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(54) IMPROVEMENTS IN OR RELATING TO THERMAL TORCHES

(71) I, PATSIE CARMEN CAMPANA, a citizen of the United States of America, residing at 2614 Sherwood Drive, Lorain, Ohio 44053, United States of America, do hereby declare the invention, for which I pray that a patent may be granted to me, and the method by which it is to be performed, to be particularly described in and by the following statement:—

This application pertains to the art of thermal torches and more particularly to consumable thermal lances or torches.

The invention is particularly applicable to an oxygen lance of the type typically employed for boring, cutting, burning and the like of hard base materials and will be described with particular reference thereto; however, it will be appreciated by those skilled in the art that the invention has broader applications and may be adapted to use in other environments and applications

The oxygen lance and oxygen lance process represent one of the oldest commercial uses of oxygen for piercing and cutting holes in hard base materials including practically all ferrous metals and many other materials such as concrete, slag, rock and the like. Initially. such lances simply comprised an elongated length of black iron pipe connected at one end to an oxygen hose, regulator and cylinder or manifold so that only oxygen flowed through the lance pipe. In operation, and in order to initiate the thermic reaction of the lance, an area on the material to be treated is preheated to kindling temperature. The end of the lance is then brought against the heated area and the supply of oxygen then turned on. This then oxydizes the material to be treated with sufficient heat being produced to continue the cut or hole with oxygen alone without any additional heat or flame required to facilitate progress. The discharge end of the lance is held in the cut or hole so that the cutting oxygen stream emerges at the point of cutting or oxidization. This heats and burns the end of the pipe so that as the operation proceeds, the lance is consumed and must be replaced from time to time with a new length of iron pipe. Only a small portion of the oxygen consumed is required by the oxidation of the lance itself but the heat of the burning lance assists the cutting. Once started, the reaction is very vigorous so that a lot of "splatter" outwardly from and the discharge end of the lance is normally associated with this process.

Until fairly recently, practically no development work had been done in the area of improving the basic oxygen lance constructions and cutting techniques as they remained substantially the same as when first developed. However, it had been previously noted that the cutting action could be increased by using a lance pipe having greater wall thickness or by inserting one or more steel rods into the pipe. The thicker pipe and rod inserts furnish both additional fuel and heat and the rods decrease the area of effective opening in the lance pipe so that the oxygen stream gains greater velocity as it travels through the lance. Thus, the eroding effect on the material being treated is increased. Such increase, in turn, increases the "splatter" problem as well as flame spreading so that the cutting action is not as concentrated as desired in order to realize the ultimate in cutting action.

Over the last ten years or so, there has been renewed interest in oxygen lance techniques resulting in many purported improvements on and to the basic oxygen lance structure. Most of these improvements are directed to the areas of the manner of disposing one or more elongated rods within the outer lance casing, the mounting of the various component parts relative to each other, particular and specialized configurations for the outer casing and inner rods and particular cooperative relationships between the inner rods when received within the outer casing. Typical of such fairly recent patents are Pat. Nos. 3,260, 076; 3,460,223 3,487,791; 3,500,774; 3,507,230; 3,507,231; 3,570,419; 3,602,620; 3,738,288; and, 3,921,542. However, none of the various improvements, as exemplified by these various patents, focus upon or provide any solution for reducing the "splattering" problem or for reducing flame spreading to intensify the overall thermic reaction.

The present invention contemplates new and improved apparatus and method which overcome the above referred to problems and others and provides a new and improved thermal torch or lance and method which is fairly simple in design, simple to manufacture, economical to use, confines and intensifies the thermic reaction and which is readily adapted to use in a plurality of boring, cutting, burning and the like operations of hard base materials in different environments.

In accordance with one aspect of the present invention there is provided a consumable thermal torch for boring, cutting, burning and the like of hard base materials, said torch comprising an elongated open ended hollow outer casing having an inlet end and a discharge end; an elongated open ended hollow inner casing having an inlet and a discharge end, said inner casing being received within said outer casing in a manner such that the inner and outer casings are generally coextensive with each other, the outside cross-sectional dimension of said inner casing being less than the inside cross-sectional dimension of said outer casing such that a first gas flow passage is defined between the outer surface of said inner casing and the inner surface of said outer casing over the length thereof between said inlet and discharge ends; and, at least one elongated burning rod received within said inner casing and extending generally coextensive therewith between the inlet and discharge ends thereof, said at least one rod having an outer cross-sectional dimension less than the inner cross-sectional dimension of said inner casing such that at least one second gas flow passage is created therebetween over the length thereof.

