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DESEAMING APPARATUS

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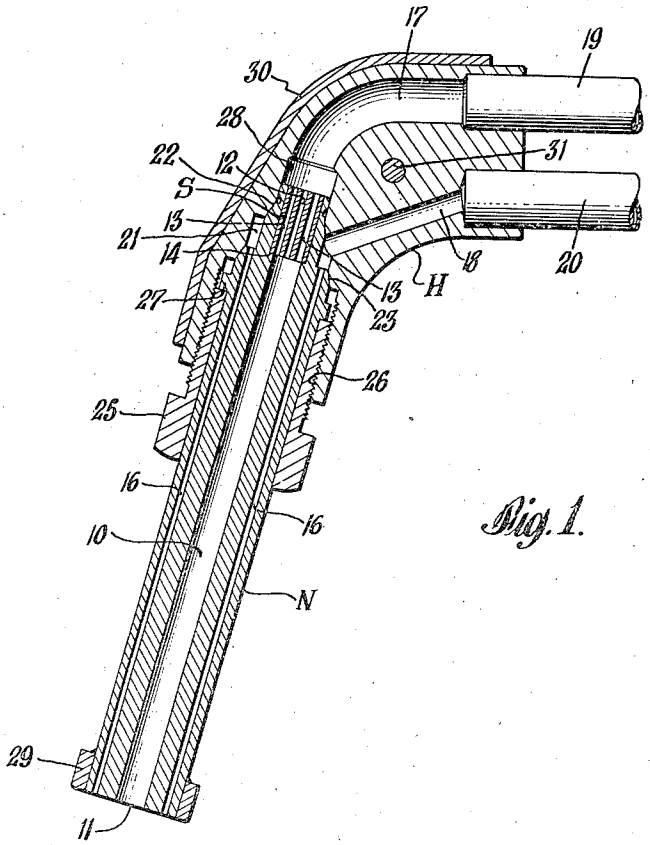


Fig. 1.

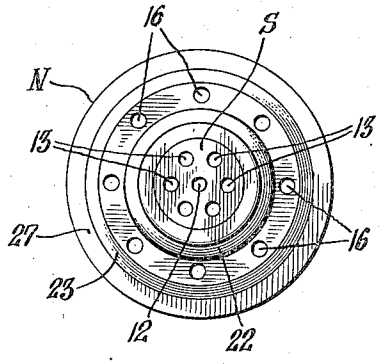


Fig. 2.

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DESEAMING APPARATUS

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8 Claims. (Cl. 158—27.4)

This invention relates to the art of thermo-chemically conditioning the surfaces of ferrous metal bodies, such as ingots, billets, blooms, slabs, and the like, and more particularly to apparatus for deseaming, in which a stream of surface conditioning fluid, such as oxygen, is discharged from a nozzle against a surface undergoing thermo-chemical treatment.

Surface seams and other defects frequently appear in steel billets, blooms, slabs, etc., in the early stages of production. These are sometimes caused by imperfections in the surface of a steel body or ingot, which imperfections are elongated in the first rolling and, as rolling is continued to produce a billet or bloom from the ingot, progress the length of the bloom or billet and form seams which also extend to an appreciable depth, causing a considerable percentage of rejections in the finished product. In order to reduce the waste involved in producing imperfect material, the steel body or ingot usually is carefully inspected and such surface defects are removed prior to certain initial rolling operations.

In the oxy-acetylene process for removing surface defects from ferrous metal bodies, a surface area on the metal body to be conditioned is heated to the kindling temperature by an oxy-acetylene preheating flame and then a stream of oxidizing gas, e. g. oxygen, is applied obliquely against the highly heated area. The greater part of the surface metal in the path of the oxygen stream is oxidized and the remainder melted and blown away. Thus, as the inclined oxygen stream is advanced with respect to the surface of the body, successive surface portions are removed. The surface portions thereby removed include the defects or imperfections which would tend to cause seams during later rolling operations, and the body is thus "deseamed."

