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FLAME BLASTING AND APPARATUS THEREFOR

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The present invention relates to high velocity flame blasting employing flames of the oxy-acetylene type.

Erectly, flame surface-heating operations, such as descaling, rust removing, paint removing, etc., by the application of high temperature flames to a surface to be treated, have been accomplished by using blowpipes of the pre-mixed and post-mixed flame types. Such blowpipes deliver flames of relatively low velocity to the surface to be treated and transfer heat to the surface at a relatively low unit heat transfer rate. It is evident that, if heat could be supplied to such surfaces at higher velocities and unit heat transfer rates, the time required for surface treatment could be greatly reduced and the effectiveness of the treatment increased.

Accordingly, it was attempted to employ for such flame surface-heating operations a flame produced by a throat combustion blowpipe, having high velocity (about 2000—3000 F. P. S.) flame jets and a high unit heat transfer rate. Due to the exceedingly high temperature and high flame velocity of the oxy-acetylene flame, these gases were preferred as oxidant and fuel. The application of a high temperature and high velocity flame to a work surface may be termed “flame blasting” and the burner for producing such flame may be termed a “flame blasting burner.” As a result of such attempts it was found that, when employing a throat combustion burner in the above manner as a flame blasting blowpipe, it became possible to form and maintain within the burner from the point of mixing and combustion of acetylene and oxygen at the entrance to the throat block along the acetylene passages, thereby producing a closer density of these passages, a sensitivity in regard to maintaining combustion within the burner, and an overall instability of the flame generated. It is believed that the deposition of carbon in this manner is attributable to the dissociation of acetylene in the region of initial mixing and combustion.

It is, therefore, an object of the present invention to provide a burner, having the velocity and unit heat transfer advantages of the throat combustion burner, which is stable in operation with an oxy-acetylene flame and which maintains mixing and combustion within the burner when operating as a flame blasting blowpipe in spite of carbon deposition.

A still further object is to provide a blowpipe having greater efficiency and reduced heat loss to the cooling fluid.

Other aims and advantages will be apparent from the following description and appended claims.

In an attempt to make the burner less sensitive to instability in maintaining combustion therein, as well as to increase the overall stability of the flame produced, a small chamber or recess was provided in a throat combustion burner in the region of mixing near the mouth or entrance to the discharge throat. It was found that this small chamber stabilized the flame and allowed combustion to be maintained within the burner despite the fact that crystalline carbon was deposited in the chamber and adjacent acetylene passages as described above.

In the drawings:
Fig. 1 is a cross-sectional view through the head of a burner embodying the invention;
Fig. 2 is a cross-sectional view of another burner embodying the invention, showing the main body of the invention, a frame, and other essential parts of the invention. Fig. 3 is a cross-sectional view of another burner embodying the invention; Fig. 4 is a front elevation of a multi-flame blasting burner embodying the invention; Fig. 5 is a side elevation view of the burner of Fig. 4; Fig. 6 is a sectional view taken along the line 6—6 of Fig. 4;
Fig. 7 is a perspective view of a portion of the body of the burner of Figs. 4—6; Fig. 8 is a sectional view of the burner taken along the line 8—8 of Fig. 6;
Fig. 9 is a sectional view of the burner taken along the line 9—9 of Fig. 6;
Fig. 10 is a sectional view taken along the line 10—10 of Fig. 9; and
Fig. 11 is a sectional view taken along the line 11—11 of Fig. 8.

Referring to Figs. 4—11 of the drawings, a multi-frame port flame blasting burner 10 is provided having an upper body 11 of metal and a flame port plate 12 of metal secured thereto by bolts 13. Oxygen, acetylene, and cooling water inlet and outlet means are supplied to upper body 11 through hoses or conduits 14, 15, 16 and 17, respectively, which are arranged in a bundle and feed into the top side of upper body 11.

