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CUTTING TIP OF COMPOSITE CONSTRUCTION

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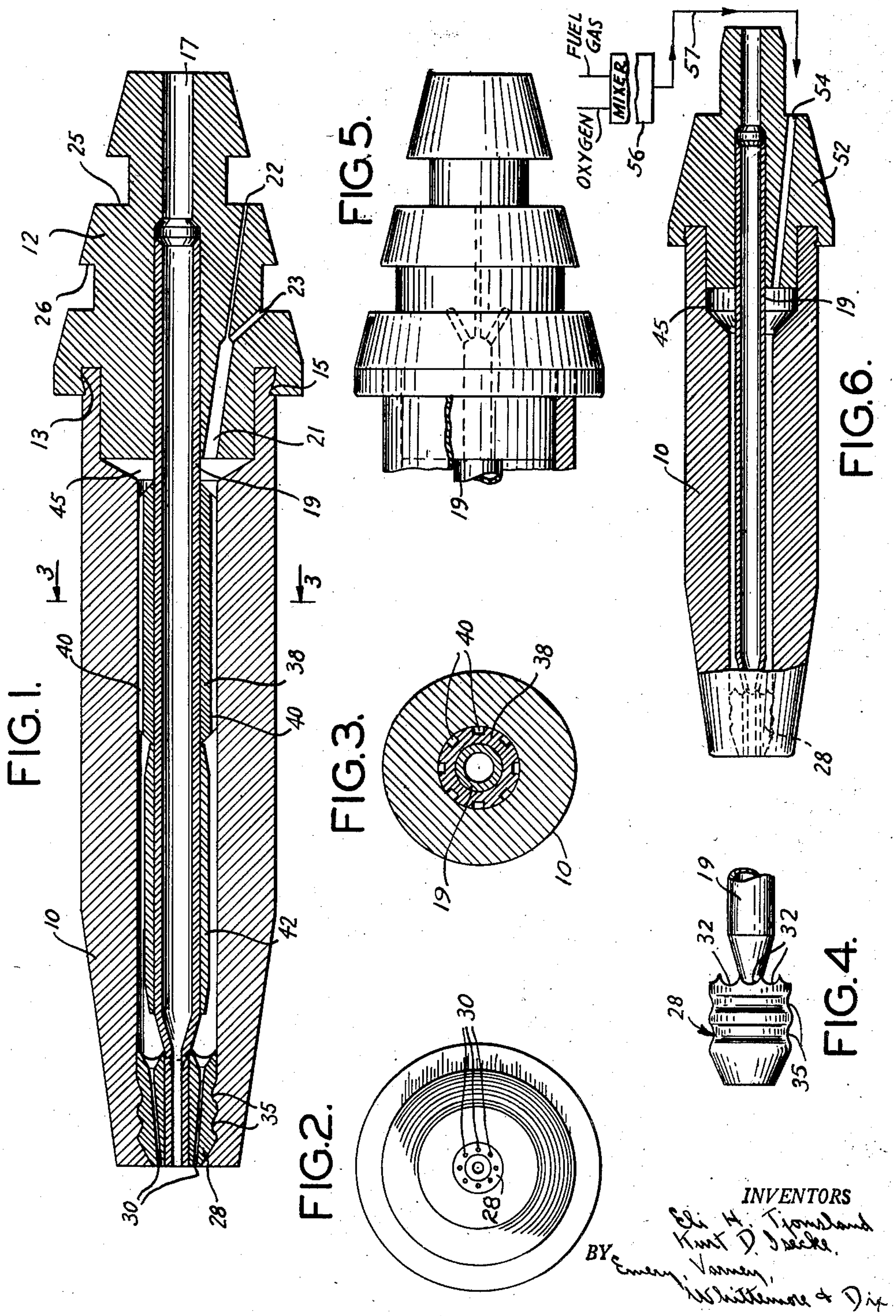

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CUTTING TIP OF COMPOSITE CONSTRUCTION

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This invention relates to oxygen cutting tips and more particularly to composite tip constructions that improve the performance of the tips, increase their useful life, and reduce the cost of manufacture.

One object of this invention is to provide a tip that prevents backfire damage. In one embodiment of the invention the flames are automatically extinguished if they flash back into the tip. In another embodiment of the invention this same feature can be obtained, or a more compact structure made in which flames that flash back into the tip burn within the tip at a region where they cause no damage to the tip.

