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3,524,962

ASPIRATING PLASMA TORCH NOZZLE

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FIG. 1

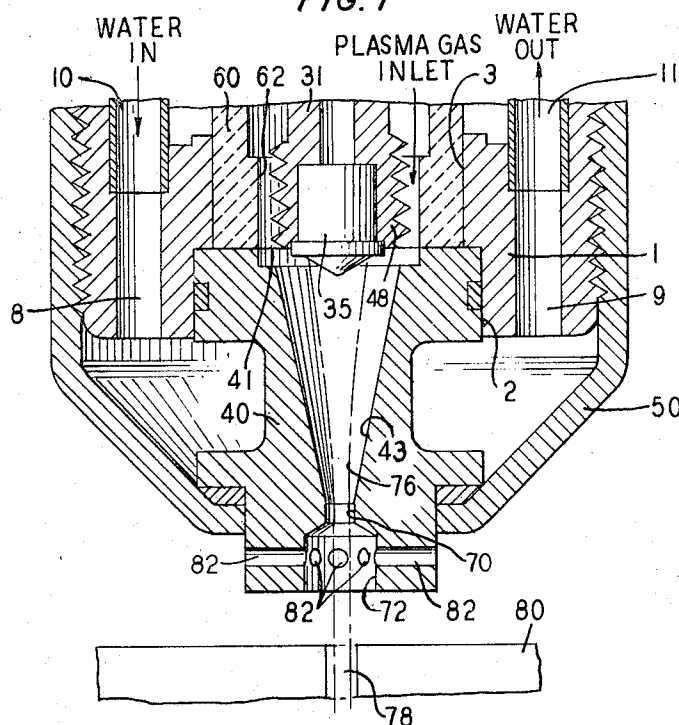


FIG. 2

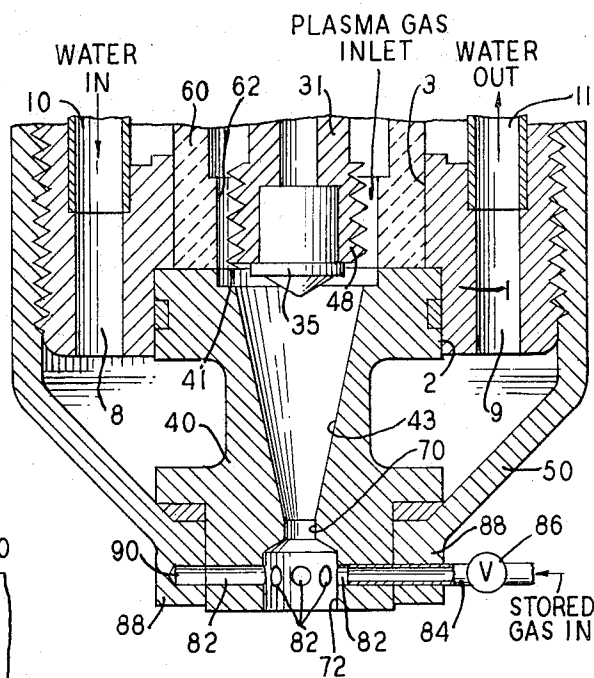
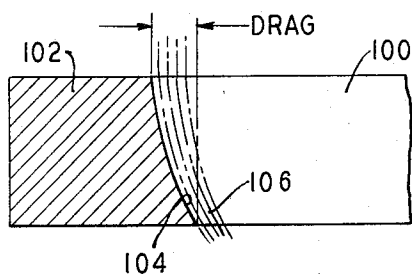


FIG. 3



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ASPIRATING PLASMA TORCH NOZZLE

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4 Claims

ABSTRACT OF THE DISCLOSURE

Air or other gas is supplied at atmospheric or slightly higher pressure to a space within the body of the nozzle, near the orifice end of the nozzle and adjacent to the plasma stream of the torch, from which space the air or other gas is aspirated by the plasma stream to form a protective sheath around the plasma stream issuing from the orifice.

