



(11) **EP 1 979 677 B1**

(12) **EUROPEAN PATENT SPECIFICATION**

(45) Date of publication and mention of the grant of the patent:  
**10.10.2012 Bulletin 2012/41**

(21) Application number: **07704896.5**

(22) Date of filing: **12.01.2007**

(51) Int Cl.:  
**F23G 7/08 (2006.01) F23M 5/00 (2006.01)**

(86) International application number:  
**PCT/GB2007/000068**

(87) International publication number:  
**WO 2007/085793 (02.08.2007 Gazette 2007/31)**

(54) **LONGEVITY AND PERFORMANCE IMPROVEMENTS TO FLARE TIPS**

LANGLEBIGKEITS- UND LEISTUNGSVERBESSERUNGEN BEI FACKELSPITZEN

AMELIORATION DE LA LONGEVITE ET DE LA PERFORMANCE DE NEZ DE TORCHE

(84) Designated Contracting States:  
**AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HU IE IS IT LI LT LU LV MC NL PL PT RO SE SI SK TR**

(30) Priority: **27.01.2006 US 762531 P**

(43) Date of publication of application:  
**15.10.2008 Bulletin 2008/42**

(73) Proprietor: **Fosbel Intellectual Limited Warwickshire, B46 3BP (GB)**

(72) Inventors:  
• **ZHU, Naiping Strongville, OH 44169 (US)**

• **KARAMBIS, Louis Houston, TX 77058 (US)**

(74) Representative: **Ward, David Ian et al Marks & Clerk LLP Alpha Tower Suffolk Street Queensway Birmingham B1 1TT (GB)**

(56) References cited:  
**EP-A1- 0 139 353 WO-A-00/47463**  
**US-A- 4 137 036 US-B1- 6 168 422**  
**US-B1- 6 210 791 US-B1- 6 626 663**

**EP 1 979 677 B1**

Note: Within nine months of the publication of the mention of the grant of the European patent in the European Patent Bulletin, any person may give notice to the European Patent Office of opposition to that patent, in accordance with the Implementing Regulations. Notice of opposition shall not be deemed to have been filed until the opposition fee has been paid. (Art. 99(1) European Patent Convention).

**Description****FIELD OF THE INVENTION**

[0001] The present invention relates generally to flare tips employed in the petrochemical industry for burning off-gases associated with the production and/or refining of petroleum-based products. In especially preferred forms, the present invention relates to flare tips coated with a low emissivity (low-E) material so as to improve the longevity and performance thereof.

**BACKGROUND AND SUMMARY OF THE INVENTION**

[0002] Flare tips are notoriously well known in the petroleum industry and are used typically to burn off-gases associated with petroleum production and/or refining. US 7 247 016 describes such a flare tip. Flare tips are therefore exposed to direct flame during their service life which can of course be quite damaging. As a result, flare tips need to periodically be taken out of service and refurbished which adds to production costs.

[0003] It would therefore be highly desirable if the service life of flare tips could be extended. It would also be especially desirable if the performance characteristics of flare tips could be enhanced. It is towards fulfilling such needs that the present invention is directed.

[0004] EP 0,139,353 (A1) describes an improved burner which is suitable for use in a ground flare.

[0005] US 6,626,663 (B1) teaches solutions to establish a more equal heat flux distribution about an entirety of an exterior circumferential surface region of a process tube as compared to the heat flux distribution thereabout in the absence of a coating.

[0006] Broadly, the present invention is directed to applying a low emissivity (low-E) coating onto flare tips to achieve longer flare tip service life, improved flare tip structural integrity and/or a more stable flame pattern under a wide range of operating conditions. In accordance with some embodiments of the present invention, low-E coatings may be applied to the flare tip burner as well as associated internal and/or external component surfaces to reduce direct flame radiation and also conductive heat transfer.

[0007] In accordance with some embodiments of the invention, the low-E coating material has an emissivity of less than about 0.80, preferably between about 0.20 to about 0.78. The coating thickness of the low-E material is preferably between about 0.0254 mm (1 mil) to about 0.635 mm (25 mils), and more preferably between about 0.0508 mm (2 mils) to about 0.2032 mm (8 mils). Coating densities of the low-E material in the coating will preferably be at least about 65%, more preferably between about 80% to about 100%.