Another object of the invention is to provide an improved tip construction in which the preheating orifices are short drillings, and in the preferred construction these drillings are made through a brass insert that is more easily drilled than copper and that permits damaged tip faces to be repaired by filing or grinding. The brass leaves the ends of the preheating orifices open and with sharp edges after filing off the tip face, whereas with copper tip faces the metal smears over the preheating orifices and closes or partially closes them when the tip face is filed off. One feature of the invention relates to a construction by which an annular brass insert is cooled from both its inside and outside faces to prevent melting of the brass under the worst conditions of service.

Some features of the invention relate to constructions that make the tip more rugged and more economical to manufacture. One of these features includes a grooved or scalloped face on the inner side of the insert through which the preheating jet orifices are drilled. These grooves or scallops serve as tapered approach passages for the preheating jet orifices. Another feature relates to the connection of the seat portion to the body of the tip in such a way that the parts cannot become loosened by repeated thermal expansion and contraction.

Other objects, features and advantages of the invention will appear or be pointed out as the description proceeds.

In the drawing, forming a part hereof, in which like reference characters indicate corresponding parts in all the views,

Figure 1 is a sectional view showing one embodiment of the invention for cutting tips in which the preheating gases mix in the tip.

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Figure 2 is an enlarged, end view showing the face of the tip of Figure 1.

Figure 3 is a sectional view taken on the line 3—3 of Figure 1.

Figure 4 is a fragmentary side elevation of a portion of the tip shown in Figure 1.

Figure 5 is an elevation of the seat portion of the tip of Figure 1 viewed at right angles to the plane of the section on which Figure 1 is taken.

Figure 6 is a reduced scale view, mostly in section, showing a modified form of the invention for torches having a mixer that brings the preheating gases together upstream from the tip.

The tip shown in Figure 1 includes a body portion comprising a shell 10, which is preferably made of copper. A substantially cylindrical opening extends lengthwise through the shell and this opening is enlarged at the upper end of the shell 10 for receiving one end of a seat portion 12, which is preferably made of brass. There is a circular groove 13 in the seat portion 12 for receiving the end of the shell 10. The end of the seat portion 12 that fits within the shell 10 fits tightly, and the seat portion 12 on the outside of the groove 13 is swedged or otherwise forced into an annular recess 15 in the outer surface of the shell 10.

The annular recess 15 is not ordinarily preformed in the sleeve 10 but is made by the pressure of the tool that forces metal of the seat portion 12 into the copper of the shell 10. After this displacement of metal of the seat portion 12 into the recess 15 in the outside surface of the shell 10, the groove 13 becomes an undercut groove filled by metal of the shell 10 to lock the shell 10 against any longitudinal displacement with respect to the seat portion 12.

Since the seat portion 12 is made of brass which has a lower coefficient of expansion than the copper shell 10, heating of the tip causes the shell 10 to expand against the outer side of the groove 13 and thus increases the pressure between the interlocked surfaces of the shell 10 and the seat portion 12.

There is a center bore 17 in the seat portion 12, and this center bore 17 is preferably of increased diameter at the downstream end of the seat portion 12. A center or inner tube 19, preferably of copper, is pressed into the bore 17 and is securely held therein. Since the coefficient of expansion of the copper tube 19 is higher than that of the brass seat portion 12, heating of the tip merely increases the pressure by which the tube 19 is gripped in the center bore 17.

The outside diameter of the tube 19 is substantially smaller than the inside diameter of the cylindrical opening through the shell 10. This leaves an annular space between the shell 10 and tube 19 for the passage of preheating gases to the face of the tip.

The preheating gases enter the annular space from a conduit 21 of the seat portion 12. Oxygen is supplied to the conduit 21 through a passage 22, and fuel gas, such as acetylene, flows into the conduit 21 from passages 23. These gas passages 22 and 23 open into peripheral grooves 25 and 26 respectively, in the tapered outside surface of the seat portion 12, and gases are supplied to these peripheral grooves 25 and 26 through passages of the torch head in a manner well understood in the art.