In accordance with another aspect of the present invention there is provided, in a thermal torch of the type employed for boring, cutting, burning and the like of hard base materials wherein said torch includes a first elongated hollow casing having inlet and discharge ends and at least one burning rod member extending therethrough generally coextensive therewith between said inlet and discharge ends and wherein at least one first gas flow passage is provided between said at least one rod and first casing longitudinally over the cooperative lengths thereof, the improvement comprising a second elongated hollow casing having inlet and discharge ends received over said first casing and fixedly positioned thereto such that said casings are generally coextensive, said second hollow casing having an inner cross-sectional dimension greater than the outer cross-sectional dimension of said first casing such that a second gas flow passage is disposed therebetween, said second gas flow passage being adapted to facilitate the provision of a gas curtain at the discharge end of said torch during operation thereof for intensifying the thermic action of said torch.

Preferably the first passage has an average transverse dimension in the range of approximately 0.023"—0.032".

Preferably also at least the inner and outer casings are positively retained in position relative to each other by a plurality of detents extending inwardly from the outer casing towards engagement with the inner casing, said detents being disposed at least at spaced intervals along the inner and outer casings.

A plurality of said rods may be disposed in a side-by-side, preferably close spaced, relationship and form a plurality of second gas flow passages.

In accordance with a still further aspect of the present invention, there is provided a method for improving the thermic reaction at the discharge end of a thermal torch of the type employed for boring, cutting, burning and the like of hard base materials and wherein said torch includes a first elongated hollow casting having inlet and discharge ends and at least one burning rod member extending therethrough generally coextensively therewith and dimensioned to define a first gas flow passage therebetween wherein the method comprises the steps of:

(a) defining a second gas flow passage round at least a portion of the circumference of the first casing;

(b) providing a second gas flow passage with a gas flow entrance area and a gas flow exit area with the gas flow exit area disposed adjacent the first casing discharge end; and,

(c) continuously introducing a gas flow into the entrance area to continuously exit from the exit area during operation of the torch for forming a gas curtain around part at least of the torch discharge end which flows generally axially of the torch to thereby confine and intensify the thermic reaction thereof.

The invention may take physical form in certain parts and arrangements of parts, a preferred and alternative embodiments of which will be described in detail in the specification and illustrated in the accompanying drawings which form a part hereof and wherein:

FIGURE 1 is a persoective view in partial cross-section, for ease of illustration, of a thermal lance or torch constructed in accordance with the subject invention;

FIGURE 2 is a cross-sectional view taken along lines 2—2 of FIGURE 1;

FIGURE 3 is a longitudinal cross-sectional view of the thermal torch or lance shown in FIGURE 1 when it has been placed into operation showing confinement of the flame generated thereby to intensify the thermic reaction achieved;

FIGURE 4 is a view similar to FIGURE 2 showing a slightly modified structural arrangement thereof; and,

FIGURE 5 is an alternative structure to that shown in FIGURE 4.

Referring now to the drawings wherein the showings are for purposes of illustrating the preferred and some alternative embodiments of the invention only and not for purposes of limiting same, the FIGURES show a thermal torch or lance comprised of an outer sleeve or casing A, an inner sleeve or casing B and a plurality of burning rods C.

More particularly and with reference to FIGURES 1—3, outer casing A is comprised of an elongated cylindrical body generally designated 10 having an inlet or entrance end 12 and a discharge end 14. The side wall of body 10 includes an inner surface 16 and an outer surface 18. Preferably, body 10 is comprised of conventional black iron pipe and has a cylindrical configuration with the length between ends 12, 14 being anywhere from 6 to 12 feet.

Inner casing B is comprised of an elongated body 30 having an inlet or entrance end 32 and a discharge end 34. The side wall of body 30 includes an inner surface 36 and an outer surface 38. As with elongated body 10, body 30 is constructed from conventional black iron pipe and may have an overall length of anywhere from 6 to 12 feet.