[0008] The improved flare tips in accordance with the present invention therefore result in significantly less deformation and distortion of the flare tip burner as well as its associated internal and/or external components there-

by prolonging its useful service life. The low-E ceramic coatings of the present invention will also provide enhanced corrosion and oxidation resistance and further improve the longevity of the flare tip burner as well as its associated internal and/or external components.

[0009] These and other aspects and advantages will become more apparent after careful consideration is given to the following detailed description of the preferred exemplary embodiments thereof.

**BRIEF DESCRIPTION OF THE ACCOMPANYING DRAWINGS**

[0010] Reference will hereinafter be made to the accompanying drawings, wherein like reference numerals throughout the various FIGURES denote like structural elements, and wherein;

[0011] FIGURE 1 is a perspective view of an exemplary flare tip in accordance with the present invention.

**DETAILED DESCRIPTION OF PREFERRED EMBODIMENTS**

[0012] According to a presently preferred embodiment of the present invention, a low emissivity (low-E) coating material is applied to the flare tip burner as well as associated internal and/or external component surfaces to reduce direct flame radiation and also conductive heat transfer. An exemplary flare tip 10 is depicted in accompanying FIGURE 1 as having a flare barrel 12 which terminates in a baffled burner element 14. Flame stabilization tabs 16 are provided at circumferentially spaced-apart locations about the burner element 14 so as to ensure stable and high efficiency flaring through a range of gas flows. According to especially preferred embodiments of the present invention, all exterior and interior surfaces of the flare tip 10 which may have exposure to the flame and its attendant radiation are coated with a low-E ceramic material. Coated structures therefore include, for example, at least an upper portion of the flare barrel 12, the burner element 14, and/or the stabilization tabs 16.

[0013] As used herein, the emissivity (E) of a material is meant to refer to a unitless number measured on a scale between zero (total energy reflection) and 1.0 (a perfect "black body" capable of total energy absorption and re-radiation). According to the present invention, a relatively low emissivity (low-E) is meant to refer to coating materials having an emissivity of less than about 0.80, and especially materials having an emissivity of between about 0.20 to about 0.78.

[0014] Virtually any commercially available low-E coating material may be employed satisfactorily in the practice of the present invention. For example, one presently preferred low-E ceramic coating includes CERAK M700 ceramic coating commercially available from Cetek, Ltd. of Berea, Ohio, having an emissivity of about 0.75.

[0015] Coating thicknesses of the low-E ceramic coat-

ing material are not critical but will vary in dependence upon the desired resulting thermal flux and/or the particular material forming the coating. Thus, coating thicknesses of from about 0.0254 mm (1 mil) to about 0.635 mm (25 mils), usually about 0.0508 mm (2 mils) to about 0.2032 mm (8 mils) may be appropriate. Coating densities will typically be greater than about 65%, more specifically 80% or greater. Coating densities will typically be greater than about 65%, more specifically 80% or greater, including up to 100%. By "coating density" is meant the amount (wt.%) of the low-E ceramic coating material that is present in the coating.

**[0016]** The low-E coating material may be applied to flare tip components in any conventional manner. The low-E coating material may thus be applied to the flare tip components via any pressurized spray system while the flare tip is being manufactured or while off-line (i.e., is not at its operational temperatures) during refurbishment.

**[0017]** The present invention will be further understood from the following non-limiting Example.

#### EXAMPLE

**[0018]** A high temperature low-emissivity coating (CE-TEK M720 high-temperature ceramic coating having an emissivity value of about 0.75) was applied to a flare tip manufactured by Callidus Technologies LLC. The low-E coating utilized a non-toxic, non-flammable carrier, with a high temperature ceramic binder and was sprayed onto the flare tip structures to be exposed to direct flame during operation by conventional spray equipment. The sprayed coating was thereafter allowed to dry in air for 4 hours and cured at 815 °C (1500°F). After curing, the coating on the flare tip surfaces exhibited a thickness of about 3 mils at a coating density of the low-E material of about 100%. The coating was intended to provide excellent thermal barrier protection, oxidation and corrosion resistance to metallic substrates at elevated temperatures up to 1315 °C (2400°F), as well as a reduction in warpage, stress corrosion cracking, and alloy leaching. The coating also was intended to provide uniform heat distribution for enclosed flare systems.

**[0019]** The flare tip with the low-E coating material applied thereto was placed into service to burn off-gases. After approximately six months of continuous operation, the condition of the coated flare tip surfaces was visually inspected and determined to be satisfactory indicating that the coating material provided protection against the direct flame during flare tip operation.