At the discharge end of the tube 19, it is swedged down to a reduced diameter and fits tightly in a center opening through an annular element 28 which is preferably an insert in the end of the body portion or shell 10. This annular element 28 is preferably tapered to a smaller diameter at the discharge end of the tip. Preheating jet orifices 30 are drilled through the insert 28; and this insert is preferably made of brass and is of short length so as to reduce the amount of drilling necessary in the manufacture of the tip. The preheating orifices are reamed from their rearward ends to give them a tapered cross section for a portion of their length.

Brass is easier to drill than copper and the brass portion of the tip face, provided by the insert 28, has important advantages when repairing or reconditioning tips. The filing or grinding of a copper tip face causes the copper around the preheating holes to be drawn over the ends of the preheating holes so that considerable labor is required to clear the ends of the holes again. The face of the brass insert 29, however, can be filed or ground without drawing metal across the preheating holes. When a tip face becomes damaged, it can be repaired and new clean discharge outlets for the preheating gases can be obtained by merely filing or grinding off the damaged face of the tip.

In order to provide tapered approach passages for the preheating jet orifices 30, radially extending grooves 32 are milled in the inner face of the insert 28 before the insert is assembled with the center tube 19. These radially extending grooves or scallops can be made by running a cutter across the full diameter of the insert 28 if there are an even number of preheating flame jet orifices and they are symetrically located around the axis of the insert 28.

The flame jet orifices 30 are preferably drilled at a slight angle so that they converge toward the discharge end of the oxygen supply tube 19. Better results are obtained by having the preheating jet orifices as close as possible to the oxygen cutting jet, and the preheating flames are located closer to the oxygen cutting jet by having them issue from converging jet passages 30. In the preferred embodiment of the invention the flame jet orifices 30 are located in a circle at substantially equal angular spacing and this spacing is of the order of 45°. By having such a large number of preheating jet orifices, and having them of small diameter, the total preheating gas mixture can be burned closer to the oxygen cutting jet and the heat of these flames is more evenly distributed around the cutting jet.

The radial grooves 32 are preferably of substantially V shaped cross section, the preheating flame jet orifices are drilled from points at the bottoms of the respective grooves 32. This gives the effect of a tapered approach passage for the flame jet orifices and changes the shape of the preheating jet flames if the passages 30 are not too long. In the construction shown the passages 30 are made with a number 73 drill and their length is approximately $\frac{7}{16}$ inch. The radial grooves 32 are located close together and are of such width as to form a scalloped edge around the outer periphery of the annular element 28. The side walls of the grooves 32 meet at the bottom of the groove with an included angle between the sides of the groove of the order of 60°. These relations give highly satisfactory results, but are given here merely as illustrations.

In order to prevent possible creeping of the annular element 28 lengthwise of the shell 10, grooves 35 are preferably provided in the outer cylindrical surface of the annular element 28. When the tip is manufactured, and the annular element 28 is pressed into the outer shell 10, and the outer shell 10 is swedged to force metal of the shell into the grooves 35 so that the element 28 is anchored in the shell 10 by engaging ridges and grooves on the confronting cylindrical surfaces of the insert 28 and shell 10.

The ends of the shell 10, annular element 28 and center tube 19 are preferably flush across the face of the tip and make up a composite face having a copper center portion surrounded by an annular brass portion which is in turn surrounded by the copper end face of the shell 10. Because of the intimate contact of the copper shell 10 and tube 19 with the outer and inner cylindrical surfaces of the insert 28, and the reduced diameter of the insert at the face of the tip, heat is carried away from the brass insert rapidly enough to prevent damage to the brass even when the tip is operating under the worst conditions of service.

Within the annular space between the shell 10 and tube 19, there is a baffle 38 that fits snugly around the outside of the tube 19. This baffle 38 is large enough to restrict the space for the flow of gas to a cross section that makes the gas velocity greater than the rate of flame propagation when the tip is being used with the intended gases and within the intended range of gas pressures.

In the preferred construction the baffle 38 extends outward into contact with the inside wall of the shell 10, and it is provided with longitudinal channels 40 in its outside surface for the flow of gas. An unchanneled baffle 38 with an annular clearance between it and the shell 10 could be used, but would not be as advantageous for some purposes of the invention.

