United States Patent [19]

Peck et al.

[11] **3,854,997**

[45] **Dec. 17, 1974**

[54] **JET FLAME CLEANING**

[75] Inventors: **Clifford S. Peck**, Elberton, Ga.; **Clarence A. Garrison**, Monroe, La.

[73] Assignee: **C. S. Peck Co., Inc.**, Elberton, Ga.

[22] Filed: **Apr. 10, 1973**

[21] Appl. No.: **349,821**

Related U.S. Application Data

[62] Division of Ser. No. 97,553, Dec. 14, 1970, Pat. No. 3,741,792.

[52] **U.S. Cl.** **134/7**, 51/8, 51/11, 134/19, 175/14

[51] **Int. Cl.** **B08b 5/02**, B24c 5/02, B24c 7/00

[58] **Field of Search** 134/7, 1, 19, 17; 117/105.2; 175/13, 14; 51/8, 11

[56] **References Cited**

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2,399,680	5/1946	Keefer	51/8 X
2,675,993	4/1954	Smith et al.	175/13 X
2,714,563	8/1955	Poorman et al.	134/7 X
2,920,001	1/1960	Smith et al.	117/105.2 X
3,212,217	10/1965	Furgason	51/11 X
3,463,249	8/1969	Browning et al.	175/14

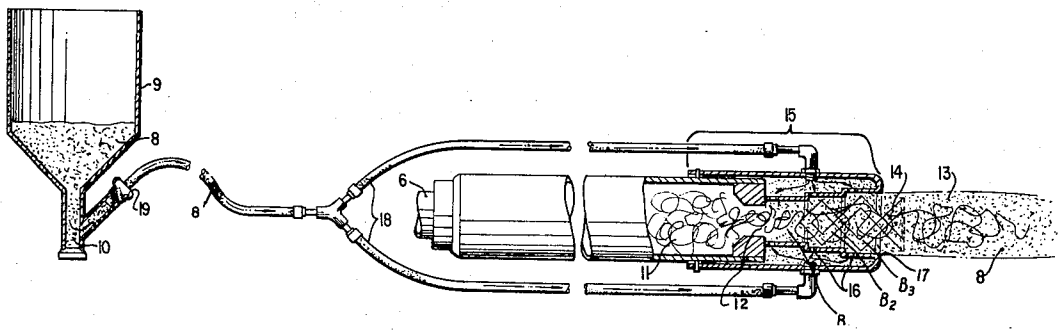
Primary Examiner—Arnold Turk

Attorney, Agent, or Firm—Newton, Hopkins & Ormsby

[57] **ABSTRACT**

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



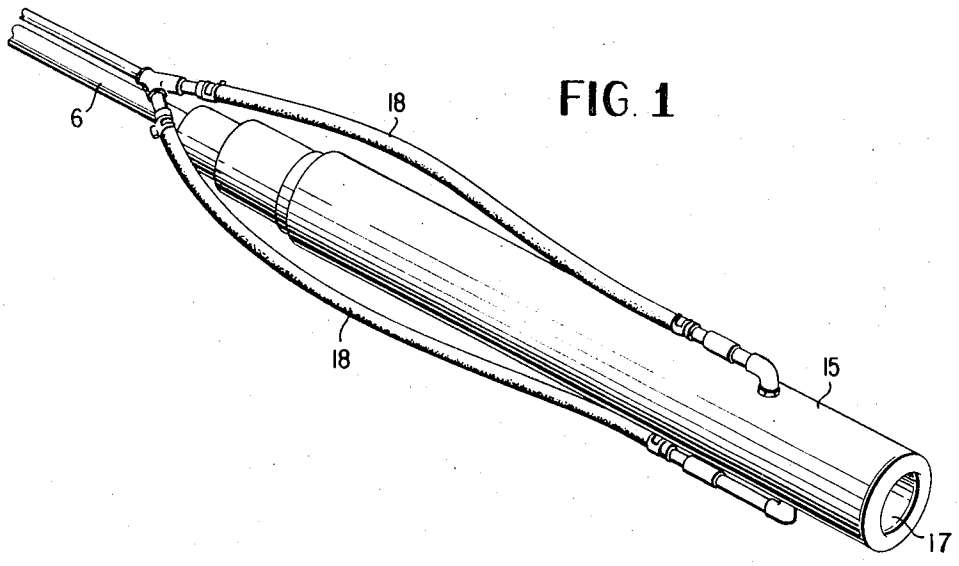