Oxygen entering the body 11 through conduit 14, passes into oxygen header passage 20 located in the upper portion of body 11. From oxygen header passage 20, oxygen is passed through a plurality of distributing and metering ports 22, to a common oxygen passage 23 in the form of a longitudinal channel in the lower face of the body 11 and then inwardly through a plurality of transverse oxygen passage means such as slots 24 to the zone of mixing and initial combustion near the inlet zone of throat 30. Concurrently therewith, acetylene from acetylene header passage 25, located in the upper portion of body 11, passes through a plurality of acetylene distributing and metering ports 26 into a common acetylene passage 27 in the form of a channel parallel to passage 23, and then inwardly through a plurality of transverse acetylene passage means such as slots 28 to the zone of mixing and initial combustion near the inlet zone of throat 30. In this manner a plurality of streams of oxygen meet head-on with a plurality of streams of acetylene, each oxygen stream intercepting an acetylene stream in a separate confined chamber.

Good distribution of both oxygen and acetylene before the gases enter the individual slots in the burner is important. Uneven distribution causes uneven combustion and therefore uneven flames. For this reason distributing ports and common passages are provided in both the oxygen and acetylene supply lines.

Each separate confined chamber is formed by an oxygen slot 24, an acetylene slot 28 and a small chamber or recess 29 formed in the under face of burner body 11 at a point above the combustion throat or flame port 30. This small chamber need not be of any particular shape but should merely be of sufficient volume to compensate for the volume of acetylene slot lost as a mixing and combustion chamber because of carbon deposition. If the chamber 28 plus 29 is too large, too much combustion will take place within the burner and the resulting flames will be less efficient for flame blasting purposes. Similarly, if the chamber 28 plus 29 is too small, an insufficient combustion and excess carbon deposition takes place within the burner and the resulting flames are also unsuitable for flame blasting operations. Since the separate confined chamber, spoken of above, is composed of slot 24, slot 28 and recess 29, it is apparent that, should slots 24 or 28 be of excessive dimensions, the effect on the re-
sultant flame would be the same as an increase in the size of recess 29. In Figs. 1-11 of the drawings the small chamber or recess 29 is formed by a counterboring. In each case the burning gaseous mixture is discharged separately from the burner to the atmosphere through a flame port disposed transversely to both of the head-on gaseous streams and drilled through the plate 12. Upon ignition, a plurality of high velocity flame jets 31 emanate from the plurality of burner flame ports.

Cooling water passes from inlet conduit 16, at the center of body 11, through a passage 32 and longitudinal passages 33 in the plate 12 on both sides of flame port plate 12 in the region surrounding flame ports 30. Cooling water is then passed back to the burner body through connecting bores 34 to and through passage 34 in the body 11 connecting to the outlet conduit 17. The cooling water passages through the burner are shown in section in Fig. 6 and in detail in Figs. 8-11 of the drawings. Sealing means 35, such as resilient O-rings are provided as water passage seals between the burner body and the flame port plate.

The burner is provided with wheels 36 at its two sides to assist in moving it along a surface to be flame treated and maintaining the flames a proper distance from the work surface during treatment. It has been found necessary, for the reasons discussed above, to provide a chamber or recess behind the flame ports in order to maintain stable operation when employing a throat combustion burner as a flame blasting burner wherein acetylene is the fuel gas employed.

With an arrangement as shown in the burner of Fig. 1 of the drawings, it is necessary to periodically dismantle the burner and chip out the carbon deposited in the region of the small chamber and acetylene slot.

It has been found preferable to overcome this need for periodic breakdown and cleaning by providing, in addition to the small chamber near the entrance to the flame port or throat, an overflow or enlarged acetylene slot which will allow satisfactory combustion and flame stability while allowing carbon buildup in such oversized acetylene slot. Burners of this type are shown in Figs. 2 and 3 of the drawings, as well as the multi-flame port burner as is shown in Fig. 6 of the drawings.

The enlarged portion of the acetylene slot may run for the entire length of the slot (as shown in the burner of Fig. 3) or may only run for that portion of the slot in which carbon deposition will normally occur, i.e., near the point of mixing and initial combustion (as shown in the burner of Fig. 2 of the drawings).

When burners having enlarged acetylene slots are employed, carbon buildup can periodically be removed by cutting back on the acetylene feed and burning the carbon deposit out with the oxygen stream. When the acetylene is again turned on the burner is immediately ready for use. This ability to clean the burner, without dismantling it for long periods of service, is a great advantage. The burning out should be done before a flame port becomes completely blocked.