For additional strength and protection, the tube 19 is preferably covered with an outer sleeve 42 throughout all or most of the length of the tube between the baffle 38 and the reduced diameter portion at the downstream end of the tube 19. It is necessary that the baffle 38 be located at a substantial distance from the preheating flame jet passages 30. This leaves an annular chamber of increased cross section between the flame jet orifices 30 and the gas passages 40 of the baffle 38. Unless there is such a spacing of the baffle from the insert 28, flames that pop back in any of the jet passages 30 will travel back along the channels 40 and cause the mixed gases to burn in the upstream end of the tip beyond the baffle 38. Such flames inside the tip will destroy the tip by melting the metal.

If the baffle 38 is sufficiently spaced from the insert 28, any flames that flash back through the flame jet openings 30 will not travel beyond the baffle 38. If the gas mixture continues to burn within the torch, it does so downstream of the baffle 38 and in flame jets at the ends of the channels 40. These flame jets lick the inside wall of the copper shell 10 but are spaced from the inner tube 19. The heat that they impart to the outer shell 10 causes no damage because this shell is cooled by radiation and contact with the surrounding atmosphere. These flames at the ends of the channel 40 do not impart sufficient heat to the tube 19 to injure it, and it is, therefore, possible for the tips to burn internally for an indefinite period without injury.

The minimum spacing between the baffle 38 and insert 28 that can be used in a construction such as illustrated, seems to be approximately equal to the inside diameter of the shell in a tip having a ¼ inch inside diameter for the shell. Longer distances are safer, and in the preferred construction the spacing of the baffle 38 from the insert 28 is at least 3½ times the inside diameter of the shell 10. The longitudinal length of the baffle 38 is preferably not less than the inside diameter of the shell 10, and in the construction shown is considerably longer, but it does not extend all the way to the seat portion 12. The baffle 38 terminates some distance from the seat portion 12 so that there is an annular chamber 45 for distribution of the gases from the conduit 21 to the channels 40 on all sides of the baffle 38. This annular chamber 45 also serves as a receiver for gas that flows back from the channels 40 when a flame flashes back into the annular space at the upstream end of the jet passages 30. Such a flash back causes a sudden increase in the pressure in that annular space and forces some of the products of combustion from that annular space back into the channels 40. This extinguishes the flame in the tip. A receiver such as provided by the annular chamber 45 permits the burned gases to travel back further aganst the pressure of the gas supply source. If this receiver is sufficiently large and the channels 40 are not too long or too small, the tip will always go out whenever a preheat flame flashes back into the tip. There is no objection in having the chamber 45 larger than necessary, except that the tip may become larger than it could be with a smaller chamber 45.

Figure 6 shows a modified construction for tips that are used with torches having mixers for supplying premixed oxygen and fuel gas to the tip. This modified tip construction includes a seat portion 52 which is attached to the torch body 10 in the same way as the seat portion 12 is attached to the torch body 10 of Figure 1. The seat portion 52 is shaped differently for insertion into the head of a premixed-type torch since only one preheating gas passage is required for the tip of Figure 6. This gas passage 54 supplies premixed oxygen and fuel gas from a mixer 56 and conduit 57 to the annular chamber 45 at the end of the seat portion 52.

A copper tube 19, with one end pressed into the brass seat portion 52, extends to a brass insert or annular element 28 of identical construction with that shown in Figure 1. The tip of Figure 6, however, has no baffle in the annular space between the element 28 and the seat portion 52. No baffle is necessary to keep this tip from backfiring to the mixer 56, and whenever a flame pops back into the annular space around the center tube 19, the tip merely goes out. It does not burn internally.

Even if the shell 10 is heated so hot that it will ignite the gas inside the tip of Figure 6, the gas within the tip explodes and the flame is extinguished. When new gas replaces the products of combustion in the tip, the new gas is again ignited with an explosion and no flame persists within the tip. This continues with a steady popping noise as long as the shell 10 is kept hot enough to ignite the gas within the tip, but there is never any steady flame at the end of the passage 54 and the tip is not heated by the internal explosions to a temperature sufficiently high to damage it. The same repeated popping occurs under similar conditions with the tip of Figure 1, when the spaces and conduits in such a tip-mix tip are proportioned to prevent the steady burning of flame jets in the tip.

The reason for this performance of the tip shown in Figure 6, and its immunity to damage by back-fire seems to be that when the annular gas passage between the insert 28 and the seat portion 52 is of sufficient volume in comparison with the outlet orifices 30, an explosion within the tip produces a pressure of the exploded gas that substantially equals or exceeds the pressure of the incoming gas in passage 54 and substantially stops or reverses the flow of the gas in that passage.