**[0020]** While the invention has been described in connection with what is presently considered to be the most practical and preferred embodiment, it is to be understood that the invention is not to be limited to the disclosed embodiment, but on the contrary, is intended to cover various modifications and equivalent arrangements included within the scope of the appended claims.

#### Claims

1. A method of improving service longevity and performance of a flare tip (10) comprising applying a coating comprised of a low emissivity (low-E) material, the low-E coating material having an emissivity of less than about 0.80, to one or more component surfaces of the flare tip (10) so as to reduce direct flame radiation and conductive heat transfer during flare tip operation.
2. Method as in claim 1, wherein the coating is applied to surfaces of a flare barrel (12), a burner element (14) and/or a stabilization tab (16) of the flare tip (10).
3. Method as in claim 1 or 2, wherein the surface(s) to which the coating is applied are exposed to a direct flame during flare tip operation.
4. Method as in any preceding claim, wherein the flare tip (10) includes a flare tip burner, and wherein the method comprising applying the coating to the burner.
5. Method as in claim 4 further comprising applying the coating to internal and/or external components of the flare tip (10) other than the burner.
6. Method as in any preceding claim, wherein the coating of the low-E material has a thickness of between about 0.0254 mm (1 mil) to about 0.635 mm (25 mils).
7. Method as in any preceding claim, wherein the low-E material is present in the coating at a density of at least about 65%.
8. A flare tip which comprises a coating on one or more component surfaces thereof comprised of a low-emissivity (low-E) material, wherein the low-E coating material has an emissivity of less than about 0.80.
9. A flare tip (10) as in claim 8, wherein the flare tip (10) comprises a flare barrel (12), a burner element (14) and at least one stabilization tab (16), and wherein the coating is applied to surfaces of at least one of the flare barrel (12), the burner element (14) and the stabilization tab (16).
10. A flare tip (10) as in claim 8 or 9, wherein the coating is on surfaces of the flare tip (10) which are exposed to a direct flame during flare tip operation.
11. A flare tip (10) as in any one of claims 8 to 10, wherein the flare tip (10) includes a flare tip burner, and wherein the coating is applied to the burner.
12. A flare tip (10) as in claim 11, wherein the coating is applied to internal and/or external components of the

flare tip other than the burner.

13. A flare tip (10) as in any one of claims 8 to 12, wherein the coating of the low-E material has a thickness of between about 0.0254 mm (1 mil) to about 0.635 mm (25 mils).
14. A flare tip (10) as in any one of claims 8 to 13, wherein the low-E material is present in the coating at a density of at least about 65%.

#### Patentansprüche

1. Verfahren zum Verbessern der Betriebslebensdauer und Leistung eines Fackelkopfes (10), welches das Aufbringen einer Beschichtung, die aus einem Werkstoff mit niedriger Emission (Low-E) besteht, wobei der Low-E-Beschichtungswerkstoff einen Emissionsgrad von weniger als etwa 0,80 hat, auf eine oder mehrere Bauteil-Oberflächen des Fackelkopfes (10) umfasst, um so die unmittelbare Flammenabstrahlung und Wärmeleitübertragung während des Fackelkopfbetriebes zu verringern.
2. Verfahren nach Anspruch 1, wobei die Beschichtung auf Oberflächen eines Fackelzylinders (12), eines Brennelements (14) und/oder einer Stabilisierungsglasche (16) des Fackelkopfes (10) aufgebracht wird.
3. Verfahren nach Anspruch 1 oder 2, wobei die Oberfläche(n), auf welche die Beschichtung aufgebracht wird, während des Fackelkopfbetriebes einer unmittelbaren Flamme ausgesetzt sind.
4. Verfahren nach einem der vorhergehenden Ansprüche, wobei der Fackelkopf (10) einen Fackelkopfbrenner einschließt und wobei das Verfahren das Aufbringen der Beschichtung auf den Brenner umfasst.
5. Verfahren nach Anspruch 4, das ferner das Aufbringen der Beschichtung auf andere innere und/oder äußere Bauteile des Fackelkopfes (10) als den Brenner umfasst.
6. Verfahren nach einem der vorhergehenden Ansprüche, wobei die Beschichtung aus dem Low-E-Werkstoff eine Dicke von zwischen etwa 0,0254 mm (1 Milli-Inch) und etwa 0,635 mm (25 Milli-Inch) hat.
7. Verfahren nach einem der vorhergehenden Ansprüche, wobei der Low-E-Werkstoff in der Beschichtung mit einer Dichte von wenigstens etwa 65 % vorhanden ist.
8. Fackelkopf, der eine Beschichtung auf einer oder

mehreren Bauteil-Oberflächen desselben umfasst, die aus einem Werkstoff mit niedriger Emission (Low-E) besteht, wobei der Low-E-Beschichtungswerkstoff einen Emissionsgrad von weniger als etwa 0,80 hat.

