A flame head producing a high velocity jet flame is utilized with a venturi type adapter unit which creates a vacuum pick-up for abrasive particles or coating materials that are stored in a non-pressurized container, said material being propelled at a high velocity and temperature through the flame. Since the flame from the head is virtually oxygen free or inert, neither the coating particles, the abrasive particles, nor the surface being treated will be oxidized.

4 Claims, 5 Drawing Figures
JET FLAME CLEANING AND COATING
APPARATUS AND METHOD

This is a division of application Ser. No. 097,553, filed 12/14/70, now U.S. Pat. No. 3,741,792.

BACKGROUND OF THE INVENTION

1. FIELD OF THE INVENTION

The present invention relates generally to improvements in jet flame heads, and more particularly, the present invention pertains to new and improved flame heads wherein a venturi type adapter is fitted to the end of the flame head thereby creating a vacuum pick-up for coating or abrasive particles which are then propelled through the flame.

2. DESCRIPTION OF THE PRIOR ART

Various methods and apparatus for flame drilling and flame coating are known in the art. It is well known to use a high velocity, inert, supersonic flame which is produced in a combustion chamber when a hydrocarbon fuel is mixed with an oxidant such as air. This results in a continuous combustion, which, in turn, produces a high velocity, high temperature, essentially oxygen-free jet flame. One such prior art flame drilling method and apparatus is disclosed in Browning, et al., U.S. Pat. No. 3,463,249, the teachings of which as to the prior art are incorporated by reference into this specification. In summary, a high velocity jet flame is produced by burning a hydrocarbon fuel with air in a combustion chamber under high pressure. The resulting jet stream composed of the products of combustion and nitrogen is directed against a rock or mineral mass. Abrasive particles may be added as a cutting aid where required. While the method disclosed by Browning has advantages, it is also apparent that it is not without its drawbacks. For example, if abrasive particles are to be used in the flame drilling process, it is necessary to introduce intermittently the abrasive particles by means of a pressurized pot into the combustion chamber. This requires additional and costly equipment, together with the attendant complications of handling and maintaining said equipment. Furthermore, while the Browning patent describes a modification of the apparatus therein suitable for using abrasive particles in a drilling process, there is no teaching or suggestion of any utilization of the apparatus therein described for coating. Since such an apparatus produces a jet flame having a very high temperature and being virtually oxygen free, it would be most desirable if means could be provided so that a jet flame having these characteristics could be used to clean a surface and coat it with organic or inorganic materials.

SUMMARY OF THE INVENTION

The general purpose of this invention is to provide a method and apparatus for flame cleaning with abrasives, and optionally for flame cleaning a surface and coating same with organic or inorganic materials. It is a general purpose of this invention to provide a method of flame cleaning with abrasives having all of the advantages of similarly employed prior art devices with none of the above described disadvantages. In order to attain this, the present invention provides a unique venturi type adapter that is positioned at the end of a flame head and which creates a vacuum pick-up for coating or abrasive particles which are then propelled at a high velocity and temperature through the jet flame. The vacuum pick-up eliminates the need for a pressurized container for the materials which are to be flame sprayed.

Accordingly, an object of the present invention is to provide a venturi type attachment that may be positioned at the end of a flame head and which creates a vacuum pick-up for particles to be propelled through the flame.

It is another object of this invention to provide a flame head suitable for propelling abrasive particles through the flame, and which does not require the use of a pressurized container for the abrasive.

Another object of this invention is to provide a flame head attachment which enables coating particles to be applied through the exhausting flame.

A further object of this invention is to provide a flame head suitable for underwater cleaning and coating.

Still another object of this invention is to provide a flame head suitable for granite channeling, or flame-sand blasting.

Still another object of this invention is to provide a flame head suitable for producing carbon black.

The foregoing and other objects are attained in accordance with the present invention by an apparatus having a venturi type attachment at the end of a flame head. The venturi adapter utilizes the velocity of the hot gases being emitted from the combustion chamber to create a vacuum, which may be attached to a non-pressurized container by suitable connecting means. The vacuum created as the flame of hot gases passes through the venturi adapter pulls either the abrasive or coating material from the non-pressurized container into the flame pattern. These particles of abrasive or coating material are picked up by the flame from the adapter, accelerated to a velocity of approximately 3,600 feet per second, and propelled by the velocity of the supersonic flame onto the surface to be coated or cleaned. The high temperature of approximately 3,000° F. of the flame also causes a thermal expansion to take place in the material being treated, thus loosen any loose or corrosive material on the surface thereof, which in turn is removed by the velocity of the supersonic flame.