By having the flame jet orifices 30 small in comparison to the volume of the annular space within the tip, the explosion pressure within the tip cannot be relieved immediately through the orifices 30, and before the pressure in the tip has dropped to a value below that of the gases supplied to the passage 54, the flame front in the tip is burned out. As new gas begins to flow into the tip through the passage 54, it is proceeded by those products of combustion which were displaced into the passage 54 and this delays the introduction of new gas into the tip and permits some cooling of the tip interior.

Probably the new gas is diluted by the products of combustion in the tip so that the mixture within the tip does not become immediately explosive until considerable new gas has flowed in and diluted the products of combustion remaining in the annular gas space around the tube 19. When this occurs, the explosion can be repeated, but no matter how often it is repeated there has been no instance where the flame front eventually traveled back into the passage 54. It is thought that the mixer 56 acts as a receiver for cushioning and limiting the back pressure and that this is necessary in order to permit the explosion in the tip to force burned gas into the passage 54 and delay the refilling of the tip with fresh gas sufficiently long to insure against possible ignition of the gas stream at the discharge end of the passage 54.

Although the determination of pressures and pressure waves within a tip is difficult, it appears that it is sufficient if the explosion pressure in the tip merely stops the flow of additional gas without causing actual reverse flow. It is probably sufficient to cut down the flow of new gas to such a low value that it is insufficient to support a flame, and for purposes of this invention flow of such low rates will be considered as "substantially stopped." In the preferred embodiment of the invention, however, the gas spaces are proportioned so that the explosion produced, when a preheating flame pops back into the tip, is sufficient to cause an actual reverse flow of gas in the restricted passages upstream from the chamber in which the explosion occurs.

It is, of course, necessary that the tip be of sufficient length so that when the tip is in use the temperature of the metal, upstream from the restricted passages that stop the flame, does not rise to a temperature higher than the ignition temperature of the fuel gas. For example, with the tip shown in Figure 1 the walls of the passages 40 and of the annular space 45 must not rise to a temperature above the ignition temperature of the preheating gas mixture. Similarly, with the tip shown in Figure 6 the passage 54 and the torch head in which the tip seats must not be above the ignition temperature of the preheating gas mixture.

The preferred proportions of the tip shown in Figure 6 include a brass insert 28 approximately ½ inch long and tapers from about ¼ inch in diameter to a diameter of about ⅜ inch. The preheating jet passages are made with a number 70 drill. The inner tube 19 is made of copper and has an inside diameter of approximately ⅛ inch, except at its discharge end where it is swedged down to a smaller diameter to extend through the insert 28 and provide a desired size of outlet orifice for the oxygen cutting tip.

The outside diameter of the outer tube 19 is approximately $\frac{3}{16}$ inch, and the inside diameter of the shell 10 is approximately $\frac{5}{16}$ inch. The spacing of the insert 28 from the seat portion 52 is of the order of 3½ inches. For a short space near the end of the seat portion 52 the inside diameter of the shell 10 is enlarged to approximately twice the diameter of the opening beyond this enlarged portion. Although this enlargement at the end of the annular gas chamber within the tip increases the volume of the chamber, the primary purpose of the enlargement is to obtain a region of low gas velocity. The passage 54 is made with a drill.

The dimensions and proportions of the preferred construction can be varied over some range without losing the feature by which this tip prevents back-fires to the mixer. The ranges within which changes and proportions may be varied is not known, and even if they are not maintained, the combination of elements comprising this invention obtains better results and less liability to back-fire and flash back damage than has been obtained in tips of the prior art.

Changes and modifications can be made, and some features can be used alone and in different combinations without departing from the invention as defined in the claims.

What is claimed is:

1. A cutting tip including an outer shell having a wall of substantial thickness, a center tube having a wall of less thickness than the wall of the shell, said tube extending lengthwise in the shell and leaving an annular space between the shell and tube for the flow of preheating gas, an annular element extending for a short distance along the outlet end portion of the center tube for closing the annular space at the discharge end of the tip, said annular element having preheating jet orifices opening through it, and a baffle in the annular space between the shell and tube for restricting the cross section of the space through which the preheating gas flows, said baffle being located at a substantial distance upstream from the annular element through which the preheating jet orifices open, and said baffle fitting around the inner tube and being dimensioned so as to confine the gas flow past the baffle to the regions in the tip adjacent the inner wall of the tube so that flames which pop back into the tip burn at the discharge end of the baffle and in close proximity to the wall of the outer tube and without damaging the center tube.