9. Fackelkopf (10) nach Anspruch 8, wobei der Fackelkopf (10) einen Fackelzylinder (12), ein Brennelement (14) und wenigstens eine Stabilisierungsglasche (16) umfasst und wobei die Beschichtung auf Oberflächen wenigstens eines von dem Fackelzylinder (12), dem Brennelement (14) und der Stabilisierungsglasche (16) aufgebracht ist.
10. Fackelkopf (10) nach Anspruch 8 oder 9, wobei sich die Beschichtung auf Oberflächen des Fackelkopfes (10) befindet, die während des Fackelkopfbetriebes einer unmittelbaren Flamme ausgesetzt sind.
11. Fackelkopf (10) nach einem der Ansprüche 8 bis 10, wobei der Fackelkopf (10) einen Fackelkopfbrenner einschließt und wobei die Beschichtung auf den Brenner aufgebracht ist.
12. Fackelkopf (10) nach Anspruch 11, wobei die Beschichtung auf andere innere und/oder äußere Bauteile des Fackelkopfes als den Brenner aufgebracht ist.
13. Fackelkopf (10) nach einem der Ansprüche 8 bis 12, wobei die Beschichtung aus dem Low-E-Werkstoff eine Dicke von zwischen etwa 0,0254 mm (1 Milli-Inch) und etwa 0,635 mm (25 Milli-Inch) hat.
14. Fackelkopf (10) nach einem der Ansprüche 8 bis 13, wobei der Low-E-Werkstoff in der Beschichtung mit einer Dichte von wenigstens etwa 65 % vorhanden ist.

#### Revendications

1. Procédé d'amélioration de la longévité de service et des performances d'un bec de torche (10), comprenant l'étape d'application d'un revêtement composé d'un matériau à faible émissivité (E faible), le matériau de revêtement à faible émissivité présentant une émissivité inférieure à environ 0,80, sur une ou plusieurs surfaces de composants du bec de torche (10), de sorte à réduire le rayonnement de la flamme directe et le transfert conducteur de chaleur au cours du fonctionnement du bec de torche.
2. Procédé selon la revendication 1, dans lequel le revêtement est appliqué sur les surfaces d'un fût de la torche de brûlage (12), un élément de brûleur (14) et/ou une patte de stabilisation (16) du bec de torche (10).

3. Procédé selon les revendications 1 ou 2, dans lequel la (les) surface(s) sur laquelle (lesquelles) le revêtement est appliqué est (sont) exposée(s) à une flamme directe au cours du fonctionnement du bec de torche. 5
4. Procédé selon l'une quelconque des revendications précédentes, dans lequel le bec de torche (10) englobe un brûleur de bec de torche, le procédé comprenant l'étape d'application du revêtement sur le brûleur. 10
5. Procédé selon la revendication 4, comprenant en outre l'étape d'application du revêtement sur des composants internes et/ou externes du bec de torche (10) autres que le brûleur. 15
6. Procédé selon l'une quelconque des revendications précédentes, dans lequel le revêtement de matériau à faible émissivité a une épaisseur comprise entre environ 0,0254 mm (1 millième de pouce) et environ 0,635 mm (25 millièmes de pouce). 20
7. Procédé selon l'une quelconque des revendications précédentes, dans lequel le matériau à faible émissivité est présent dans le revêtement à une densité d'au moins environ 65%. 25
8. Bec de torche, comprenant un revêtement sur une ou plusieurs surfaces de composants, composé d'un matériau à faible émissivité (E faible), le matériau de revêtement à faible émissivité présentant une émissivité inférieure à environ 0,80. 30
9. Bec de torche (10) selon la revendication 8, dans lequel le bec de torche (10) comprend un fût de torche (12), un élément de brûleur (14) et au moins une patte de stabilisation (16), le revêtement étant appliqué sur des surfaces d'au moins un élément, le fût de torche (12), l'élément de brûleur (14) ou la patte de stabilisation (16). 35  
40
10. Bec de torche (10) selon les revendications 8 ou 9, dans lequel le revêtement est appliqué sur des surfaces du bec de torche (10) qui sont exposées à une flamme directe au cours du fonctionnement du bec de torche. 45
11. Bec de torche (10) selon l'une quelconque des revendications 8 à 10, dans lequel le bec de torche (10) englobe un brûleur de bec de torche, le revêtement étant appliqué sur le brûleur. 50
12. Bec de torche (10) selon la revendication 11, dans lequel le revêtement est appliqué sur des composants internes et/ou externes du bec de torche, autres que le brûleur. 55
13. Bec de torche (10) selon l'une quelconque des revendications 8 à 12, dans lequel le revêtement de matériau à faible émissivité a une épaisseur comprise entre environ 0,0254 mm (1 millième de pouce) et environ 0,635 mm (25 millièmes de pouce).
14. Bec de torche (10) selon l'une quelconque des revendications 8 à 13, dans lequel le matériau à faible émissivité est présent dans le revêtement à une densité d'au moins environ 65%.