These and other objects, features, and advantages of the invention will become more fully apparent to those skilled in the art from the following description of an illustrative embodiment of the invention and as shown in the annexed Drawings wherein like reference numerals designate corresponding parts throughout the several Figures.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a perspective view of a flame blasting head incorporating the venturi abrasive adapter;
FIG. 2 is a perspective view of a flame head incorporating the venturi coating adapter;
FIG. 3 is a partial cross-sectional view of a flame blasting adapter of the type shown in FIG. 1;
FIG. 4 is a top view of a flame coating adapter of the type shown in FIG. 2; and,
FIG. 5 is a partial cross-sectional view of the adapter shown in FIG. 4.
DESCRIPTION OF AN ILLUSTRATIVE EMBODIMENT

Referring now to FIG. 1, the flame cleaning device of the present invention is shown in perspective view, having central pressurized air and fuel lines 6, and vacuum pick-up lines 18, which lead to a non-pressurized container or pot 9, which may contain, for example, abrasive particles. The venturi adapter 15 is attached at the outlet side of the flame sprayer, and has a terminal orifice 17 at the distant end thereof.

In FIG. 2, a modification of the apparatus is shown which is suitable for coating purposes. The venturi adapter 25, having an aerated powder injector 21, is disposed at right angles to the outlet orifice 12. A center air line 26 is provided in addition to the two side vacuum lines 18.

The actual operation of a flame blasting device in accordance with the present invention is illustrated in FIG. 3. A non-pressurized abrasive container or pot 9 is filled with abrasive particles 8. Pressurized air and fuel lines 6 feed into combustion chamber 11, where the fuel is ignited. The heated, expanding gases are forced through the head outlet orifice 12, and thence through the stepped bores $B_1$, $B_2$, and $B_3$ of the venturi adapter 15 of the present invention. It will be noted that the distant end of the bore of largest diameter $B_3$ is the terminal orifice 17. The pressure in the combustion chamber is generally of the order of 70 psi, resulting in a supersonic jet flame 13, which forms shock diamonds 14 after passing through the head outlet orifice 12 as the inert gases are expanded to the atmosphere. The supersonic jet flame is typically moving at a velocity of about 3,600 feet per second. As this flame passes the apertures 16, it creates a vacuum with the range of 18 to 25 inches of mercury. This vacuum acts through vacuum lines 18, sucking abrasive particles from the abrasive container or pot 9 through vacuum abrasive pick-up unit 10 which is provided with an air inlet 19 that may be adjusted to regulate the amount of abrasive particle pick-up. Thus, the vacuum created as the flame of hot gases passes through the venturi adapter pulls the abrasive particles from the non-pressurized container or pot 9 through the apertures 16 into the flame pattern. These abrasive particles are then picked up by the flame inside the venturi adapter, and increased to a velocity of approximately 3,600 feet per second. The particles are propelled by the velocity of the supersonic flame onto the surfaces to be cleaned. In a cleaning operation, the high flame temperature of approximately 3,000°F. also causes a thermal expansion to take place on the material being cleaned, thus loosening the corrosive material which is in turn removed by the velocity of the supersonic flame with the aid of the abrasive particles therein. In combination with the shock waves and the heat of the flame, a highly efficient cleaning method is provided, since the flame and abrasive particles are essentially oxygen-free. Thus, it will be apparent that this apparatus is suitable for use in a wide variety of applications, such as cleaning underwater, channeling granite etc.

In one modification of the present invention, carbon black may be produced merely by substituting a hydrocarbon compound for the abrasive particles (usually sand) contained in the pot 9. The extremely high temperatures of the venturi adapter flame result in an instantaneous conversion of the hydrocarbons into carbon black, which is propelled through the supersonic jet flame in the same manner as the aforementioned abrasive particles.

A modification of the venturi apparatus of the present invention for coating purposes is shown in FIGS. 4 and 5. An air line from a compressor or other suitable source of pressurized air is shown at 24, which supplies air to be forced through the aerator 23, and coating particles are then carried upwards by the air flow through the fluffering screen 22. The particles are maintained in the upper chamber of the coating aerator by aerator lid 20. These aerated coating particles 30 are then drawn by the vacuum through vacuum lines 18 into the venturi injector, then into the supersonic jet flame 13 where they are melted and fused on the substrate.

