contiguous faces of a metal body leaves the corners perfectly clean. Considering the top face alone, the tips 16 are constructed and arranged to remove metal from the entire width of the top face. The molten slag and metal removed from the top face goes off over the left-hand edge, but some of this mass would turn the corner and stick to and harden on the upper part of the side face if it were not for the cooperative scouring action of the molten stream from the side face.

Figs. 5 and 6 are assembly views of the surfacing apparatus. Between two rollers 27 and 28 of the mill table, there is a roller omitted. A carriage 30 has wheels running on two sets of track, a narrow gauge track 31 and a broader gauge track 32.

The carriage 30 has a right-hand portion 34 with wheels 35, 36 that run on the narrow gauge track 31, and the right-hand portion of the carriage is narrow enough to extend between the rollers 27 and 28. To give the carriage greater stability, however, the left-hand portion 38 of the carriage, which never has to run in between the rollers 27, 28 or their supporting means, is made wide enough to give the apparatus the desired stability and has wheels 40 running on the broader gauge track 32. The tracks 31 and 32 are long enough so that the entire carriage 30 can move transversely of the mill table and completely out from between the rollers 27, 28. In Figs. 5 and 6 the apparatus is shown in position to surface a bloom or other metal member 17 as it travels down the conveyer or mill table. The metal member 17 is indicated in broken lines in Figs. 5 and 6 and in a number of the other views.

Referring again to Fig. 5, the carriage 30 is driven by a motor 44 through a chain and sprocket drive 45, reduction gearing 46, and a second chain and sprocket driving connection 47 between the reduction gearing and the driving axle of the carriage. Suitable control means are provided for starting, stopping, and reversing the motor 44, but such control means are well known and need not be explained for a complete understanding of this invention.

The torch for surfacing the top face of the metal member 17 comprises a group of tips 16 extending from a body 50 which is supported by end bearings 51 (Fig. 8). The body 50 has a limited rotary movement about an axis parallel to the top face of the metal member 17 for changing the angle that the tips 16 make with the top face. The end bearings 51 are a part of a supporting frame 53.

The torch tips 18 that direct streams of oxygen against the left side face extend from a body 54 that is supported at its ends in bearings 55 in which it can turn about an axis parallel to the side face of the metal member 17. The end bearings 55 are part of the supporting frame 53.

The tips 16 and 18 are preferably constructed with a central oxygen jet orifice and one or more orifices for oxy-fuel gas flames for preheating the surface. The gases for operating the torches are supplied to the torch bodies through hose 56.

A bevel gear 57 attached to one end of the torch body 50 meshes with a similar gear 58 attached to the end of the torch body 54. The gear 58 meshes with a gear 59 on the end of a shaft 60 that can be turned by a handle 61 to rotate the torch bodies 50, 54 and change the angle that the torch tips make with the surfaces of the metal member 17. The gearing causes both torch bodies to move at the same time and by the same amount.

The handle 61 is on the same side of the metal member as the tips 18 and in a position where an operator grasping the handle can get an unobstructed view of the torch tips and the faces of the metal member for which the handle 61 adjusts the torches.

The edges of the supporting frame 53 fit into guides 63 on a main frame 64 that extends up from the carriage 30 and is a rigid part of the carriage. There is a rack 65 secured to the frame 53 near each edge. A pinion 66 that turns with a shaft 67 moves the frame 53 along the guides or holds it against movement at any desired location. The guides 63 extend parallel to a diagonal plane through the metal member 17 so that movement of the frame 53 along the guides adjusts the positions of the torches for different size metal members, a small member being shown in dotted lines and indicated by the reference character 70 in Fig. 8.

The frame 53 and the torch apparatus which it carries are counterbalanced by a weight 71 hanging from a cable 72 that passes over a sheave 73 on the main frame 64 and is connected to the slidable supporting frame 53 by a connection 74.

A bracket 76 fastened to the upper end of the frame 53 extends downward and has a bearing 77 for supporting the end of the shaft 60. A latching member 78 is pivoted to the handle 61 and latches in any one of a row of openings in the bracket 76 to hold the shaft 60 in set position. There is an intermediate bearing for the shaft 60 in a bracket 80 secured to the slidable supporting frame 53 just below one of the racks.

The supporting frame 53 is preferably moved up and down by power mechanism, such as shown in Fig. 6. The shaft 67 turns in bearings 82 that are fastened to the main frame 64. An electric motor 84 drives the shaft 67 through a reduction gearing 85 and bevel gearing 86. A motor control box 87 for starting, stopping and reversing the motor is located on the apparatus in some position within convenient reach of the operator who shifts the handle 61, and is so located that the operator when effecting the adjustment can see the torches, which are affected by the controls in box 87.

