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[54] **PLASMA JET CUTTING TORCH HAVING
REDUCED NOISE GENERATING
CHARACTERISTICS**

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abandoned.

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[51] Int. Cl. **B23k 9/00**

[58] Field of Search **219/121 P, 74, 75;
313/731**

[56]

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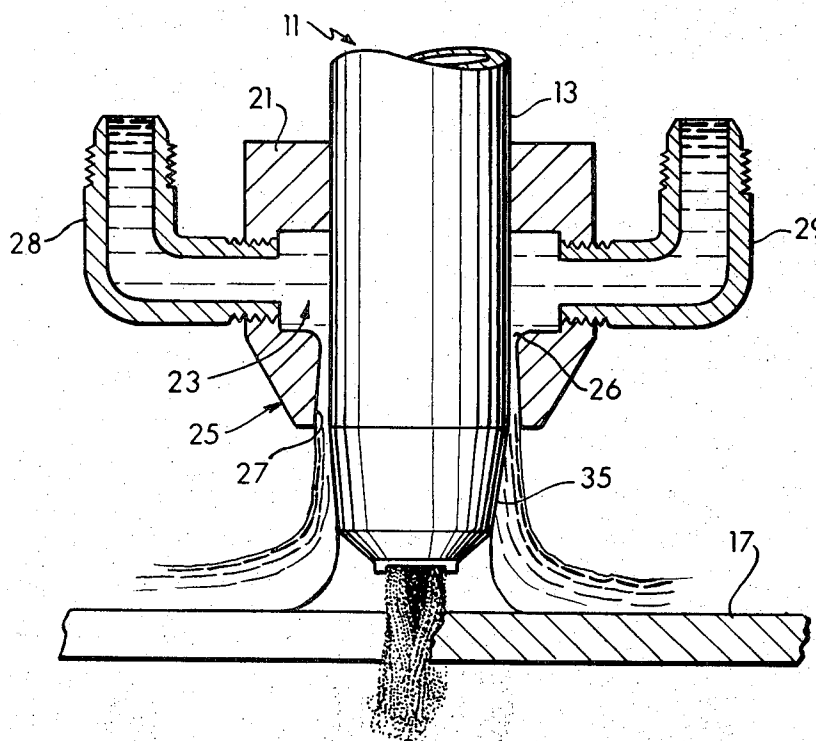
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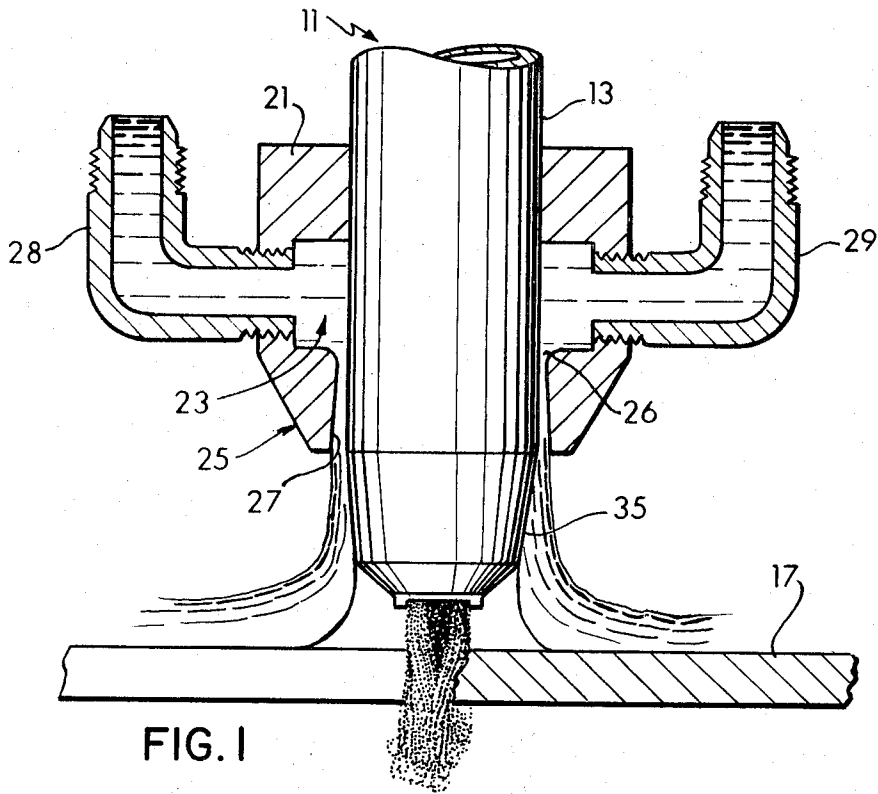
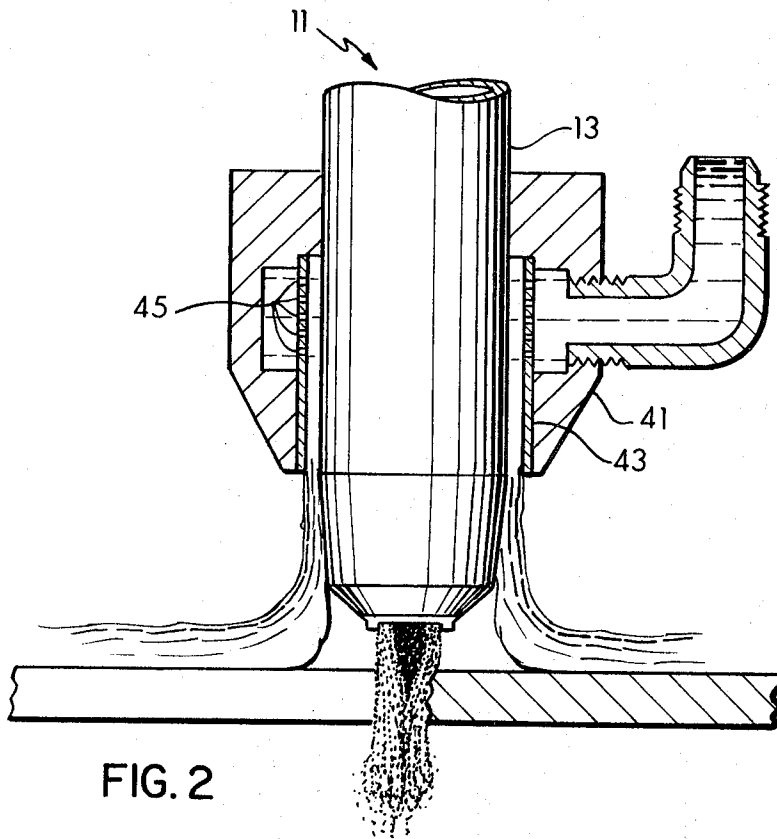
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ABSTRACT

