

THERMAL CUTTING EQUIPMENT FOR CONSTRUCTION MATERIALS WITH THERMAL LANCING

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Abstract: In this study is presented the equipment and cutting technology with metallic lancing and hybrid cutting lancing and metallic dust. Thermal lance boring is a method of boring and severing concrete, steel, cast iron and hard materials without noise or vibration in less time than conventional methods. It is ideal for demolition work.

Key words: materials, cutting, technology.

1. Introduction

Thermal lancing is made from low-carbon steel tube ($C < 0.2\%$), consumable by oxygen burning in which we can introduce wires with same diameter made from a low-carbon steel (Figure 1) or from rolled carbon steel plate [1]. These wires are usually supplied in different lengths and diameters, accordingly to Figure 1.



Fig. 1. Lances for thermal cutting

The thermal lance is capable of processing by thermal cutting high melting materials

and at high functioning temperatures is capable to cut virtually any material.

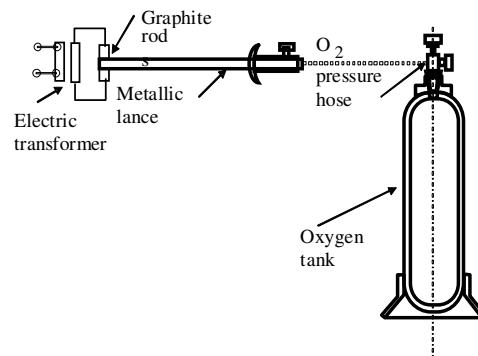


Fig. 2. Basic circuit of metallic lance cutting equipment

Through this method it is possible to cut carbon alloyed steel and high-alloyed steel, cast irons and non-metallic materials such as bricks, concretes etc. with no vibrations and noises. This procedure is ideal for demolitions where vibrations and noises are unacceptable or where is desired a high

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work speed, for instance reinforced concrete. The equipment is quite simple (Figure 2) easy to handle with a low cost compare with classic demolition equipments such as an auger drill [3].

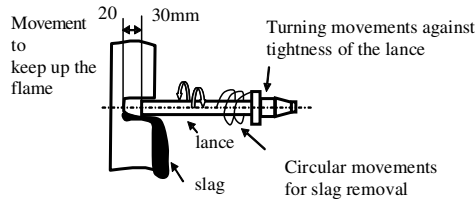


Fig. 3. Lance maneuvering for thermal cutting

Starting the lance derives in next mode:

At the opposite end of lance's support through the lance's port support the top of the lance will be brought to incandescence via a thermal process, in our case (Figure 2) the heating is possible with graphite rod crossed by electric current accordingly to Joule effect.

When the end of the lance is already red, ignition is initiated due to the oxygen from an admission valve positioned on the lance's support.

At the end the iron oxide is forming. Melting point for iron oxide is 800-900 °C [2]. Oxygen high pressure combined with the speed blast out the oxide coating and another one is forming and then again is blasted out.

This is a heat-production reaction and will continue as long as the top of the lance is red and in presence of oxygen. The action of thermal cutting can stop when oxygen is present no more.

Practical depth cutting is limited due to the operator's ability to keep the top of the lance without any melted metal and oxides.

2. Lances and Equipment

In this paper in order to increase cutting speed for metallic and non metallic materials,

thermal lance from Figure 1a was modified with following features: inside the lance for small diameter values, on the center of cross cut no more metallic rods are inserted and for higher diameter values, on the center of cross cut a small diameter steel rod is inserted (Figure 4).

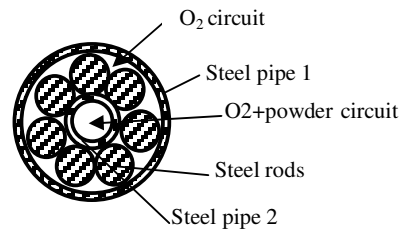


Fig. 4. Lance types for thermal cutting with internal O_2 circuit

In order to increase lance cutting speed along with internal carbon steel rods one or two aluminum, copper, titanium rods are inserted as well (Figure 5).

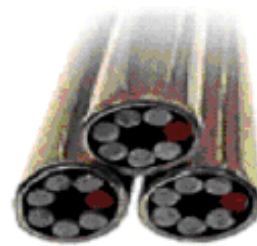


Fig. 5. Lance for thermal cutting with steel and Cu rods

In Figure 6 is presented thermal cutting equipment with lance, hybrid, steel rods and metallic powder with 2 type of handles (a and b), straight and at 90° and in Figure 7 thermal cutting with metallic lance installation.

