United States Patent [19]
Brandenberger

[11] 3,921,542
[45] Nov. 25, 1975

[54] OXYGEN SUPPLIED THERMAL LANCE

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[22] Filed: **Jan. 15, 1975**

[21] Appl. No.: **541,276**

[30] **Foreign Application Priority Data**

Jan. 23, 1974 Switzerland 897/74

[52] **U.S. Cl.** .... **110/1 R**; 431/99
[51] **Int. Cl.²** **F23B 7/00**
[58] **Field of Search** .... 110/1 R; 431/99

[56] **References Cited**

UNITED STATES PATENTS

3,460,223	8/1969	Berczes et al.	110/1
3,500,774	3/1970	Meier	110/1
3,570,419	3/1971	Brandenberger	110/1
3,738,288	6/1973	Brandenberger	431/99

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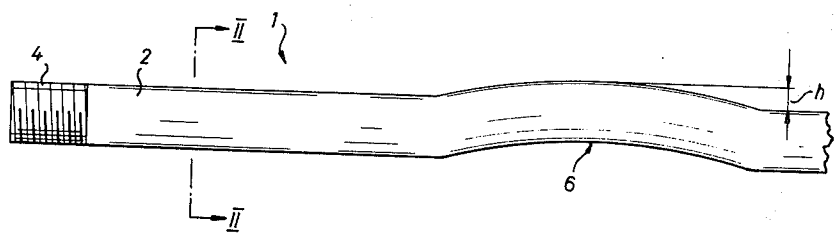
[57] **ABSTRACT**

To permit smaller cross section of thermal lances, in which a plurality of core wires are inserted in a jacket tube with space between the core wires and the jacket tube for the supply of oxygen, the relative dimensions of the elements of the lance are selected as follows: The outer diameter of the jacket tube is between 3 mm and 10 mm; 8 to 16 core wires are used; the ratio of the diameter of the space to form a duct for oxygen to the overall diameter of material is between 1 : 4 to 1 : 10; the ratio of core wire diameter to the wall thickness of the jacket tube is between 1 : 0.7 to 1 : 2; and, to hold the wires in place, the jacket tube is formed with a bulge or undulation adjacent the end formed with a connection for the supply of oxygen, the bulge or deformation being so formed that, essentially, there is no reduction in cross section. In a preferred form, the wall thickness of the tube, and the cross section of the core wires are all, about, 1 mm and about 10 to 11 core wires are used, the clear diameter of the jacket tube being about 4 to 6 mm.

16 Claims, 2 Drawing Figures



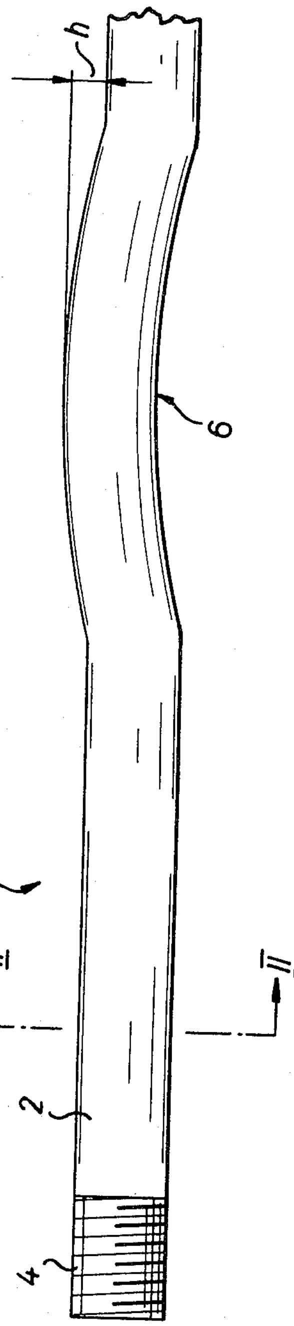


Fig. 1

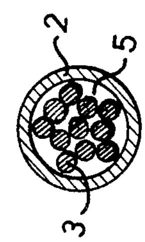


Fig. 2

OXYGEN SUPPLIED THERMAL LANCE

Cross reference to related patents:

U.S. Pat. Nos. 3,570,419 and 3,738,288, by the inventor hereof.