As best shown in FIGURES 1—3, elongated bodies 10, 30 are dimensioned so that body 30 may be received within body 10 with a gas flow passage *a* defined between inner surface 16 of body 10 and outer surface 38 of body 10. In the arrangement here under discussion, the two bodies are generally coaxially disposed with passage *a* thus having an annular configuration. It is preferred that gas flow passage *a* has a transverse dimension in the range of approximately 0.023″—0.032″ as it has been found that this particular dimensional relationship provides particularly advantageous operational results which will be described in greater detail hereinafter.

In order to maintain outer and inner sleeves or casings A and B in the positively located position generally coextensive and coaxial with each other, a plurality of detent sets are conventionally employed at spaced intervals axially along the lance or torch structure. As particularly shown in FIGURES 1 and 2, one of these sets is shown and is comprised of individual detents 40, 42 and 44 equidistantly spaced apart from each other circumferentially around the lance. These detents extend inwardly from outer casing A into positive engagement with inner casing B and may be conveniently made by conventional metal working techniques so that inner surface 16 of elongated body 10 is forced into positive engagement with outer surface 38 of elongated body 30 at the detent areas. Since the detents of each set as exemplified by detents 40, 42 and 44 are equidistantly spaced apart circumferentially around the lance or torch, the inner and outer casing will be coaxially disposed relative to each other. Additional detent sets are conveniently included at axially spaced intervals along the torch or lance structure with the number and distance between such intervals being determined by the overall length and sizes of the casings A, B themselves. It is necessary to include sufficient detent sets so that the inner and outer casings will be retained in position relative to each other as the lance is consumed during use thereof. It is possible to use other combinations of detents and/or other means entirely for mounting the inner and outer casings together and such modifications are deemed to come within at least the broadest concepts of the subject invention.

A plurality of solid burning rods 50, 52 and 54 are closely received within inner casing B and disposed so as to extend generally coextensive therewith. In FIGURES 1—3, and while three such rods are shown, a greater or lesser number of rods could also be advantageously employed without in any way departing from the intent or scope of the present invention. Rods 50, 52 and 54 are preferably constructed from mild steel and are dimensioned so that when all three are placed into the inner sleeve or casing, they will be closely retained therein by engagement with each other and with inner surface 36 of elongated body 30. In the event that an alternative configuration for these rods is desired or in the event they are not closely and retainingly received within inner casing B, means similar to the detents discussed in detail hereinabove could also be advantageously employed for retention purposes. When rods 50, 52 and 54 are so received within inner sleeve B, a plurality of second gas flow passages *b* are defined between inner surface 36 and the rods as well as between the rods themselves.

With particular reference to FIGURE 3, description will hereinafter be made to operation of the thermal torch or lance hereinabove previously described. In use, the inlet or entrance end of the torch as defined at ends 12, 32 of casings A, B is affixed by convenient means (not shown) to a source (not shown) of oxygen as is conventional. Typically, this connection merely comprises a valve arrangement connected to an oxygen hose, regulator and cylinder or manifold so that oxygen may flow through gas flow passages *a, b*. As the specified hookup is deemed to be conventional and already known in the art and further, since it does not form a specific part of the present invention, a detailed description thereof is deemed unnecessary.

In any event, and with oxygen flowing in direction *c*, through gas flow passages *a, b* toward the discharge end of the torch or lance as defined by ends 14, 34 of casings A, B, the lance or torch is ignited by conventionally known means. Once ignited, combustion is self supporting through the supply of oxygen so that a flame F is directed axially outward at the discharge end of the torch or lance onto the material being cut or otherwise processed. This flame acts to perform the boring, cutting, burning and the like action desired and during such action, the entire lance structure is consumed from the discharge end toward the inlet end. According to the concepts of the subject invention, oxygen flowing through gas flow passages *b* in conjuncture with elongated body 30 and rods 50, 52, 54 provide the primary thermic reaction for the desired boring, cutting, burning and the like. Because the primary thermic reaction is centered at this point, these particular structural components will be consumed at a slightly faster rate (FIGURE 3) than will outer casing A as defined by elongated body 10. Oxygen flowing through gas flow passage *a* exits axially outward from the discharge end of the torch to provide a gas curtain around the primary thermic reaction. The effect of this curtain is enhanced by the fact that outer casing A is not consumed as fast as the remainder of the inner structural components so that the gas curtain remains intact and does not spread outwardly from the torch or lance at the point of the primary thermic reaction. The gas curtain confines flame F and forms it into a bullet-like configuration as shown in FIGURE 3 which results in an intensifying action of the flame to enhance and improve the thermic reaction. Further, and due to the fact that flame F is confined and configured into a bullet-like structure, the thermic reaction is concentrated so as to substantially eliminate "splattering" as has heretofore been the case with prior known thermal torches or lances.