Compared with classical lance thermal cutting, in this case on the inside of the modified lance in oxygen jet will circulate metallic powders of Fe and Al types and powdery chemical substances of lime type. The pure lime is a high refractivity oxide and

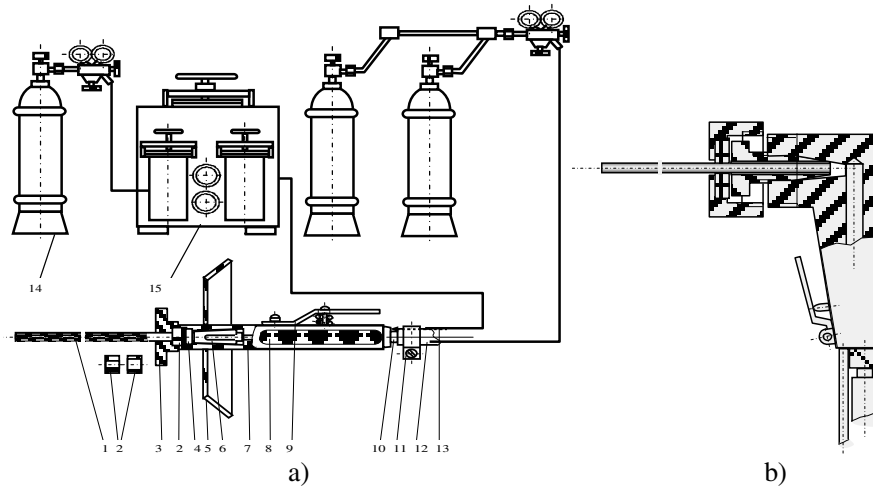
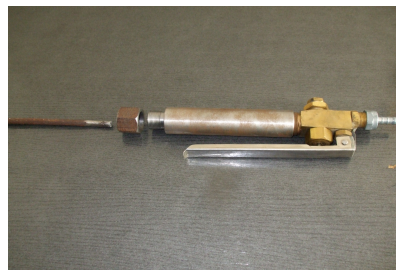


Fig. 6. Hybrid thermal cutting with lance and powder: a) straight handle; b) 90° handle.
 1 - metallic lance; 2 - sealing gaskets; 3 - lance clamping nut; 4 - washer; 5 - hand guard; 6 - elastic electric connection; 7 - lance support; 8 - insulating handle; 9 - valve O_2 + powders; 10 - fitting; 11 - collar; 12 - rubber hose; 13 - electric connection; 14 - cylinders with O_2 ; 15 - metallic powders bunker and chemical substances



a)



b)

Fig. 7. Thermal cutting with hybrid metallic lance installation:
 a) metallic lance handle; b) powder transport installation

it melts at temperatures of 2575 °C. Associated with iron oxide and sodium oxide, barium oxide, aluminum oxide and others, in certain proportions, may form low fusion eutectic materials with temperatures from 900...1200 °C, which

will increase cutting speed.

The pipe inside the metallic lance or steel stripes can be replaced with other metallic materials such as Al, Mg, Cu rods which can increase the temperature within pure oxygen jet.

Classic cutting for lance

Table 1

Position	Probe dimension [mm]	Lance consumption [mm/sec]	Oxygen consumption [m ³]	Cutting time [sec]
1	120 x 150	5.4	3	365
2	120 x 150	4.7	3	287

In Table 1, position 1 is presented classic cutting for a concrete plate (120 x 150 mm) and in position 2 thermal cutting with hybrid lance for the same concrete plate.

For different oxygen pressures, specific consumptions for metallic lance, burning speed and oxygen consumption has been determined (Table 2).

Cutting for hybrid lance

Table 2

Pressure [bar]	Lance consumption [mm/sec]	Boring speed [mm/sec]	Oxygen consumption [m ³]
3	5.53	2.1	1.22
4	7.98	2.7	1.62
5	9.22	4.2	2.1
6	11.1	4.4	2.4
7	12.5	5.0	4.1
8	14.4	5.7	4.7

3. Conclusions

During experiment and tests was taken in consideration manufacturing of hybrid thermal cutting equipment with metallic lance, cutting speed augmentation for cast iron, high alloyed steel and non ferrous materials used in construction (concrete, bricks etc.).

Modernizing the lances and usage of powdery mixtures lead to a significant reduction of lance consumption (costs are increased, though, by using powdery mixtures), cutting speed augmentation extremely important for material (metallic and non metallic) cutting and demolition works.

A favorable influence regarding thermal cutting is due to Al, Mg, Cu rods within the lance as well regarding oxygen

consumption, lance consumption, cutting speed, cut material and powdery mixtures usage in order to eliminate the oxides.

In order to elaborate the technology the parameters involved were lance consumption, oxygen consumption, working depth and oxygen pressure.

References

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