The present invention relates to a thermal lance to be supplied with oxygen, and more particularly to a thermal lance in which a plurality of consumable core wires are located within a jacket tube, oxygen being supplied to the interior of the jacket tube to generate extreme heat at the end of the lance upon ignition of the oxygen, and especially to such lances which have a smaller diameter than those heretofore made.

Thermal lances, for example of the type described in my prior patent U.S. Pat. No. 3,738,288 use an outer jacket tube which has a clear or inner diameter of about one-fourth inch to three-eighths inch, and is formed at the end with a standard thread adapted for connection to standard plumming lines. The outer diameter of such tubes then corresponds to 13.5 mm and 17.2 mm, respectively. Such thermal lances are capable of burning holes of from 4–8 cm diameter, approximately, or to make longitudinal cuts of a width of from 4–8 cm in such substances as concrete, rock aggregate, rocks and stones, and the like, and other hard material, when oxygen is supplied to the interior of the jacket tube.

A need for smaller thermal lances has arisen. It was not possible to reduce the diameter of the lances, however, since they tended to extinguish in operation, or to burn asymmetrically, or were uneconomical in consumption of lance material or oxygen.

It is an object of the present invention to provide a thermal lance which is capable of making holes or cuts of smaller cross section, or width, respectively, and which is satisfactory in operation, corresponding to the operation of larger lances.

Subject matter of the present invention: Briefly, a smaller lance can be constructed when observing a number of limiting conditions. Such lances have, as heretofore, a plurality of core wires in a jacket tube. The core wires are held in the jacket tube by a deformation or bulge, which may be an undulation which, in accordance with the invention, is so formed that essentially there is no reduction is cross-sectional area in the region of the bulge, or deformation. The limiting dimensions for small-size lances, in accordance with the present invention, have an outer diameter of between 3 and 10 mm, in which 8 to 16 core wires are inserted. The ratio of cross-sectional area of free space, left for conduction of oxygen, to the cross-sectional area of total material is between 1 : 5 to 1 : 10, and the ratio of core wire diameter to the wall thickness of the jacket tube is between 1 : 0.7 to 1 : 2.

Lances of this type permit substantially extending the utility thereof, and to use such lances in locations and under conditions in which, previously, other and more complicated and difficult methods and processes of working materials were required. The lance in accordance with the present invention can, for example, cut through heavily reinforced concrete walls. Holes made through such walls with customary drills are difficult to maintain in a straight line, since the drills are deflected by the reinforcing elements. Holes made in accordance with the present lances can be cut in surprisingly short time, for example for subsequent installation of water or gas pipes, electrical conduit, or the like.

The invention will be described by way of example with reference to the accompanying drawings, wherein:

FIG. 1 is a schematic fragmentary side view of a thermal lance; and

FIG. 2 is a schematic cross-sectional view through the lance along line II—II of FIG. 1.

Lance 1 is used to cut holes, grooves, or slits in concrete, rock, building walls, metal plates, or the like, by combustion of the material. Such openings are generated by introducing oxygen into a jacket tube filled with metal wires, which are ignited at the far end. At the ignition end of the lance, extreme heat will be generated which is so high that concrete, rock, steel plates, and the like, will melt; combustible material will burn. The lance, itself, is also consumed and must be renewed from time to time.

The lance **1** is usually about 2 meters long. It has a jacket tube **2**, about 2 meters long, made of steel. Usually, the jacket tube **2** has circular cross section. Core wires **3**, which preferably are all alike, and likewise of steel which may have a higher carbon content than that of the jacket steel, are introduced into the jacket tube. The number of the core wires **3** is so selected that they fill the clear space of the round jacket tube **2** without, however, causing difficulties in introducing the core wires, and leaving some free space. A jacket tube **2** having a clear diameter of about 4 mm and eleven core wires of 1 mm, each, has been found eminently suitable. The outer diameter of such a lance is about 6 mm. It should be less than 10 mm, but more than 3 mm. Longitudinal spaces, or ducts, or channels **5** remain between the various core wires themselves, and between the wires and the inner surface of the jacket tube **2**, to permit oxygen to pass longitudinally of the lance. The wires **3** extend essentially parallel to the longitudinal extent of the jacket tube.