The venturi 25 shown in FIG. 5 is disposed at right angles 35 with respect to the outlet orifice. An air line is provided at 26 to regulate the rate of coating pick-up. The twin venturi type aerated powder injector 21 is held in place by one or more injector securing bands 27, or other suitable means, attached to the burner tip 33. The combustion of a hydrocarbon fuel and oxidant in the combustion chamber 11 creates a supersonic jet flame passing through head outlet orifice 12 at speeds of approximately 3,600 feet per second. A vacuum is created by the flow of these gases at right angles to the outlet 35 of the venturi coating adapter 25. Additional vacuum may be provided within the adapter at the juncture of vacuum lines 18 by forcing air through one or more air lines 26 that pass into the venturi adapter, thereby aiding the venturi adapter 25 in introducing coating particles into the supersonic jet flame. An air flow provided through air line 26 may serve two main functions: first, to assist in keeping the venturi adapter cool; second, to increase the velocity of the fine coating particles into the jet stream. Thus, if an air line 26 is used, there will generally be no need for an additional cooling provision, since it will serve to keep the venturi adapter 25 relatively cool.

METHOD

The method of the present invention utilizes the high velocity, inert, supersonic flame that is processed in the combustion chamber where a hydrocarbon fuel is mixed with an oxidant. The high velocity gases are released through a restricted orifice and are of a temperature within the range of 2,800°F. to 4,000°F. and travel at a velocity within the range of 3,000 to 3,800 feet per second. Either an abrasive material or protective coating material is introduced into the jet flame exteriorly of the combustion chamber. The method of the present invention may be utilized with either a pressurized or non-pressurized abrasive pot as the distinctive step advanced in the present method is the introduction of abrasive or protective coating materials exteriorly of the combustion chamber. The venturi adaptors which have heretofore been described in detail are particularly adapted to this method. The protective coating material may be an organic or inorganic material as well as blends of organic, blends of inorganic, or blends of organic and inorganic materials. A particularly suitable coating is polyethylene. It should be noted that the present method may be used to clean a surface, to coat a surface with a protective material, or to both clean and coat.
It will be appreciated that while the foregoing disclosure relates only to illustrative embodiments of the invention in flame cleaning with abrasives and flame coating with organic or inorganic materials, and in the production of carbon black, it is capable of delivering and coating many materials for various purposes, and will provide suitable cleaning and coating methods under different conditions.

What is claimed is:

1. A flame jet apparatus comprising a combustion chamber, pressurized means for feeding a hydrocarbon fuel and oxidant into said chamber, said chamber having at least one outlet orifice for releasing a combustion jet flame, a venturi type adapter disposed outwardly of said outlet orifice, a non-pressurized container for storing a material to be dispensed, and at least one pick-up line leading from said venturi adapter to said container, whereby passage of the combustion jet flame past the venturi adapter creates a vacuum in said pick-up line drawing said material into said flame, said apparatus being characterized in that the venturi adapter is a twin venturi type aerated injector having two pick-up lines entering said adapter from opposite sides thereof, said adapter having its principal axes angularly disposed to the axis of said outlet orifice, and a pressurized air line entering said adapter along its principal axis prior to the points of entry of the pick-up lines.

2. A flame jet apparatus comprising a combustion chamber, pressurized means for feeding a hydrocarbon fuel and oxidant into said chamber, said chamber having at least one outlet orifice for releasing a combustion jet flame, a venturi type adapter disposed outwardly of said outlet orifice, a non-pressurized container for storing a material to be dispensed, and at least one pick-up line leading from said venturi adapter to said container, whereby passage of the combustion jet flame past the venturi adapter creates a vacuum in said pick-up line drawing said material into said flame, said apparatus being characterized in that the venturi adapter is a twin venturi type aerated injector having two pick-up lines entering said adapter from opposite sides thereof, said adapter having its principal axes angularly disposed to the axis of said outlet orifice, and a pressurized air line entering said adapter along its principal axis prior to the points of entry of the pick-up lines.

3. The apparatus of claim 1 in which the container stores abrasive particles, said container having a hollow projecting portion at the bottom thereof that connects with said pick-up line, and an air intake means being provided at the end of said projecting member.

4. The apparatus of claim 2 in which the container stores a coating material, said container having an inlet at the bottom thereof for a source of pressurized air, an aerator located above said inlet, a screen located above said aerator, and a cover for the container to keep the supply of aerated coating particles in the container.