Fig. 11 shows a supporting frame 90 for the tips 21 and 22 that surface the bottom and right-hand face of the metal member 17. Each group of tips 21 and 22 extends from a torch body that is similar to the torch body 50 or 54, heretofore described, and similarly rotatable in end bearings on its supporting frame 90. Such rotation of the torch bodies from which tips 21, 22 extend is effected by bevel gearing, designated generally by the reference character 91 and similar in construction and operation to the gears 57, 58, and 59, already described. A shaft 92 in Fig. 11 corresponds to the shaft 60 of Fig. 8. The shaft 92 (Fig. 11) is turned by a handle 94 at the right end of the carriage 30, and the handle has a latching lever 95 that engages in openings in an end plate and holds the handle, and the torch bodies that are shifted by the handle, set in adjusted position.

Since the gear 91 moves up and down with the slidable supporting frame 90 and since the handle 94 does not partake of that movement, it is necessary to have a telescoping section 97 in the shafting that connects the gearing 91 with the handle 94. The telescoping section 97 is connected with the shaft 92 and with a shaft 99 by universal joints 100. The handle 94 is secured to the end of the shaft 99.

The supporting frame 90 has edges that slide in guides 103 that are fixed to the carriage 30. The frame 90 moves in the same direction as the upper supporting frame 53, that is, in the direction of a diagonal plane through the corners of the metal member 17.

There is a rack 104 attached to the slidable supporting frame 90 along the center of that frame. A shaft 105 is journaled in bearings 106 and 107 on the main frame of the carriage 30, and there is a pinion 108 fixed to the lower end of the shaft 105 and meshing with the rack 104.

A bevel gear 110 on the upper end of the shaft 105 meshes with a similar bevel gear 111. The driving mechanism for the gear 111 is best shown in Fig. 6. A motor 112 drives a shaft 113 through reduction gearing 114 and suitable couplings. The shaft 113 turns in bearings 115 connected to the carriage 30, and the bevel gear 111 is secured to the shaft 113. The weight of the slidable supporting frame 90 and the torch apparatus which it carries is counterbalanced by a mass 117 hung from a cable 120 that wraps around a drum on the shaft 113.

A switch box 122 contains switches to control the starting, stopping and reversing of the motor 112, and these switches together with the handle 94 are located on the same side of the metal member as the tips 21, 22 whose adjustment they control. It is a feature of the invention that the handle 94 and switch box 122 are both located within convenient reach of an operator who is in such position that he can get a view of both faces of the metal member which are surfaced by the torch apparatus under his control.

The wheels 36 are carried on sliding blocks 124 (Fig. 11) and can be adjusted to take their share of the total load by the adjusting screw 125.

The system of piping and valves by which the gas supply is regulated is not shown or described because it is not necessary to a full understanding of the invention. Various modifications of the apparatus can be made, two different arrangements of the torch tips being illustrated in Figs. 7 and 14.

Fig. 7 is a plan view showing a torch body 128 that extends across the top face of the metal member 17 at an angle to a right section through the metal member. The tips 16 extend from the torch body 128 at an angle with the long dimension of the torch body so that the total horizontal angle of the gas streams from the tips is equal to the sum of these angles.

The angle of the torch body 128 with a right section through the metal member 17 is approximately 15° in Fig. 7, and the horizontal angle of the tips with a right section through their respective torch bodies in all of the views is shown as approximately 15°, making the total angle between the tips of Fig. 7 and the direction of relative movement of these tips and the metal member equal to 30°.

A torch body 130 to which the tips 18 are connected in Fig. 7 makes an angle with a right section through the metal member 17. The projection of the torch body 130 on the vertical side face of the metal member makes the same angle with an edge of the metal member as does the projection of the torch body 128 on the top face.

The tips 21 and 22 extend from torch bodies 131 and 132, respectively, and these torch bodies are angularly disposed with respect to a right section through the metal member 17. The advantage of increasing the transverse inclination of the gas streams by angularly disposing the torch bodies as shown in Fig. 7 is that the streams cover a wider area, and the ridges which the respective streams make lengthwise of the metal member are less pronounced, or stated in another way, the thickness of metal removed is more uniform with the torch bodies arranged as in Fig. 7.

Fig. 14 shows a modified torch structure in which a single torch body 135 receives all of the tips 16, 18, 21 and 22. With this construction the tips 16 and 18 are in substantially the same plane with the tips 21 and 22. The apparatus is suitable for surfacing the metal member 17 which is of the size that the torch body 135 was designed for, but it has no adjustments by which it can be accommodated to metal members or work-pieces of other sizes.

One embodiment of the invention has been described and some modifications suggested, but other changes can be made and some features of the invention may be used without others without departing from the invention as defined in the claims.

I claim:

1. The method of removing the surface metal from a plurality of different surfaces of a metal work-piece that is combustible in oxygen, such as a steel bloom, which method comprises simultaneously directing streams of oxygen against the respective surfaces with said surfaces heated above their kindling temperature and while causing relative movement of the gas streams and said surfaces lengthwise of the work-piece, and directing the gas streams against intersecting sur-

faces at oblique angles along lines which, when projected on the respective surfaces, converge toward the line of intersection of said surfaces.