In the plasma jet cutting torch construction disclosed herein, a low velocity annular water sheath is provided around the plasma jet to absorb and dampen acoustic energy generated by the jet. This sheath forms an essentially continuous shield around the jet between the torch and the workpiece.

3 Claims, 2 Drawing Figures





PLASMA JET CUTTING TORCH HAVING REDUCED NOISE GENERATING CHARACTERISTICS

RELATED APPLICATIONS

This is a continuation of application Ser. No. 262,091 filed June 12, 1972, now abandoned.

BACKGROUND OF THE INVENTION

This invention relates to plasma jet cutting torches and more particularly to means for reducing the noise generated by such torches.

In the cutting of metal plate with a plasma arc torch, a high energy noise field is generated in the cutting region by mixing of the high velocity plasma jet with the surrounding atmosphere. The generation of noise by jet mixing occurs both above and below the workpiece being cut.

As the plasma jet expends some of its energy in melting the material of the workpiece and ejecting the molten metal from the kerf, the sound levels produced in the region below the workpiece are typically not as intense as those produced above the workpiece. Further, as described in my copending application for a Water-Scrubber Cutting Table, filed Apr. 6, 1972, now U.S. Pat. No. 3,787,247 issued Jan. 22, 1974, the noise generated in the region beneath the workpiece can be substantially reduced by providing a body of water directly under or in contact with the plate. The high velocity mixing of the exiting plasma jet with this body of water both reduces the level of noise generated and tends to scrub particulate pollutants from the exhaust gases.

Among the several objects of the present invention may be noted the provision of means for reducing the noise generated by a plasma jet cutting torch, particularly the noise generated in the region between the torch and the workpiece; a further object is to reduce the light generated from that same region; a still further object is to provide an improved torch which can be constructed relatively simply and economically and is reliable and efficient in operation. Other objects and features will be in part apparent and in part pointed out hereinafter.

SUMMARY OF THE INVENTION

Briefly, the present invention relates to a plasma arc torch of the type which projects a high velocity plasma jet against a workpiece, thereby to cut the workpiece. A collar member is provided around the torch itself so as to form an annular, downwardly directed nozzle. A liquid flow is coupled to the nozzle thereby to provide, around the plasma jet, a thick liquid sheath which extends essentially continuously between the torch and the workpiece. This sheath operates to absorb and dampen acoustic energy generated by the plasma jet.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a side view, with parts broken away, of a plasma jet plate cutting system constructed in accordance with the present invention; and

FIG. 2 is a similar side view of a modification.