By way of specific example, it has been found that the best and most efficient burn or thermic reaction will occur at 90 to 100 psi gauge pressure of oxygen introduced at the inlet end of the torch into gas flow passages *a,b*. The corresponding oxygen pressures developed at the discharge end of the torch for these pressures are approximately 124 and 140 psi respectively, and are deemed optimal when combined with the amount of metal being consumed so that the burn is steady and extremely efficient.

The above noted specific pressures allow the torch to burn freely in free air, cut deep and narrow paths very quickly and provide the best bullet-like effect for the lance. Work is accomplished faster because the thermal torch melts the workpiece faster, more precisely and blows molten waste out of the work area easier because of the discharge or tip pressures being developed. At 90 psi gauge pressure, the center portion pf the lance as defined by elongated body 30 and rods 50, 52, 54 will burn back approximately 1/2 ″ from the outer casing A as defined by elongated body 10 and at 100 psi gauge pressure, it will burn back at from 3/4″ to 1″. At these points, the inner portion of the lance which is feeding the flow of metal is shielded by the oxygen curtain and being directed centrally into the work area. If the inner portion does not burn back far enough, the torch can lose efficiency because of "splatter" outwardly of the side walls and if the oxygen pressure is too high, the center portion will burn back too far and the flow will be less efficient. The oxygen curtain is very important to the overall operation of the subject invention and it has been found that it is most effective when the average transverse dimension of gap *a* is in the range of approximately 0.023″—0.032″.

FIGURE 4 shows a slight modification to the structure hereinabove described in detail with reference to FIGURES 1—3. For convenience and ease of appreciation of this modification, like components are identified by like numerals with a primed (′) suffix and new components are identified by new numerals. Accordingly, the only difference in the arrangement of FIGURE 4 and the arrangement of FIGURE 2 is in the relative disposition between the outer and inner casings as defined by elongated bodies 10′, 30′. In FIGURE 4, elongated bodies 10′, 30′ are not disposed in a coaxial relationship but rather, are disposed so that outer surface 38′ of body 30′ is in line contact with inner surface 16′ of elongated body 10′ over the cooperative lengths thereof. In order to retain the two casings in this particular position, a plurality of detents 60 are disposed at axially spaced intervals along the outer casing. Since only one such detent is employed at each axially spaced interval, the natural tendency thereof is to force the inner casing toward line engagement with the inner surface of the outer casing opposite from the detent itself. Detents 60 may be made by conventional metal working techniques similar to detents 40, 42 and 44 as outlined above with regard to the embodiment of FIGURES 1—3.

The FIGURE 4 arrangement is deemed advantageous in that it facilitates ease of assembly for the overall torch or lance structure. While gas flow passage *a'* is generally crescent shaped and does not entirely encircle the area of primary thermic reaction, it has been found that a sufficient area is nevertheless surrounded so that there is no loss in burning efficiency from the FIGURES 1—3 arrangement discussed above in detail. Moreover, and since the relative sizes of outer and inner casings A, B are the same as the FIGURES 1—3 embodiment, the average thickness of gas flow passage *a'* will be in the preferred range of 0.023"—0.032".