2. A composite cutting tip comprising an outer shell having a substantially cylindrical inside surface, a center tube extending lengthwise of the outer shell and of reduced diameter at the discharge end of the tip, the outside diameter of said tube upstream of said reduced diameter end having a ratio to the inside diameter of the shell of the order of 3 to 5, an annular element surrounding the reduced diameter end of the tube and fitting within the discharge end of the shell, said annular element being of a length less than twice the inside diameter of the shell and having preheating jet orifices opening therethrough, a baffle surrounding the tube and spaced from the annular element by a distance at least four times as great as the inside diameter of the shell, said baffle fitting around the inner tube and leaving space between the baffle and the shell for the flow of preheating gas through the tip, said space being sufficiently restricted to give the preheating gas a velocity in excess of the rate of flame propagation when the tip is used with the intended fuel gas and gas pressure, the length of said baffle being of the order of at least three times the inside diameter of the shell.

3. A cutting tip having a composite face of copper and brass with an oxygen cutting jet orifice opening through a copper portion of the face formed by an end face of a copper tube through which the oxygen of a cutting jet flows to the tip face, and with a plurality of preheating jet orifices opening through the brass portion of the face at regions in an annular area around the end face of the copper tube and an outer shell having an end face providing an annular copper surface surrounding the brass area on the face of the tip, the brass area being substantially flush with the copper areas, so that the face can be filed or ground to repair the preheating jet orifices without drawing copper over their discharge ends.

4. A composite cutting tip including a copper tube through which an oxygen cutting jet is discharged, an annular brass element surrounding and in contact with the outer surface of the copper tube along a zone extending from the discharge end of the tube for a distance equal to the axial thickness of the brass element, said element having preheating flame jet orifices opening through it, an outer copper shell fitting tightly around the outer surface of the annular element for conducting heat away from said annular element, the contacting surfaces of the outer shell and annular element being locked together by circularly extending projections on one of said surfaces engaging complementary recesses on the other of said surfaces to prevent longitudinal creep of the annular element with respect to the outer shell.

5. A cutting tip comprising an outer shell, an inner tube of copper for a cutting oxygen jet,

said inner tube extending lengthwise of the outer shell, said tube being open at its upper and lower ends for the flow of cutting oxygen, and said tube having its intermediate portion spaced from the outer shell to provide an annular chamber for the flow of oxygen and fuel gas to preheating jet orifices, an annular wall at the outlet end of the tip of short longitudinal extent as compared with the inner tube, said wall being made of different and more easily drilled and less malleable material from the inner tube and extending between the lower end of the outer shell and the inner tube and forming a portion of the face of the tip and having a plurality of relatively short and circular drilled passages therein around the discharge end of the cutting oxygen tube for the discharge of preheating jets from the face of the tip, and a seat portion at the inlet end of the tip comprising a body that spaces the inner tube from the outer shell and that is connected with both the inner tube and the outer shell by gas tight connections.

6. A cutting tip comprising an outer shell, a seat portion at the upper end of the shell, an inner tube of copper extending from said seat portion lengthwise of the shell and spaced from said outer shell, said tube being open at its upper and lower ends for the flow of cutting oxygen to the discharge face of the tip, an annular insert in the face of the tip surrounding and in firm contact with an end zone of the tube and located between the end of the outer shell and the corresponding end of the inner tube, and comprising an end wall of the chamber between the outer shell and the inner tube, said end wall being made of different and more easily drilled and less malleable material from the inner tube and having a plurality of circular preheating jet passages opening through it and said passages having cross sections that expand at their inlet ends to the inside surface of the wall to provide tapered approach passages through which gas from the annular chamber between the the outer shell and inner tube enters said preheating jet passages.

7. A cutting tip in accordance with claim 6 and in which the tapered approach passages at the inner end of the preheating jet orifices comprise radially extending grooves or scallops in the inner face of the end wall.