One end of jacket tube **2** is formed with a stud thread **4**, so that the jacket tube can be connected to a supply hose which, in turn, can be connected to an oxygen supply, such as a pressurized oxygen bottle, by means of a pressure hose. The thread is merely exemplary of any suitable connection arrangement; rather than using a thread, a quick-release snap-on plug-and-socket connection may likewise be used. Oxygen is supplied under a pressure which, preferably, is in the order of from 8–20 bar, most desirably about 10 bar. The pressure to be used depends on the requirement of the specific use. High pressure results in small diameter of the hole being cut, with short operating periods; low pressure results in greater diameter of the resulting hole, or cut, but requires longer operating time.

It has been found that the ratio of overall cross-sectional area of the ducts **5**, through which oxygen passes, to the overall cross-sectional area of material (that is, jacket tube plus core wires) should be preferably about 1 : 6, although a range of 1 : 4 to 1 : 10 will provide good results. The wires should preferably be so arranged that the ducts **5** are distributed over the entire cross-sectional area of the jacket tube and as uniformly as possible, so that combustion at the ignition end of the lance is uniform. Such lances operate practically smoke-less, and with only little sparking, so that they can also be used in enclosed spaces.

The various core wires **3** should be retained in position in the lance. Vibration and shock arise during combustion. The jacket tube **2**, therefore, and the core wires **3** are locked together, for example by bulging the jacket tube into a bulged, or bowed shape **6**. This bulge, or bow, is located adjacent the side of the gas connection, nearer the end of the lance. The cross section, and the shape of the cross section of this bulge or bow should preferably interfere little with oxygen ducts, and should leave the cross-sectional aspect of the lance as undisturbed as possible, and without necking or regions of reduced diameter. The ducts **5**, in the region of the bow or bulge, should not have reduced diameter so that oxygen can pass without constriction, and so that lamina flow of gases is retained throughout the length of the lance. The deflection height *h* preferably corresponds approximately to half the outer diameter of the jacket tube.

The bulge **5**, as shown in FIG. **1**, may be followed by a further, directly joined bulge **5** in the same, or in opposite direction (with respect to the major axis of the lance) so that a flat undulation results. Each one of the bulges then need not deflect as much as the height *h* from the major axis of the lance, and the total deflection of two opposed bulges may, each, be about one-half *h*.

The small, shallow bulge **6** prevents losening of core wires **3**, even if they are subjected to vibration, disturbances, or shock during combustion. The core wires **3** will have the same bulged shape as the surrounding jacket tube **2**, and will be securely retained therein.

The material of the jacket tube **2** is a steel which, preferably, has a higher silicon content than the material of the core wires **3**. The steel of jacket tube **2** preferably has a lower carbon content than that of the core wires. Thus, the interior, that is the core of the lance, will have a particularly high temperature arise thereat which facilitates melting of the material to be removed on the one hand and, on the other, effectively prevents formation of a weld, or adhesion of the jacket tube on the edge of the wall, or slit of the material being cut. The tendency of the jacket tube to weld to the material is effectively inhibited. The relative low carbon content of the jacket tube additionally assists in ignition of the lance at the initiation of cutting.

A particularly desirable relationship of dimensions is given in Table 1. The lances are made by first introducing as many core wires **3** into a jacket tube **2** — with circular cross section — as desired; the number of core wires is so selected that the cross-sectional space is well filled. Ten to eleven core wires are suitable. Thereafter, the jacket tube **2** with the core wires inserted therein, is deformed in a press to obtain the bulge **6**. The deformation should be carefully carried out, so that the inner cross-sectional aspect of the jacket tube **2** is changed as little as possible so that passage of oxygen is not impeded.

An example of a suitable lance which, in actual operation, has been found desirable, is given in Table 2.

The composition of materials for the jacket tube **2**, and core wires **3**, respectively, is given in Table 3. These, of course, are only examples and various changes and modifications may be made within the scope of the inventive concept.

TABLE 1

Relationship of Cross-Sectional Areas with Respect to the Total Cross-Sectional Area of Core Wire 3, taken as Unity.

Core Wires	Cross-Sectional Area of Jacket Tube 2	Cross-sectional Area of Oxygen Ducts 5
1.0	lower limit 1.6	0.4
1.0	higher limit 2.7	0.8
1.0	preferred range:	0.4 to 0.6

TABLE 1-continued

Relationship of Cross-Sectional Areas with Respect to the Total Cross-Sectional Area of Core Wire 3, taken as Unity.

