May 2, 1944. W. S. WALKER ET AL 2,347,758

METHOD OF REMOVING METAL FROM METAL BODIES

Original Filed Nov. 26, 1937

Fig. 1.

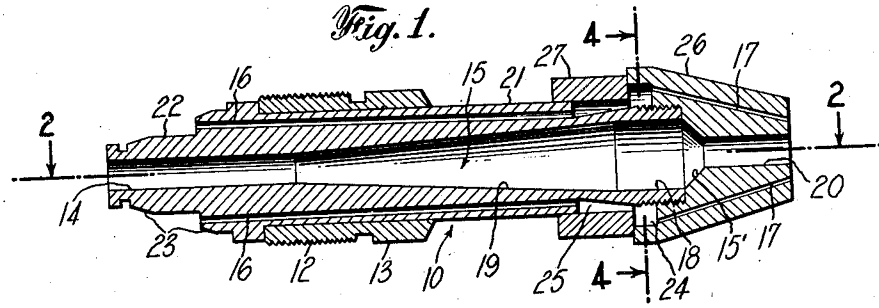


Fig. 2.

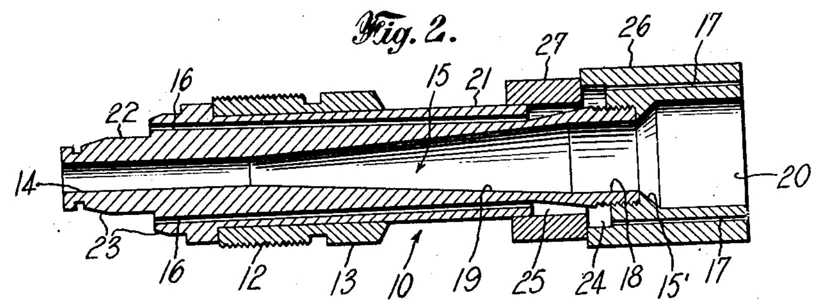


Fig. 3.

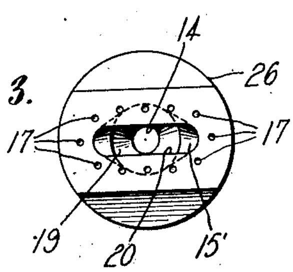


Fig. 4.

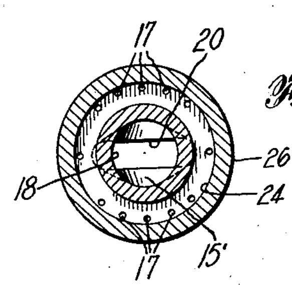
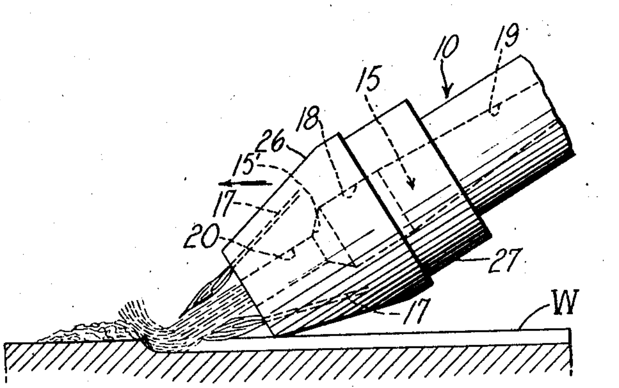


Fig. 5.



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METHOD OF REMOVING METAL FROM METAL BODIES

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Application November 26, 1937, Serial No. 176,400, now Patent No. 2,266,834, dated December 23, 1941, which is a division of application Serial No. 536,254, May 9, 1931. Divided and this application May 28, 1940, Serial No. 337,632

3 Claims. (Cl. 148—9)

This invention relates to a method of thermo-chemically removing surface metal from ferrous metal bodies and more particularly to a method of scarfing or removing surface metal in relatively wide shallow paths or channels. Such method is particularly useful for removing seams or other defects from steel slabs, blooms, or billets. It is important that all defective metal portions in the surface of such masses of metal be removed before they are initially rolled and before each succeeding rolling process. When metal containing surface fissures or other surface defects is rolled, the defects are not eliminated and they are sometimes rolled into the body of the metal in the form of concealed unbonded seams or cracks. Also, when the surface of metal having steep projections thereon or grooves therein with steep sides is rolled out, the sides of these irregular surfaces fold over and include oxides within the folds and cause concealed cracks in the body of the metal in the same way. In order to eliminate the defects and the formation of seams within the body of the metal, it is necessary to remove the defective metal portions so that only sound bonded metal remains and so that the slopes of the depressions and elevations that may be left on the surface of the billet will be so gradual that these slopes will not be folded over and rolled into the body of the metal when it is rolled.

This application is a division of our copending application Serial No. 176,400 filed November 26, 1937, entitled "Blowpipe nozzle," now United States Patent No. 2,266,834 issued December 23, 1941, which is a division of our application Serial No. 536,254, filed May 9, 1931.