BACKGROUND OF THE INVENTION

Field of the invention

The invention relates to electric torches for cutting metal plates or other workpieces, and more particularly to a nozzle for a cutting torch by means of which a shield of gas is caused to surround the plasma stream formed by the torch.

It is well known in the prior art to have a plasma torch with a nozzle in which a gas designed to form a protective sheath around the plasma stream of the torch is introduced under significant pressure into the interior of the nozzle at a place relatively close to the orifice of the nozzle and the force of the stream of sheathing gas serves to aspirate air into the nozzle at the end remote from the orifice, with the result that the aspirated air comes in immediate contact with the very hot arc electrode at a place where the air can chemically and physically attack the electrode and contribute to rapid destruction of the electrode.

SUMMARY OF THE INVENTION

The invention utilizes the simplicity and low cost of supplying a sheathing gas to the plasma stream of the electric torch by using the action of the plasma stream to aspirate the gas from the atmosphere or from a relatively low pressure source while avoiding the subjection of the arc electrode to destructive action of air or other oxidizing gas in immediate contact with the electrode. Tests have shown that the use of the invention permits faster cutting at a given power level, or reduction of power consumption at ordinary cutting speeds, with decreased drag, as explained hereinafter.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a fragmentary elevational sectional view of a cutting head including a nozzle for aspirating air in accordance with the invention, the cutting head being shown in operative relationship to a workpiece;

FIG. 2 is a fragmentary elevational sectional view of a preferred nozzle for aspirating gas from storage; and

FIG. 3 is a diagram illustrating the manner of measuring the drag of a cut.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

Referring to FIG. 1, the torch illustrated is of the general type disclosed in my copending application Ser. No. 585,528, filed Oct. 10, 1966, assigned to the same assignee as the present application. However, other torch forms may be used instead, and the invention is to be understood as not limited to the torch form illustrated.

With particular reference to the present invention, an

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annular recess 72 is provided for the purpose of surrounding the plasma stream with a gaseous sheath of air or other gas, particularly a gas which serves as an oxidizing agent to facilitate the cutting operation or for other purposes. To use atmospheric air as the oxidizing or shielding agent a plurality of passages 82 are provided extending from the recess 72 to the ambient atmosphere. To use another gas for example from a storage vessel (not shown), a tip nut 50 may be extended downward as shown at 88 in FIG. 2 to surround the exterior openings of the passages 82. An annular passage 90 may be provided within the portion 88 interconnecting the passages 82. A conduit 84, shown provided with a valve 86, is connected to the passage 90. The gas is admitted to the passages 90 and 82 when the valve 86 is open.

When the torch is in operation, the force of the plasma stream aspirates air into the recess 72 through the passages 82 directly in the embodiment shown in FIG. 1, or other gas through the conduit 84 and valve 86 as shown in FIG. 2, in either case to surround the plasma stream as it emerges from the nozzle 40 to perform the cutting operation.

As shown in FIGS. 1 and 2, I prefer to use a plurality of aspirating passages 82, e.g., eight arranged symmetrically about the circumference of the nozzle. Also, I find it is advantageous to make the inside diameter of the bore 74 larger than that of the bore 70, to accommodate an increased volume of gas resulting from the aspirating action.

Certain cooperating portions of the torch will now be described including, within a tip nut 50, a metallic head 1 of substantially circular cylindrical form, which is traversed by respective holes 8 and 9 displaced from its axis in opposite directions in the plane of FIG. 1 and parallel to the axis. From enlarged mouths of these holes there extend respective metallic tubes 10 and 11 whose end portions may be brazed to the head 1.

The head 1 is provided with an axial bore, the lower portion 2 of which may have a diameter somewhat less than the separation of the holes 8 and 9 from each other, and the upper portion 3 of which bore is of somewhat further reduced diameter.