It has been found that a desirable result is produced by operating the blowpipe of the present invention with some carbon deposit in the region of the small combustion chamber and acetylene slot. The carbon so deposited insulates a large portion of the combustion zone from the rest of the burner body, thereby greatly reducing the heat loss to the cooling water and consequently increasing the overall efficiency of the blowpipe.

Additionally, it has been found that this carbon deposit aids in insuring proper combustion through the 'glow-plug initiation' principle. It is most desirable to maintain sufficient amount of carbon deposit during operation to obtain this heat insulation benefit and the increased stability, while at the same time not allowing the deposit to increase to such a point where it interferes with the stability of the flame.

It has been found that the burners, particularly those contours of Figs. 6, 2, and 3, operate to provide a very slow or substantially no increase of carbon deposit buildup soon after initial operation.

It is to be understood that the burners in accordance with the present invention are so designed that gas mixing will be carried out with both the oxygen gas and acetylene gas at approximately equal pressure at the point of mixing in the region of the small combustion chamber or recess 29 and the entrance to the flame port or throat 30. A pressure difference of about 12-15 psi is generally found to be very desirable, although higher and lower pressures have been satisfactorily employed.

It was found that, when a ratio of cross-sectional area of oxygen slots to cross-sectional area of acetylene slots (a/b of Fig. 2) is less than about 1/4, the efficiency of the burner falls off greatly for blasting purposes due to too much combustion taking place within the burner, i.e., in the acetylene slots. The ratio of about 1.5 was found to be preferred for burners employed in flame blasting operations.

One burner, having 26 flame ports and an internal construction similar to that shown in Fig. 1 of the drawings, was successfully operated as a blasting blowpipe with oxygen and acetylene gases, but had to be shut down periodically and mechanically cleaned to remove carbon deposits. The dimensions of the oxygen slots were 0.12" x 0.015"; those of the acetylene slots were 0.12" x 0.015" and the flame ports were 0.064" in diameter.

Another burner, having 26 flame ports and an internal construction similar to that shown in Fig. 2, was operated successfully as a flame blasting burner for well over 100 hours without cleaning. This burner had an oxygen slot 0.12" x 0.015", acetylene slots 0.12" x 0.045" max. (dimension "b" of Fig. 2) and 0.015" min. (dimension "a" of Fig. 2), and conically shaped small chambers 29 of 1/4-inch depths positioned above the inlet to flame ports of 0.064" diameters. The thickness of the restriction maintained in each acetylene slot was 0.040" (dimension "c" of Fig. 2) but this dimension was not found to be critical, and the restriction could be omitted (as in Figs. 3 and 6) without a significant change in burner operation.

In general, when employing the flame blasting blowpipe of the present invention for light rust and paint removal, the gas supplies should be adjusted to give flames slightly off the yellow color into the bluish range. For highest heat output for scale and heavy rust removal the flames should be more into the yellow range.

The flame blasting process of the present invention has been found effective in removing paint, rust and scale encrustations and the like by progressively passing the series of flame blasting jets along the work surface to be flame blasted, at an angle thereto. The combined thermal and mechanical actions of the blasting jets thoroughly remove these encrustations.

What is claimed is:

1. An internal combustion burner comprising a burner body having supply means for supplies of oxygen and acetylene; an internal combustion discharge outlet passage provided with an inlet zone for oxy-acetylene mixture and an outlet through an external face of the burner; oxygen passage means communicating with said oxygen supply passage means and terminating adjacent and transversely to the inlet zone of said internal combustion discharge outlet passage; acetylene passage means communicating with said acetylene supply passage means and terminating adjacent and transversely to the inlet zone of said internal combustion discharge outlet passage; acetylene passage means communicating with said acetylene supply passage means and terminating adjacent and transversely to the inlet zone of said internal combustion discharge outlet passage; said recess having a volume sufficient to promote sustained mixing of oxygen
and acetylene and the internal combustion process both before and after a reduction of volume in the region of the junction and in the acetylene passage means due to a normal deposition of carbon therein.