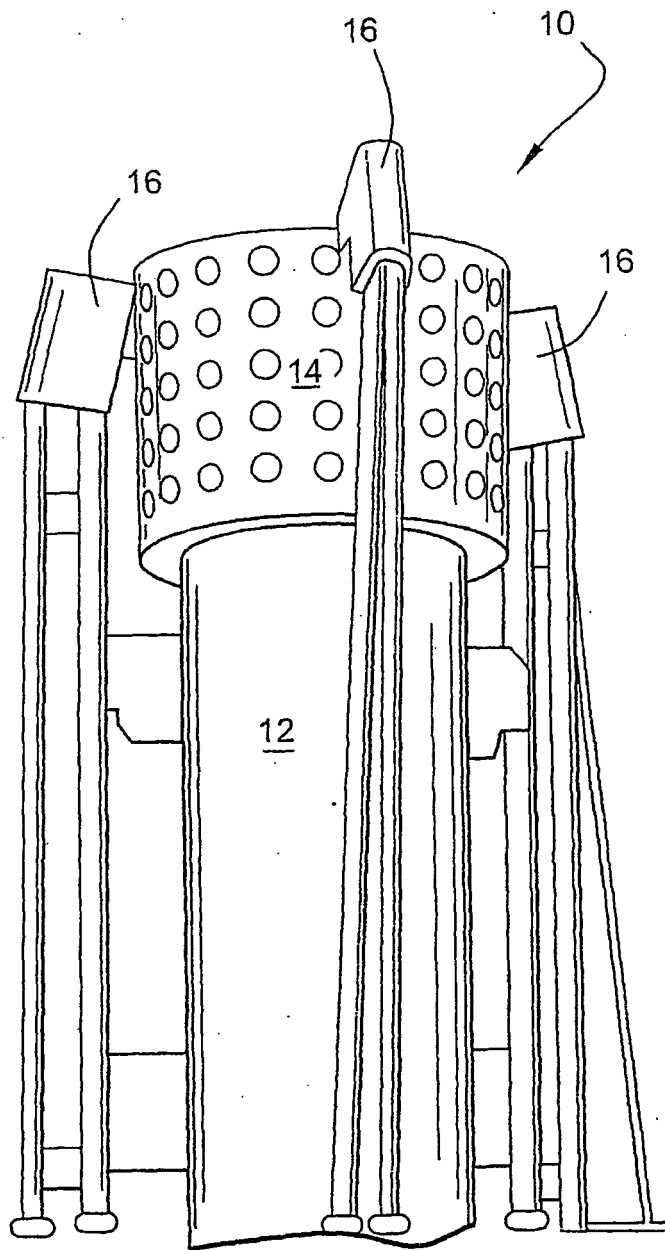


Fig. 1

**REFERENCES CITED IN THE DESCRIPTION**

*This list of references cited by the applicant is for the reader's convenience only. It does not form part of the European patent document. Even though great care has been taken in compiling the references, errors or omissions cannot be excluded and the EPO disclaims all liability in this regard.*

**Patent documents cited in the description**

- US 7247016 B [0002]
- EP 0139353 A1 [0004]
- US 6626663 B1 [0005]