Finally, FIGURE 5 shows an arrangement substantially similar to that hereinabove just described with reference to FIGURE 4 except for modification to the arrangement and number of inner rods which are employed. For ease of illustration in appreciating this modification, like components are identified by like numerals and include a double primed (") suffix and new components are identified by new numerals. In FIGURE 5, rods 50, 52 and 54 have been replaced by a plurality of smaller burning rods generally designated 70 and nine such rods 70 are specifically shown with the center one of these rods being slightly larger than the other eight. However, it is entirely possible and within the scope of the present invention to have these rods all be of the same diameter and/or to use a greater or lesser number thereof.

Indeed, in some instances it has been found that a single internal rod totally suffices and in such instances, that rod could be coextensively positioned and retained in elongated bodies 30, 30' or 30" by detents similar to those employed as between bodies 10 and 30, 10' and 30' or 10" and 30". Still further, it would also be possible to employ materials other than the black iron pipe specifically mentioned above, modify the cross-sectional configurations of casings A and B and rods C from that specifically shown and described for retaining the various components in a desired position relative to each other.

The invention has been described with reference to the preferred and alternative embodiments. Obviously, modifications and alterations will occur to others upon the reading and understanding of this specification. It is my intention to include all such modifications and alterations insofar as they come within the scope of the appended claims.

WHAT I CLAIM IS:

1. A consumable thermal torch for boring, cutting, burning and the like of hard base materials, said torch comprising: an elongated open ended hollow outer casing having an inlet end and a discharge end; an elongated open ended hollow inner casing having an inlet and a discharge end, said inner casing being received within said outer casing in a manner such that the inner and outer casings are generally coextensive with each other, the outside cross-sectional dimension of said inner casing being less than the inside cross-sectional dimension of said outer casing such that a first gas flow passage is defined between the outer surface of said inner casing and the inner surface of said outer casing over the length thereof between said inlet and discharge ends; and, at least one elongated burning rod received within said inner casing and extending generally coextensive therewith between the inlet and discharge ends thereof, said at least one rod having an outer cross-sectional dimension less than the inner cross-sectional dimension of said inner casing such that at least one second gas flow passage is created therebetween over the length thereof.

2. The thermal torch as defined in claim 1 wherein said first gas flow passage has an average transverse dimension in the range of approximately 0.023"—0.032".

3. The thermal torch as defined in claim 1 or claim 2 wherein at least said inner and outer casings are positively retained in position relative to each other by a plurality of detents extending inwardly from said outer casing toward engagement with said inner casing, said detents being disposed at least at spaced intervals along the said inner and outer casings.

4. The thermal torch as defined in any preceding claim wherein said inner casing is generally coaxially disposed within said outer casing.

5. The thermal torch as defined in claim 4 wherein both of said inner and outer casings have cylindrical configurations, said first passage having a generally annular configuration.

6. The thermal torch as defined in any one of claims 1 to 3 wherein said inner and outer casings are disposed relative to each other such that a portion of said inner casing outer surface engages a portion of said outer casing inner surface.

7. The thermal torch as defined in claim 6 wherein both said inner and outer casings have cylindrical configurations, said inner casing outer surface being in line contact with said outer casing inner surface and retained in that position by a plurality of detents extending inwardly from said outer casing toward engagement with said inner casing and wherein said first gas flow passage has a generally crescent-like configuration.

8. The thermal torch as defined in any preceding claim wherein a plurality of said rods are disposed in a side by side relationship and form a plurality of second gas flow passages.

9. In a thermal torch of the type em-

ployed for boring, cutting, burning and the like of hard base materials wherein said torch includes a first elongated hollow casing having inlet and discharge ends and at least one burning rod member extending therethrough generally coextensive therewith between said inlet and discharge ends and wherein at least one first gas flow passage is provided between said at least one rod and first casing longitudinally over the cooperative lengths thereof, the improvement comprising:

a second elongated hollow casing having inlet and discharge ends received over said first casing and fixedly positioned thereto such that said casings are generally coextensive, said second hollow casing having an inner cross-sectional dimension greater than the outer cross-sectional dimension of said first casing such that a second gas flow passage is disposed therebetween, said second gas flow passage being adapted to facilitate the provision of a gas curtain at the discharge end of said torch during operation thereof for intensifying the thermic action of said torch.

10. The improvement as defined in claim 9 wherein said second gas flow passage has an average transverse dimension in the range of approximately 0.023″—0.032″.