2. A multi-flame internal combustion burner comprising a burner body having supply passage means for supplies of oxygen and acetylene; a series of internal combustion discharge outlet passages each provided with an inlet zone for acetylene mixture and an outlet through an external face of the burner; a series of oxygen passage means communicating with said oxygen supply passage means and terminating adjacent and transversely to the inlet zone of each of said internal combustion discharge outlet passages; a series of acetylene passage means communicating with said acetylene supply passage means and terminating adjacent and transversely to the inlet zone of each of said internal combustion discharge outlet passages, said series of oxygen passage means and said series of acetylene passage means being directed toward each other; and walls defining a series of recesses positioned at the junctions of said series of oxygen and acetylene passage means with the series of inlet zones of said internal combustion discharge outlet passages; each of said recesses having a volume sufficient to promote sustained mixing of oxygen and acetylene and the internal combustion thereof in the region of said junction and in the series of acetylene passage means due to a normal deposition of carbon therein.

3. A flame blasting burner comprising a burner body having header means for introducing oxygen gas and acetylene gas; an internal combustion throat provided with an inlet zone for combustible oxy-acetylene mixture and an outlet through an external surface of said burner body; oxygen passage means communicating with said oxygen header means and terminating adjacent and transversely to said inlet zone of said internal combustion throat; acetylene passage means communicating with said acetylene header means and terminating adjacent and transversely to the inlet zone of said internal combustion throat in substantially axial alignment with said oxygen passage means; and a recess positioned at the junction of said oxygen passage means, acetylene passage means, and the inlet zone of said internal combustion throat, said recess having a volume sufficient to sustain normal mixing and combustion in spite of the reduction in volume of said junction and acetylene passage means due to carbon deposition therein.

4. A flame blasting burner in accordance with claim 3, having acetylene and combustion means in the region of said junction up to 4.0 times greater in cross-sectional area than the area of said oxygen passage means.

5. A multi-flame blasting burner in accordance with claim 3 wherein passages are provided for the circulation of oxygen fluid in the region around said internal combustion throats and said junctions.

6. A multi-flame blasting burner in accordance with claim 5, wherein passages are provided for the circulation of cooling fluid in the region around said internal combustion throats, said junctions, and said recesses.

7. A multi-flame blasting burner in accordance with claim 5, wherein said oversized acetylene passage means provided is reduced in area in the portion of said passage remote from said junction.

8. A multi-flame blasting burner in accordance with claim 7, wherein said oversized acetylene passage means provided is reduced in area in the portion of said passage remote from said junction.

9. A multi-flame blasting burner in accordance with claim 8, wherein a series of recesses between said series of oxygen and said series of acetylene is forward from said junction.

10. A multi-flame blasting burner in accordance with claim 9, wherein a series of recesses between said series of oxygen and said series of acetylene is forward from said junction.

11. A multi-flame blasting burner in accordance with claim 10, wherein said oxygen passage means and said acetylene passage means communicating with said internal combustion throat provided with an inlet zone for combustible oxy-acetylene mixture and an outlet through an external surface of said burner body, oxygen passage means communicating with said oxygen header means and terminating adjacent and transversely to said inlet zone of said internal combustion throat, acetylene passage means communicating with said acetylene header means and terminating adjacent and transversely to the inlet zone of said internal combustion throat in substantially axial alignment with said oxygen passage means, and walls defining a recess positioned at the junction of said oxygen passage means, acetylene passage means, and the inlet zone of said internal combustion throat, in which a layer of carbon is deposited upon the walls of said recess and in the region of said junction, which carbon layer is of sufficient thickness to retard loss of heat from the internal combustion reaction to said walls.

12. A flame blasting burner having header means for introducing oxygen gas and acetylene gas, a series of internal combustion throats each provided with an inlet zone for combustible oxy-acetylene mixture and an outlet through an external surface of said burner body, a series of oxygen passage means each communicating with said oxygen header means and terminating adjacent and transversely to the inlet zone of each of said internal combustion throats; a plurality of acetylene passage means each communicating with said acetylene header means and terminating adjacent and transversely to the inlet zone of each of said internal combustion throats; a plurality of acetylene passage means each communicating with said acetylene header means and terminating adjacent and transversely to the inlet zone of each of said internal combustion throats; a plurality of acetylene passage means each communicating with said acetylene header means and terminating adjacent and transversely to the inlet zone of each of said internal combustion throats.

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