We have discovered that much time and labor can be saved by removing the defective surface portions of the steel or iron thermo-chemically with the use of an oxidizing stream of gas, and that the desired contour of the groove cut by the oxidizing gas can be obtained with a blowpipe nozzle constructed to permit the passage of a suitable volume of gas at a relatively low orifice velocity, such as, for example, about 585 feet per second, and that the contour of the cut can be controlled by the shape of the orifice and the velocity of the oxidizing stream issuing therefrom. Velocities of the gas stream commonly used for oxygen cutting or severing of metals are equal to or higher than the velocity that is produced by gas flowing through a passage of uniform cross-sectional area. Therefore, the relatively low predetermined orifice velocity desired for removing surface metal is one which is below that commonly used for cutting kerfs.

The principal object of this invention is therefore to provide a method of thermo-chemically removing surface metal from ferrous metal bodies to form wide shallow channels having gradual side slopes and substantially uniform depth.

The above and other objects of our invention will be best understood by referring to the following description and accompanying drawing, in which:

Fig. 1 is a longitudinal cross-sectional view of an exemplary form of our blowpipe nozzle having its discharge end face perpendicular to the axis of the nozzle and having an oblong or transversely elongated discharge orifice in said face;

Fig. 2 is a longitudinal cross-sectional view taken on line 2—2 of Fig. 1;

Fig. 3 is a view of the discharge orifice end of the nozzle shown in Figs. 1 and 2;

Fig. 4 is a view of a transverse section taken on the line 4—4 of Fig. 1; and,

Fig. 5 is a semi-diagrammatic side view of the nozzle showing its relation to the work surface during operation.

Referring to Figs. 1 and 2, the blowpipe nozzle 10 has an inlet end suitably formed to be attached to the head (not shown) of a suitable blowpipe. The external threads 12 on the coupling nut 13 cooperate with internal threads in the blowpipe head to maintain the inlet portion 14 of a central oxygen passage 15 and the inlet portions 16 of the ring of combustible gas mixture passages 17 in the nozzle in communication with corresponding oxygen and combustible gas supply passages in the blowpipe head. The combined area of the combustible mixture passages 17 is made sufficient to maintain a flame of sufficient size and intensity to heat the metal quickly to the ignition temperature to start the scarfing cut, the heat of the flame thereafter assisting in producing a clean cut or channel by adding heat to the oxygen and the burning metal.

The oxygen passage 15 in the nozzle 10 is enlarged adjacent to the inlet 14 by a gradually tapered or flared portion 19 which extends divergently toward the discharge orifice 20. In order that the gas stream passing through the portion 19 may have its flow velocity reduced, it is apparent that the gradually flared portion 19 should be proportioned to have a sufficient degree of expansion to cause the velocity of the gas stream to be reduced. The tapered portion terminates in a plane a substantial distance from the discharge orifice 20, and the bore from the termination of the taper 19 for a short distance toward the discharge orifice 20 continues as a cylindrical enlarged portion 18. As seen in Fig. 3 the orifice 20 is oblong or widened and has relatively flat upper and lower walls and rounded side walls and the walls extend inwardly to a portion 15' connecting the orifice 20 with the enlarged portion 18.

Exclusive of the coupling nut 13, this nozzle comprises three parts which are welded or silver soldered together. The stem 21 of the body 10 is provided with a head 22 of the type having conical seats 23 to fit complementary seats (not shown) in a blowpipe head adapted to receive a nozzle head of this well-known construction. The stem 21 is provided with a plurality of combustible gas mixture passages 16 which deliver gas to a distributing chamber 24 surrounding the outer end of the stem 21. The distributing chamber 24 is formed by cutting a circumferential groove 25 about the stem 21 at its outer end and enclosing this groove with a discharge orifice piece 26 which is secured to the end of the stem 21 and a ring 27 which is silver soldered to the end of the orifice piece 26 and to the outer wall of the stem 21. A large number of equally spaced combustible mixture passages 17 are formed in the wall of the orifice piece 26 about the relatively wide oblong or slot-shaped oxygen passage 20. Preferably about 12 combustible gas mixture passages 17 are formed in the orifice piece 26 in order to envelope the sheet-like stream of oxygen which may issue from the orifice piece 26 with a flame of uniform cross-sectional intensity. The mixture passages 17 on the broader sides of the orifice piece 26 converge toward the oxygen discharge orifice 20. The combustible gas mixture, passages 17 and the oxygen passage 20 in the orifice piece 26 are straight and have the same area of cross-section as their respective discharge orifices for a substantial distance backward therefrom.

The wide slot-like oxygen outlet orifice 20 of the oxygen passage communicates through the enlarged cylindrical portion 18 with the large conical divergent passage 19, smoothly connecting the portion 18 with the inlet portion 14. It will be seen, therefore, that the relatively large oxygen passage of the nozzle is unconstricted and of either constant or gradually increasing cross-sectional area from the inlet portion up to the outlet orifice 20 and that the maximum cross-sectional area occurs in the cylindrical portion 18, the cross-sectional area of the orifice 20 being slightly smaller. The slot-like orifice 20 is connected with the cylindrical portion 18 by the portion 15' having side walls that diverge from the width of the portion 18 to the width of the orifice 20 and upper and lower walls that converge from the height dimension of the portion 18 to the height dimension of the orifice 20.