Core Wires	Cross-Sectional Area of Jacket Tube 2	Cross-sectional Area of Oxygen Ducts 5
	1.6 to 2.3	

TABLE 2

Jacket tube 2:	outer diameter	= 6 mm
	inner diameter	= 4 mm
cross-sectional area		= 15.7 mm^2

core wires: number = 11; diameter = 1 mm; cross-sect. area, all wires = 8.58 mm^2
total cross-sect. area, core 3 and tube 2 = 24.3 mm^2
cross-sect. area, oxygen ducts 5 = 4 mm^2
oxygen pressure = approximately 10 bar

Table 3

Material	Composition of Materials Jacket Tube 2	Core Wires 3
carbon (C)	0.04 – 0.10 %	0.08 – 0.12
silicon (Si)	0.03 – 0.15 %	none
manganese (Mn)	0.20 – 0.45 %	0.25 – 0.35
phosphorus (P)	0.04 %	0.050
sulphur (S)	0.04 %	0.045

Remainder: iron (Fe) and usual trace elements and contaminants.

I claim:

1. Thermal, consumable lance comprising

a jacket tube (**2**) and a plurality of core wires inserted in the jacket tube, the core wires having an overall cross-sectional area which is less than the cross-sectional area within the jacket tube to leave space for passage of oxygen between the core wires and the jacket tube, the lance and core wires being relatively formed to retain the core wires within the jacket tube,

wherein the improvement comprises

the jacket tube has an outer diameter of about 3 to 10 mm;

eight to sixteen core wires (**3**) are located within the jacket tube (**2**);

the cross-sectional area of the space forming oxygen ducts (**5**) has a ratio to the total cross-sectional area of jacket tube (**2**) material and core wire (**3**) material of between about 1 : 4 to 1 : 10; and the ratio of diameter of core wire (**3**) to the wall thickness of the jacket tube (**2**) is between about 1 : 0.7 to 1 : 2.

2. Lance according to claim **1**, wherein the outer diameter of the jacket tube (**2**) is in the range of 5 to 8 mm.

3. Lance according to claim **2**, wherein the outer diameter of the jacket tube is about 6 mm.

4. Lance according to claim **1**, wherein the number of core wires (**3**) is between 10 and 11, and the core wires have, each, a diameter of about 1 mm.

5. Lance according to claim **1**, wherein the ratio of the cross-sectional area of the oxygen ducts (**5**) to the total cross-sectional area of jacket tube (**2**) material and core wire (**3**) material is between about 1 : 5 and 1 : 8.

6. Lance according to claim **5**, wherein said ratio is in the order of about 1 : 6.

7. Lance according to claim 1, wherein the wall thickness of the jacket tube (2) is about the same as the diameter of any one of the core wires (3).

8. Lance according to claim 1, wherein the lance is essentially straight and is formed with a bulge-like deformation adjacent one of the ends, said one end being adapted for connection to a supply of oxygen, the extent of deformation having a height (*h*) of approximately half the outer diameter of the jacket tube (2).

9. Lance according to claim 1, wherein the outer diameter of the jacket tube is in the order of from 6 to 6.5 mm;

the jacket tube (2) has a wall thickness in the order of 1 to 1.3 mm;

the core wires, each, have a diameter in the order of about 1 mm;

and between ten and eleven core wires (3) are located within the jacket tube.

10. Lance according to claim 1, wherein the jacket tube (2) has a circular cross section throughout essentially its entire length.

11. Lance according to claim 1, wherein the ratio of wire diameter of the core wires (3) to the wall thickness of the jacket tube (2) is in the order of 1 : 0.8 to 1 : 1.5.

12. Lance according to claim 11, wherein said ratio is in the order of 1 : 1.

13. Lance according to claim 1, wherein the jacket tube (2) and the core wires (3) each comprise steels of different metallurgical composition, and wherein the silicon content of the steel of the jacket tube (2) is higher than the silicon content of the material of the core wires (3).

14. Lance according to claim 13, wherein the carbon content of the material of the jacket tube (2) is smaller than the carbon content of the material of the core wires (3).

15. Lance according to claim 1, wherein the jacket tube (2) and the core wires (3) each comprise steels of different metallurgical composition, and wherein the carbon content of the steel of the jacket tube (2) is less than the carbon content of the material of the core wires (3).

16. Lance according to claim 1, wherein the ratio of diameters of core wires to jacket tube to oxygen ducts is between:

1 : 1.6 : 0.4 and 1 : 2.7 : 0.8.

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