11. The improvement as defined in claim 9 or claim 10 wherein said first and second casings are positively retained in position relative to each other by a plurality of detents extending inwardly from said second casing toward engagement with said first casing, said detents being disposed at least at spaced intervals along said first and second casings.

12. The improvement as defined in any one of claims 9—11 wherein said first casing is generally coaxially disposed within said second casing.

13. The improvement as defined in any one of claims 9 to 11 wherein said first and second casings are disposed relative to each other such that a portion of said first casing outer surface engages a portion of said second casing inner surface.

14. The improvement as defined in claim 13 wherein said first and second casings are retained in position relative to each other by a plurality of axially spaced apart detents extending inwardly from said second casing toward engagement with said first casing in a manner such that said first casing is placed into line contact with said second casing.

15. A method for improving the thermic reaction at the discharge end of a thermal torch of the type employed for boring, cutting, burning and the like of hard base materials wherein said torch includes a first elongated hollow casing having inlet and discharge ends and at least one burning rod member extending therethrough generally coextensively therewith and dimensioned to define a first gas flow passage therebetween, said method comprising the steps of:

(a) defining a second gas flow passage around at least a portion of the circumference of said first casing;

(b) providing said second gas flow passage with a gas flow entrance area and a gas flow exit area with said gas flow exit area disposed adjacent said first casing discharge end; and,

(c) continuously introducing a gas flow into said entrance area to continuously exit from said exit area during operation of said torch for forming a gas curtain around part at least of said torch discharge end which flows generally axially of said torch to thereby confine and intensify the thermic reaction thereof.

16. The method as defined in claim 15 wherein said step of defining includes the step of dimensioning said second gas flow passage to have an average transverse dimension in the range of approximately 0.023″—0.032″.

17. The method as defined in claim 15 or claim 16 wherein said step of introducing comprises introducing said gas flow into said second gas flow passage at a pressure in the range of approximately 90 to 100 psi.

18. The method as defined in any one of claims 15 to 17 wherein said step of defining comprises providing said second gas flow passage generally coextensively over the length of said first casing between said inlet and discharge ends by means of a second casing received over said first casing in a radially spaced relationship therfrom.

19. A consumable thermal torch substantially as herein described with reference to Figures 1—3, Figure 4 or Figure 5 of the accompanying drawings.

20. A method for improving the thermic reaction at the discharge and of a thermal torch substantially as herein described with reference to the accompanying drawings.

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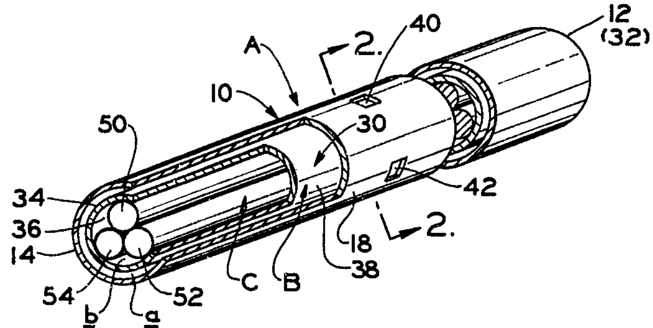
FIG. 1



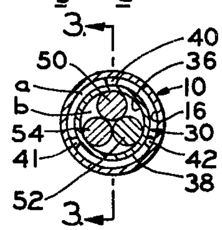


FIG. 2

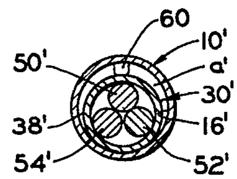


FIG. 4

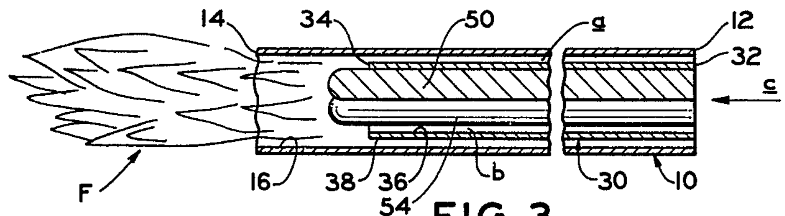


FIG. 3

FIG. 5