The efficiency of deseaming and surface conditioning operations is normally measured by the relation between the amount of oxygen used and the amount of metal removed. That is, approximately 4.5 to 4.6 cubic feet of oxygen are theoretically required to oxidize one pound of steel, and when the amount of oxygen used is reduced, say to about 3 cubic feet of oxygen per pound of steel removed, the efficiency is increased. However, when the efficiency of the operation is increased so that less oxygen is used, less metal is oxidized and more metal is removed by melting. The reaction products which are blown ahead of the advancing jet of oxygen tend to preheat subsequent surface portions to be removed, but the reaction products which are blown or flow to either side of the advancing jet solidify on the surface at either side of the deseamed area and produce what may be termed "fins." Since solidified ferrous oxides are friable and rather brittle, fins composed principally of such oxides are easily removed, but fins having a greater proportion of solidified steel or ferrous metal are more difficult to remove. In some cases, such fins tenaciously adhere to the lateral edges of the deseamed area, and may be bent back and forth several times before breaking. In addition, it is also desirable to remove lateral slag accumulations and formations to provide the best condition for subsequent rolling.

Among the objects of this invention are: to provide a blowpipe for thermo-chemically conditioning a surface of a ferrous metal body, in which a novel stream of surface conditioning fluid, such as oxygen, is produced and utilized to inhibit slag and fin production; to provide a nozzle inlet construction for controlling the fin and slag inhibiting characteristics of a stream of surface conditioning fluid or oxygen discharged from such nozzle; to provide an improved deseaming nozzle that is simple and economical in its parts, and very efficient and effective in operation; to provide novel means for improving the slag and fin inhibiting characteristics of an oxidizing gas stream discharged from a deseaming nozzle; and to provide improvements in the art of thermo-chemically conditioning the surfaces of ferrous metal bodies with a single oxygen stream or a plurality of oxygen streams.

Further objects and novel features of this invention will be apparent from the following description and accompanying drawing, in which:

Fig. 1 is a longitudinal sectional view of the head and nozzle of an oxy-acetylene blowpipe adapted to operate in accordance with the principles of this invention; and

Fig. 2 is an enlarged plan view of the inner end of the nozzle of Fig. 1.

In accordance with this invention, a stream of oxidizing gas or oxygen, a portion of which has a lower velocity than the remainder of the stream, is directed against a heated area on the surface of a ferrous metal body to be conditioned. The oxygen stream may be discharged from a nozzle passage substantially circular in crosss-section, and the outer or peripheral portion of the oxygen stream has a lower mean velocity than the central portion of the oxygen stream. The velocity of these portions of the

oxygen stream need not be uniform. For example, in deseaming a steel body with a stream of substantially pure oxygen, excellent results are obtained with a stream in which the velocity of the central portion of the stream varies over a range from 600 to 1000 feet per second and the velocity of the most effective peripheral portion varies over a range from 200 to 400 feet per second. Also, there need be no sharp line of demarcation between the central and peripheral portions.

One form of apparatus constructed in accordance with this invention and adapted to carry out the above method is illustrated in the drawing, and comprises a spud or insert S which is located at the upper or inlet end of a main oxygen discharge passage 10 of a nozzle N, removably secured to a head H of a conventional blowpipe. A stream of oxygen is discharged from orifice 11 of passage 10, at the lower or outer end of the nozzle. Spud S is provided with a central passage 12 and a plurality of outer passages 13, six in number as illustrated, although other numbers of passages, even down to two, may be used. The passages 12 and 13 collectively constitute the nozzle inlet means for admitting the oxygen to the passage 10. Passages 12 and 13 are relatively small in diameter, are much shorter than passage 10, and outer passages 13 preferably symmetrically surround central passage 12. The passages in spud S are each considerably longer than their respective diameters and distribute the flow of oxygen through the nozzle in such a manner that the central portion of the stream discharged from orifice 11 has a higher velocity than the outer or peripheral portion of the stream; but, at the same time, the stream flows smoothly and without excessive turbulence, which is a highly desirable characteristic, because the metal removal efficiency of a non-turbulent stream is considerably greater than that of a turbulent stream.