Within the bore 3 there is fitted a spacer number 60, preferably made of a suitable ceramic material, and having a bore 62 concentric with the bore 3.

Centrally supported within the bore 62 is an electrode holder 31, illustrated as externally threaded at 48 to provide a path within the threads to impart whirling motion to a stream of gas. Alternatively, instead of external threads on number 31, internal threads may be provided in the spacer 60 to produce the whirling. Centrally fitted within the member 31 is an electrode 35.

A nozzle member 40 is supported within the bore 2 in the form of a generally spool-like metallic member coaxial with the spacer 60, electrode holder 31 and electrode 35. The nozzle 40 has an upper port 41 into which the electrode 35 may extend slightly as illustrated. Below the port 41 there extends a truncated conical bore 43, a straight bore 70, and the annular recess 72.

The function of the electrode 35 is to serve as one terminal, typically the cathode, of an arc stream having the form of an intense and constricted ionized gas plasma which issues from the torch and by which, as is known in the art, various functions such for example as cutting may be usefully performed. A purely illustrative example of the gas is a mixture of 90% nitrogen and 10% hydrogen. The shape of the contour of the plasma stream is indicated schematically by broken line 76, extending into a kerf 78 in a workpiece 80 upon which workpiece a cutting operation is illustrated. Gas to form the plasma may be supplied in the space between the spacer 60 and the whirler 31. Coolant, e.g., water, to cool the nozzle 40

may be fed into tube 10 and drawn out from the tube 11.

In successful tests of a nozzle embodying the invention, I have been able to cut metal plates at greater linear speed with a given expenditure of power, and to cut at ordinary speeds with reduced power. In cutting one inch thick mild steel plate I attained a cutting speed of 36 inches per minute with an aspirating nozzle embodying the invention, as compared with 30 inches per minute using the best available prior art nozzle. The power required when using the prior art nozzle was about 101 kilowatts as compared with about 87 kilowatts when using the nozzle embodying the invention.

In cutting one inch thick aluminum plate I attained a cutting speed of 80 to 85 inches per minute compared to 70 inches per minute with a prior art nozzle. These nozzles had a throat diameter at the narrowed point of 0.187 inch. With other nozzles having a throat diameter of 0.161 inch, I attained a cutting speed of 50 to 60 inches per minute compared to 40 inches per minute with a prior art nozzle.

In every case, the edges of the cut piece were consistently more nearly vertical using the nozzle embodying the invention than when using a prior art nozzle.

Use of the invention also reduced the drag encountered in making a cut. FIG. 3 shows how the drag is measured. One face of the cut is shown at 100 and the uncut portion of the plate is shown in section at 102, with the freshly cut contour shown at 104. The plasma stream is shown schematically at 106. The drag is measured parallel to the upper and lower plate surfaces between the upper and lower extremities of the contour 94. In practice, the measurement is made by stopping a cut in progress and measuring the drag when the plate has cooled.

While illustrative forms of apparatus and methods in accordance with the invention have been described and shown herein, it will be understood that numerous changes may be made without departing from the general principles and scope of the invention.

I claim:

1. In a plasma torch, in combination, a nozzle means having a passageway therethrough including a restricted part, means to generate a plasma stream and direct the same through said nozzle passageway, aspirating means located beyond the downstream end of the restricted part and operated by said plasma stream, said aspirating means comprising a connection means between the ambient atmosphere and the surface of said passageway.

2. Apparatus according to claim 1, in which said connection from the ambient atmosphere to said nozzle passageway beyond the downstream end of the restricted part extends substantially perpendicularly to the central axis of said plasma stream.

3. Apparatus according to claim 1, in which said aspirating means further comprises a portion of the nozzle structure forming an enlarged bore concentric with the central axis of the nozzle passageway.

4. Apparatus according to claim 3, in which said connection runs from said enlarged bore and extends substantially perpendicularly to the direction of said central axis.

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