When the nozzle described herein is used for making surface cuts, such as channels or scarfs, the main axis of the oxygen passage 15 in the nozzle is held at an acute angle to the surface of the work and in a plane which will include the direction of movement and which is normal to the surface of the work. As the scarf is made the nozzle is advanced parallel to the surface in the direction of the inclination of the nozzle and toward the surface portions to be removed. One of the broad sides of the orifice 20 is positioned adjacent to and parallel to the surface of the work W and to initiate a desurfacing cut, the heating flames produced by the heating mixture orifices 17 are applied to a transverse zone of surface metal where the cut is to begin until the zone reaches an ignition temperature, then the oxidizing gas stream is turned on and the nozzle advanced relatively to the work at a uniform speed in a direction parallel to the surface and in the general direction of flow of the ribbon-like stream.

The speed of cutting and the contour of groove obtained with our nozzle depends upon the kind of metal being removed, the shape, volume and velocity of the discharged oxygen stream, and the rate of delivery and distribution of the combustible gas mixture. As a specific example in the process of removing seams from steel billets having about .4% of carbon and 1.05% chromium with the usual amounts of impurities it has been found that a nozzle having a circular oxygen orifice .438" in diameter, when employing an oxygen discharge velocity of 585 ft. per sec., will successfully remove at a speed of 6 ft. per min. a seam ½ in. in depth and leave a groove 1½ in. in width at the top which is suitable to be rolled out without causing its sides to be folded over. In the above example the axis of the nozzle was held at an angle of about 38° with the surface of the work.

The figures given herein are in reference to a nozzle having a circular oxygen orifice disclosed in our aforementioned United States Patent No. 2,266,834 and are given as a specific example only, and it is to be understood that these figures may be varied within wide limits depending upon varying conditions and results desired. For example, the discharge velocity of the oxygen may be increased when it is desirable to increase the speed of cutting and the depth of the cut, and the velocity may be decreased to decrease the speed of cutting and the depth of the cut.

The curvature of the scarf may be controlled by the shape of the oxygen discharge orifice for any given projected length of orifice opening upon the work. It has been found that a nozzle having a circular orifice of a given diameter cuts a scarf with a smaller radius of curvature at the bottom than a nozzle having an oblong orifice with a major axis equal to the diameter of the circular orifice. The selection of a nozzle having a particular shape of orifice depends upon the class of work to be done. For example, in cutting out isolated seams, the circular orifice is suitable. In making broad surface cuts, as when the surface of the metal is skinned off, the nozzle described herein adapted to discharge an oblong or sheet-like column of oxygen is preferable, because a greater area of surface metal can be removed per cubic foot of oxygen consumed. Furthermore, the surface of the metal is left in a smoother condition because wider scarfs, each having a greater radius of curvature, can be made. Therefore, there are fewer ridges formed by the juncture of one scarf with another, and the tendency to form fins or slivers along these ridges or at the marginal edges of the scarf is reduced.

Other uses not mentioned herein may be found for our nozzle and the details thereof may be changed without departing from the scope of our invention as defined in the appended claims.

We claim:

1. Method of scarfing or gouging a shallow layer of surface metal from a ferrous metal body, such as a steel billet, which comprises heating at

least a portion of the surface of said billet to be gouged to an ignition temperature; providing a relatively voluminous stream of oxidizing gas; reducing the velocity of flow of said stream; discharging said stream through an orifice elongated transversely of the direction of flow to provide a substantially sheet-like stream having a predetermined velocity; directing said stream at an acute angle against the preheated surface portion; maintaining said sheet-like stream positioned with its longer transverse dimension substantially parallel to said surface; and relatively moving said stream and said surface in a direction parallel to the surface and in the general direction of flow of said stream.

2. Method of scarfing or gouging a shallow layer of surface metal from a ferrous metal body, such as a steel billet, at least a portion of the billet surface to be removed being at an ignition temperature, which method comprises forming a relatively voluminous oxidizing gas stream to flow as a transversely wide thin sheet-like stream having a predetermined velocity; directing said stream at an acute angle against said surface heated to ignition temperature while maintaining the wide transverse dimension of said stream substantially parallel to said surface; and relatively moving said stream along said surface in a direction parallel to said surface and in the general direction of flow of said stream.

3. Method of scarfing or gouging a shallow layer of surface metal from a ferrous metal body, such as a steel billet, at least a portion of the billet surface to be removed being at an ignition temperature, which method comprises forming a relatively voluminous oxidizing gas stream to flow as a transversely wide thin sheet-like stream having a predetermined velocity; directing said stream at an acute angle against said surface heated to ignition temperature while maintaining the wide transverse dimension of said stream substantially parallel to said surface; simultaneously applying a wide substantially sheet-like stream of combustible gas against said surface while maintaining such combustible gas stream adjacent a wide side of said sheet-like oxidizing gas stream, said stream of combustible gas providing a flame of substantially uniform intensity throughout; and relatively moving said streams in unison along said surface in a direction parallel to said surface and in the general direction of flow of the oxidizing gas stream.

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