FIG. 1

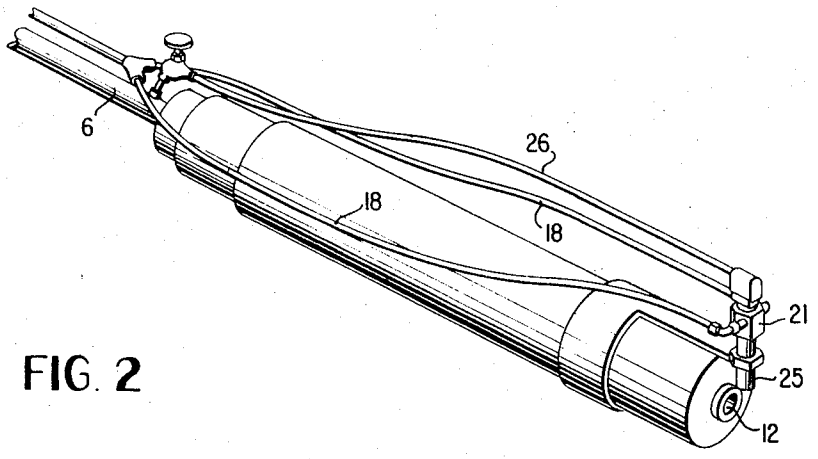


FIG. 2

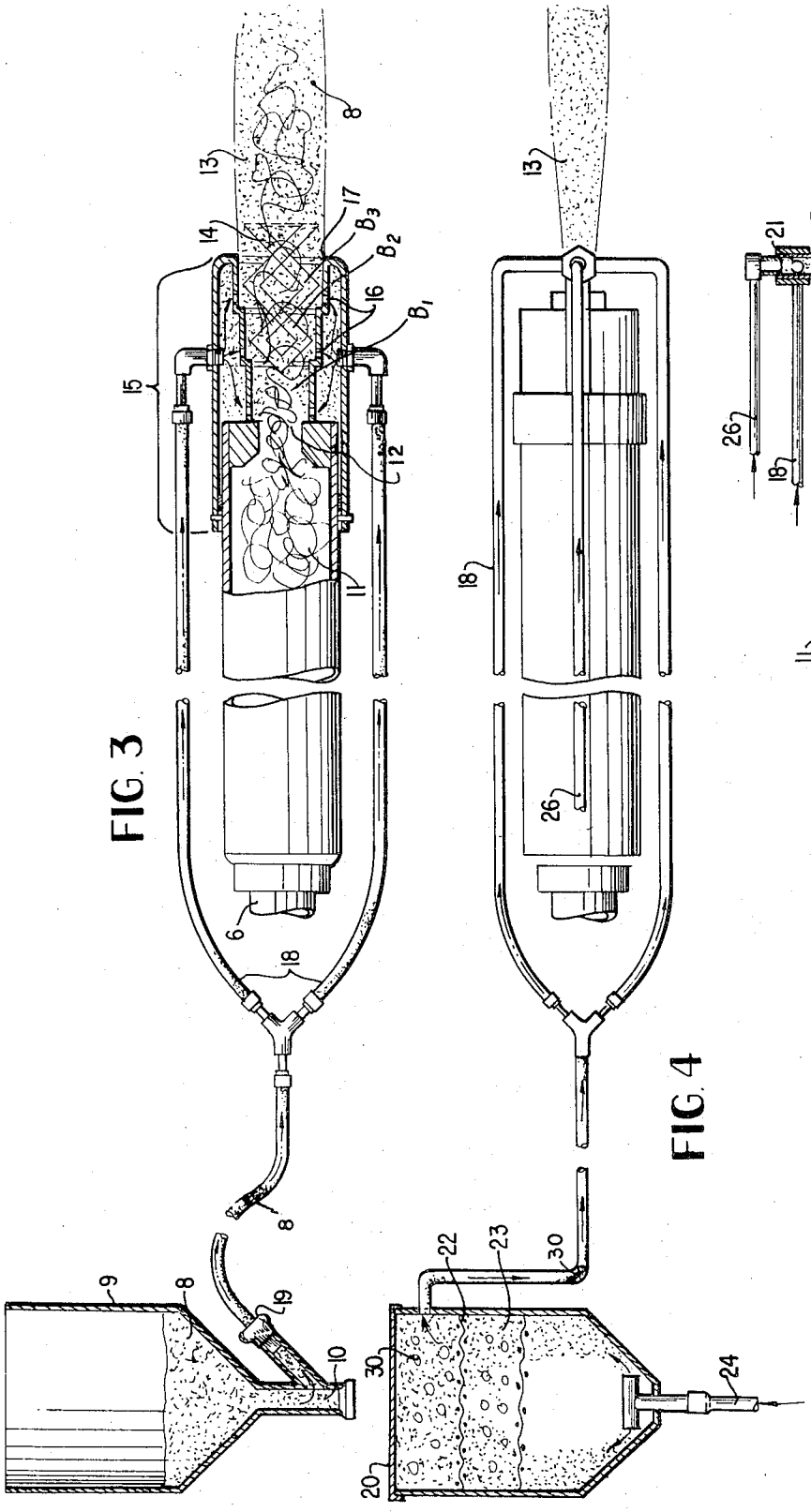


FIG. 3

FIG. 4

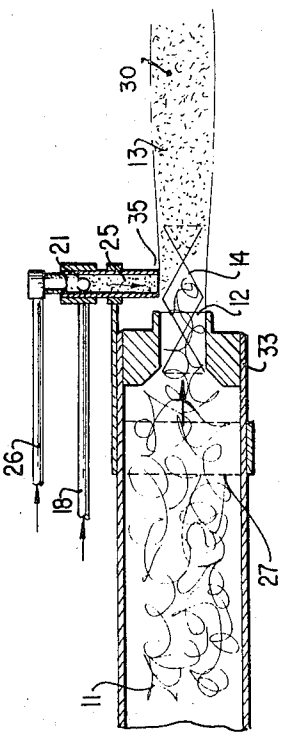


FIG. 5

JET FLAME CLEANING

CROSS REFERENCE TO RELATED APPLICATION

This application is a division of Ser. No. 97,553, filed Dec. 14, 1970 and now U.S. Pat. No. 3,741,792 issued June 26, 1973.

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 cleaned or coated. The high temperature of approximately 3000° F. of the flame also causes a thermal expansion to take place in the material being treated, thus loosening 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, 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 aperatures **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 aperatures **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 3000° 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 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 2800°F. to 4000°F. and travel at a velocity within the range of **3000** to **3800** 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 in-

vention 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 method of cleaning a surface with abrasive material including the steps of:

a. producing a supersonic jet flame by combusting a fuel within a combustion chamber;

b. passing said flame through a venturi element positioned exteriorly of said combustion chamber, said element being in communication with a supply of said abrasive material;

c. introducing said abrasive material into said flame at circumferentially and axially spaced points relative to the flame passage and from a nonpressurized container by means of the vacuum created in said venturi element acting on said supply by the passage of said flame through said venturi element; and,

d. directing said abrasive material-carrying flame onto the surface to be cleaned.

2. The method of cleaning as defined in claim **1** wherein said jet flame is of a temperature within the range of **2800**°F. to **4000**°F.

3. A method of cleaning as defined in claim **1** wherein said jet flame has a velocity within the range of **3000** to **3800** feet per second.

4. The method of cleaning as defined in claim **1** wherein said abrasive material is continually introduced.

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