In further accordance with this invention, as has been found by experiment, the characteristics of the stream may be altered by changing the length or longitudinal position of the spud within the nozzle N. As an example of the latter, a spud $\frac{9}{32}$ inch long used in connection with the nozzle shown in the drawing, which is about five inches in length, the passage 10 being about 0.281 inch in diameter, produced the most satisfactory all-around results when the upstream end of the spud was flush with the inner end of the nozzle, in the position shown in Fig. 1. When the spud was moved $\frac{9}{32}$ inch, or a distance of its own length, into head H so that the opposite or downstream end of the spud was flush with the inner end of the nozzle, the efficiency of metal removal was increased, i. e. slightly less oxygen was used to remove the same amount of steel, but the slag removal and fin inhibiting qualities were slightly decreased. Again, when the spud was moved toward the outer end of the nozzle so that the inner or upstream end of the spud was spaced $\frac{9}{32}$ inch, or its own length, from the inner end of the nozzle, the metal removal efficiency was slightly decreased, but the slag removal and fin inhibiting qualities were slightly improved. In each of the above instances, the slag removal and fin inhibiting qualities were, of course, a considerable improvement over those qualities in instances when the spud was not used.

In addition, it was also found by velocity measurements of the streams discharged from the nozzle during the above experiments, that a critical range apparently exists above 400 feet per second and up to about 600 feet per second. That is, any portion of the oxygen stream having a velocity above 600 feet per second apparently tends to remove metal, whereas any portion of the stream having a velocity somewhat below 600 feet per second, and located at or near the edge of the stream, apparently tends merely to remove slag and oxidize metal previously removed in molten form. The most effective range for the latter, which apparently supplies the fin inhibiting and slag removal characteristics, was found to be about 200 to 400 feet per second.

The nozzle N is a conventional type, consisting of a generally tubular body member of metal, such as swaged copper, which may be chromium plated, but provided with a shoulder 14 on which spud S is seated. In addition to central oxygen passage 10, which is rectilinear or straight and is substantially uniform in cross-section from end-to-end, nozzle N is provided with a plurality of equally spaced heating gas passages 16 surrounding the central passage. Head H is also a part of a conventional type of blowpipe, and is provided with an oxygen passage 17 and a heating gas passage 18, to which tubes 19 and 20, respectively, conduct oxygen and a combustible mixture of heating gases, such as a mixture of oxygen and acetylene. Heating gas passage 18 connects with an annular space 21 formed between head H and nozzle N, the annular space 21 distributing the heating gas to passages 16 in nozzle N. To provide gas-tight seals between head H and nozzle N, and to prevent leakage of oxygen or heating gas, the head and nozzle are provided with cooperating conical seating surfaces 22 and 23.

Nozzle N is secured to head H, and the conical seating surfaces 22 and 23 are held in gas-tight engagement, by a nut 25 which engages threads 26 in head H and which bears against an annular flange 27 formed on nozzle N. The inner or upper end of nozzle N extends into an annular space 28, formed as a slight enlargement of oxygen passage 17, while the outer or lower end of the nozzle is provided with a protective ring 29 of relatively hard metal. Ring 29 may be formed of a cobalt-chromium-tungsten alloy of the type known as "Stellite," and is preferably cast separately, then secured to the nozzle in any suitable manner, such as by welding, as shown. Head H is also provided with a protective shield 30, formed of the same or similar metal as ring 29. Shield 30 may be cast onto head H, being locked securely thereto by a key 31 which is formed by metal flowing into and solidifying in a suitable hole in head H, provided for the purpose. Ring 29 and shield 30 protect nozzle N and head H from excessive wear.

To thermo-chemically condition the surface of a ferrous metal body, the combustible gas mixture supplied by tube 20 is turned on, and the heating flames ignited in the usual manner as they issue from passages 16 of nozzle N. The heating flames are applied to a relatively small area on the surface of the body, and as soon as this area is heated to the ignition temperature, oxygen supplied through tube 19 is turned on. The stream discharged through orifice 11 of passage 10 is then applied to the heated area, thereby removing a surface layer and forming a depression. The blowpipe is held with the nozzle at a constant angle of about 30° with respect to the surface and advanced relatively thereto substantially in the direction of discharge of the oxygen stream, to cut a smooth groove having sloping sides in the surface of the metal body.

A series of closely spaced parallel grooves may

be produced by two or more deseaming nozzles operated side by side, and a layer from an entire surface of a metal body may be removed by a sufficient number of nozzles. When two or more deseaming nozzles are thus used side by side, there is a tendency for a fin to form between each set of adjoining parallel grooves, but with nozzles constructed in accordance with this invention, such fins are eliminated or easily removed.