8. A cutting tip including a center tube of copper from which a cutting jet is discharged, an annular element surrounding the center tube for a short distance at the discharge end of the tube, said annular element being of different and more easily drilled and less malleable material from the center tube and one face of said element being substantially flush with the discharge end of the tube, and an outer sleeve surrounding the annular element and extending lengthwise of the center tube beyond the annular element to provide an annular chamber for a preheating gas mixture, said annular element comprising a wall closing one end of the chamber and having a plurality of short passages therein opening through its face close to the center tube, said passages being of circular cross section and substantially equally spaced around a circle with the angular spacing of the order of 45°.

9. A composite cutting tip construction comprising an outer shell, a seat portion at one end of the shell, a tip face at the other end of the shell, a copper inner tube extending from the seat portion to the tip face through said outer shell and spaced from the outer shell, and a brass insert of an annular extent that closes the space between the outer shell and inner tube at the face end of the tip, one end of said brass insert comprising a portion of the face of the tip, and said brass insert having circular preheating jet conduits opening through it and the tip face and communicating with the annular space in the tip between the outer shell and inner tube.

10. A composite cutting tip comprising an outer shell, a seat portion connected with one end of the outer shell, an annular insert held in the other end of the outer shell and having preheating jet orifices opening through its end face, and a central tube spaced from the outer shell by the seat portion of the tip and extending lengthwise within the outer shell and having one end pressed into a longitudinal opening in the seat portion of the tip and its other end of reduced diameter and fitting into a center opening through the insert.

11. A cutting tip construction comprising an outer shell, a center tube extending lengthwise within the outer shell, a seat portion that spaces the outer shell and the center tube and into which one end of the center tube is pressed, said seat portion having a circular groove in one end for receiving the end of the outer shell, said circular groove being of undercut cross section and the outer tube being held within the circular recess by metal of the outer tube that fills the undercut portion of said recess, and an insert connected with the other end of the center tube and spacing the center tube from the outer shell at the discharge end of the tip.

12. A cutting tip construction comprising an outer shell, a center tube of copper extending through the outer shell and separated therefrom by an annular space, said tube having an open lower end which comprises the cutting jet outlet for the tip, a short annular insert that is of different and more easily drilled and less malleable material from that of the center tube and that comprises a wall which closes the space between the tube and shell at the discharge end of the tip, said insert having short drilled preheating gas passages therein at locations around the cutting jet outlet and having inner and outer side surfaces in contact with the tube and shell respectively, and means for preventing longitudinal displacement of the insert with respect to the outer shell, said means comprising interlocking circular ridges and grooves on the contacting surfaces of the outer shell and insert.

13. A composite cutting tip construction comprising a tubular body portion having a circumferential groove in its outside surface and near the upper end of the body portion, a seat portion having an annular groove into which the upper end of the body portion extends with the circumferential groove of the body portion within the annular groove of the seat portion, a center cutting oxygen tube extending from the seat portion into the body portion of the tip and forming a chamber for gas between the tube and the inner wall of the body portion, the body portion being permanently secured to the seat portion with a gas-tight seal by metal of the seat portion displaced into the circumferential groove of the body portion, and the seat portion being made of different material from the body portion, which material has a co-efficient of expansion lower than that of the body portion so that the circumferential groove surface of the body portion expands against the side of the groove in

which it is held in the seat portion as the temperature of the torch tip increases.

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References Cited in the file of this patent

UNITED STATES PATENTS

Number	Name	Date
1,237,534	Martin	Aug. 21, 1917
1,483,467	Meden	Feb. 12, 1924
1,631,007	Bucknam	May 31, 1927
1,679,586	Quelch	Aug. 7, 1928
1,693,838	Faudi	Dec. 1, 1928

Number	Name	Date
1,872,409	Coberly	Aug. 16, 1932
1,941,467	Fausek et al.	Jan. 2, 1934
2,080,396	Campbell	May 18, 1937
2,363,250	Jenkins	Nov. 21, 1944
2,368,716	Marra	Feb. 6, 1945
2,376,413	Babcock	May 22, 1945
2,380,570	Babcock	July 31, 1945
2,386,113	Harper	Oct. 2, 1945
2,391,934	White	Jan. 1, 1946
2,392,386	Jenkins	Jan. 8, 1946
2,392,593	Jenkins	Jan. 8, 1946
2,514,777	Marra	July 11, 1950