2. The method of removing surface metal from contiguous faces of a metal member that is combustible in oxygen, which faces meet in angular relation along a common edge, said method comprising directing streams of oxygen against both faces simultaneously with said surfaces heated above their kindling temperature and while causing relative movement of the metal member and streams of gas, and directing the streams of gas at oblique angles along lines that are in such angular relation to the direction of said movement that the projections of said lines on the surfaces against which the gas streams are directed converge toward said common edge so that the streams of gas and the material removed from the two faces meet to form one stream that leaves the metal body along said edge.

3. The method of simultaneously removing the surface metal from all four sides of a metal work-piece that is combustible in oxygen, such as a steel bloom, which method comprises directing a number of oxygen streams against two adjacent sides at oblique angles to those sides, the streams directed against each of said adjacent sides having a directional component at right angles to the plane of the other of said adjacent sides, so that the streams converge toward the common edge of those sides while the metal work-piece and gas streams move relatively to one another in the direction of the length of said work-piece and with the sides of the work-piece at ignition temperatures, and similarly directing oxygen streams against the other two sides of the metal work-piece in directions that converge toward the edge diagonally opposite to the common edge of the first two adjacent sides so that the material removed by the oxygen streams is discharged from the metal member at two diagonally opposite corners.

4. The method of simultaneously removing metal at ignition temperature from all four longitudinal faces of a metal work-piece that is combustible in oxygen and of generally rectangular cross-section, which method comprises projecting a number of substantially parallel gas streams against the top face of the work-piece while causing relative movement of said work-piece and the gas streams in the direction of the length of the work-piece, directing said gas streams along lines that when projected on the top face extend obliquely toward one longitudinal edge of the top face, projecting similar oxygen streams against the side face that terminates in said longitudinal edge of the work-piece and along lines that when projected on the side face extend obliquely toward said longitudinal edge in such a manner that the streams of slag from the top and side faces meet and form a common stream that is discharged along said longitudinal edge, and similarly directing gas streams against the bottom face and other side face of the work-piece at oblique angles toward the longitudinal edge common to the bottom face and said other side face so that the slag from these latter faces meets in a single stream and is discharged from the work-piece along a longitudinal edge of the bottom face.

5. In a machine for removing surface metal from a bloom, billet, or the like, torch means located in position to direct generally parallel streams of oxygen at an acute angle to the top surface of the metal member and in directions that have components toward and normal to the plane of a side surface of the metal member, other torch means similarly related to said side surface of the metal member with directional components toward and normal to the plane of the top surface, a common support for both of said torch means, apparatus for moving the torch means on said support into positions from which the oxygen streams will impinge upon the metal member at different angles to the surfaces that are to be removed, guides in which the support is movable, and common adjustment means operable to change the positions of both of the torch means when the frame is in any of a variety of positions.

6. The combination with a rolling mill that produces blooms, billets, or the like, of apparatus located along the path followed by the metal member as it comes from the mill, said apparatus including torches with jet orifices constructed and arranged to direct streams of oxygen against the faces of the metal member to remove the surface from said member as it moves past said apparatus, means supporting said torches over, under, and on both sides of the metal member in positions to remove the surface from all sides of said member simultaneously, said torches being located in position to direct oxygen streams against each surface with a directional component normal to the plane of a contiguous longitudinal surface and toward the same edge as that toward which the streams of oxygen on said contiguous longitudinal surface are directed so that the molten material produced on the faces of the metal member is discharged from the diagonally opposite longitudinal corners of the metal member.

7. The combination of a rolling mill that produces blooms, billets, or the like, torch-supporting means near the path followed by the metal member, a torch on the supporting means constructed and arranged to direct streams of oxygen at an angle against the top face to remove the surface metal from that face, said streams having directional components normal to a side face of the metal member, a similar torch for surfacing that side face with oxygen jet orifices that have directional components normal to said top face so that the oxygen streams directed against said top and side surfaces converge toward the edge along which said side face meets the top face of the metal member, and other torches in position to direct oxygen jets against the bottom face and other side face of the metal member at similar angles transverse of the length of said member and toward the edge at which the bottom face and said other side face intersect.

8. Apparatus for removing metal simultaneously from contiguous faces of a metal member including torch means with orifices disposed to direct a plurality of gas streams against the contiguous faces along lines which, when projected on the respective faces, extend at an acute angle toward the edge where said faces meet.

9. Apparatus for surfacing a metal member as the member moves along a conveyer, said apparatus comprising a supporting frame located at a gap in the conveyer, and torch means carried by the frame and having orifices that direct oxygen streams against all of the longitudinal faces of the metal member as it travels lengthwise along the conveyer, said orifices being in such relation that they direct streams against contiguous faces along lines which, when projected on the respective faces, extend at transverse angles toward the common edge of said contiguous faces.

JAMES L. ANDERSON.