From the foregoing it will be apparent that this invention provides a blowpipe for thermochemically conditioning surfaces of ferrous metal bodies which is effective and can be constructed to produce a desired relation between the fin inhibiting qualities and the metal removing efficiency of a stream of deseaming oxygen. It will also be apparent that the apparatus necessary, over and above conventional parts, is simply and easily constructed, and very little change in a conventional deseaming nozzle is required to produce a considerable improvement in the fin inhibiting qualities of the oxygen stream discharged therefrom.

Although several changes have been described, such as variations in the length and longitudinal position of spud S, and also variations in the number and/or size of the passages in spud S, it will be apparent to those skilled in the art that other changes and modifications may be made without departing from this invention. It is therefore intended in the appended claims to cover all such changes and modifications as fall within the true spirit and scope of this invention.

What is claimed is:

1. A deseaming nozzle comprising, in combination, a generally tubular body member having a central oxygen passage with a delivery portion of substantially uniform cross-section from end-to-end, and a plurality of heating gas passages surrounding said oxygen passage in spaced relation thereto; and a spud disposed within said oxygen passage adjacent the inlet end of said delivery portion and having a plurality of spaced symmetrically arranged passages each of considerably greater length than diameter, parallel to said oxygen passage and extending through said spud, for increasing the slag removal efficiency of the oxygen stream discharged by said oxygen passage.

2. A deseaming nozzle having a centrally disposed longitudinal passage of cylindrical shape for discharging a stream of deseaming oxygen; and means associated with the inlet end of said passage for controlling the stream of deseaming oxygen discharged from the outlet end of said passage and comprising an insert having a central passage concentric with the longitudinal axis of said nozzle passage and a plurality of uniformly spaced passages surrounding said central passage.

3. A deseaming blowpipe nozzle for thermochemically removing metal from the surface of a ferrous metal body, said nozzle having a central longitudinal passage of cylindrical shape for discharging a stream of oxidizing gas against the surface of said body; and means associated with the inlet portion of said passage for causing said stream of oxidizing gas to have a central portion of relatively high velocity and an outer portion of relatively low velocity, said means comprising an insert having a central passage concentric with the longitudinal axis of said nozzle passage and a plurality of uniformly spaced passages surrounding said central passage.

4. A blowpipe nozzle having preheating gas passages and an oxygen passage extending longitudinally thereof, and also having a plurality of inlet passages each considerably longer than its diameter but much shorter and of smaller diameter than said oxygen passage, said inlet passages collectively constituting the nozzle inlet means for admitting oxygen to said oxygen passage.

5. A blowpipe for thermochemically removing metal from a metal body comprising nozzle means having preheating gas outlet passages and a main cylindrical passage for discharging a stream of oxidizing gas against a surface of said body; and a plurality of inlet passages collectively constiuting the inlet means for supplying oxidizing gas to said main passage, said inlet passages being each much shorter and of smaller cross-sectional area than said main passage, and one of said inlet passages being coaxial with said main cylindrical passage.

6. A blowpipe for thermochemically removing metal from a metal body comprising nozzle means having preheating gas outlet passages and a main cylindrical passage for discharging a stream of oxidizing gas against a surface of said body; and at least three inlet passages collectively constituting the inlet means for supplying oxidizing gas to said main passage, said inlet passages being each much shorter and of smaller cross-sectional area than said main passage, and one of said inlet passages being coaxial with said main cylindrical passage.

7. A blowpipe for thermochemically removing metal from a metal body comprising nozzle means having preheating gas outlet passages and a main cylindrical passage for discharging a stream of oxidizing gas against a surface of said body; and seven cylindrical inlet passages collectively constituting the inlet means for supplying oxidizing gas to said main passage, said inlet passages being each much shorter and of smaller cross-sectional area than said main passage, and one of said inlet passages being coaxial with said main cylindrical passage.

8. A blowpipe for thermochemically removing metal from a metal body comprising nozzle means having preheating gas outlet means and also having an axial oxidizing gas passage extending therethrough and comprising a cylindrical inlet portion, and a delivery portion of relatively smaller diameter than said inlet portion in axial alignment with said inlet portion for discharging a stream of oxidizing gas against a surface of said body; and a spud device fitted into said inlet portion and provided with a plurality of open-ended passages extending lengthwise thereof, said plurality of open-ended passages each having a substantially greater length than its greatest transverse dimension and collectively constituting the inlet means for supplying oxidizing gas to said delivery portion.

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