Corresponding reference characters indicate corresponding parts throughout the several views of the drawings.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring now to FIG. 1, there is indicated at 11 a plasma arc cutting torch having a generally cylindrical body shell 13. Preferably, torch 11 is generally of the type disclosed in U.S. Pat. No. 3,641,308 issued to myself and Robert C. Dean, Jr., on Feb. 8, 1972, for a Plasma Arc Torch Having Liquid Laminar Flow Jet For Arc Constriction. As is described in greater detail in the specification of that patent, the torch 11 employs an electrode which is connected to an electric power source so as to generate an arc between the torch electrodes and the workpiece being cut. Such a workpiece is indicated at 17 in FIG. 1. As is further described in the patent, a flow of an ionizable inert gas is directed around the electrode, so that a plasma is formed by the arc, which plasma is then projected as a jet to cut the workpiece.

In accordance with the invention disclosed and claimed in the aforesaid patent, the plasma jet is constricted by a flow of liquid which is directed radially inwardly against the plasma thereby to reduce its cross-section and concentrate the application of heat on the workpiece. While, as described hereinafter, the present invention also employs a liquid flow in the general vicinity of the plasma jet, this latter flow is a relatively low velocity or stagnant flow as compared with the inwardly directed constricting jet which is impinged upon the plasma and thus should be clearly distinguished therefrom.

In accordance with the present invention, the torch 11 is provided with an annular collar member 21 which, together with the torch body 13, forms an annular plenum chamber 23 and a downwardly-directed, annular nozzle 25 having a constricted entrance 26 followed by a section 27 with a flaring or increasing cross-sectional area. A pair of inlets 28 and 29 are provided for coupling a flow of a liquid, such as water, to the plenum chamber 23. This water flow leaves the plenum chamber 23 through the nozzle portion 25, the constricted entrance 26 providing a pressure drop causing distribution of the flow around the plenum with the flaring cross-section of the nozzle operating to slow the liquid flow as much as possible prior to its departure from the nozzle. In the embodiment illustrated, the removable cap 35 which permits replacement of various torch components is constructed so as to be essentially flush with the torch body 13 at the mouth of the nozzle 25. Accordingly, the water leaving the nozzle will continue to follow the side of the torch and is led by the side of the torch to the gap between the torch and the workpiece. Thus, a slow moving, almost stagnant sheath of falling liquid is provided around the plasma jet between the torch and the workpiece.

As noted previously, the proportioning of the various components is selected so that the liquid sheath is as thick as possible for a given water flow while maintaining the continuity of the sheath around the arc. In accordance with the invention, this sheath operates to absorb and dampen acoustic energy generated by the plasma jet in the region between the torch and the workpiece.

Various tests were conducted to determine the effectiveness of the annular liquid sheath in the present invention in attenuating noise, together with the water-scrubber cutting table described in my previously men-

tioned copending application. In cutting 1/2 inch stainless steel at a power level of 65 kw, the sound intensity 6 feet from the torch was 108 db. without water in the cutting table and without the annular water sheath of the present invention. With the cutting table filled with water so as to minimize the noise emitted from the region on the underside of the workpiece, the noise level was reduced to 101 db. With the addition of an annular water sheath of approximately 1/8 inch thickness, the sound intensity was reduced to 86 db., a further reduction of 15 db. The 1/8 inch thick water sheath was produced by a flow of 18 gallons per minute, the flow velocity at the mouth of nozzle 25 being about 8.7 feet per second. The relationship between the thickness of the water sheath and the efficiency of noise attenuation is illustrated by an experiment conducted when the flow rate was reduced to 10 gallons per minute. The sound intensity then rose to a level of 93 db.

Since the water sheath is formed by a nozzle construction which is located well above the lowermost point of the torch, with the water sheath being then allowed to flow downwardly along the torch body, the nozzle itself is effectively protected from flying material ejected from the cut. Further, the nozzle is located well above the retaining cap 35 so that the cap can be removed to permit the replacement of internal torch components without removing the collar member 21.

In the embodiment illustrated in FIG. 2, the nozzle 41 employs a cylindrical sleeve 43 which is uniformly spaced from the torch body. The upper portion of the sleeve extends into the plenum 23 and includes a multiplicity of holes 45. The screen thereby formed generates a pressure drop providing for distribution of the flow around the plenum chamber so that a nozzle of uniform cross-section may be used.

A further advantage of using the liquid sheath of the present invention is that the intensity of light radiated from the plasma is substantially reduced. This attenuation can be further increased by adding dye to the water used in the annular sheath.

In view of the foregoing, it may be seen that several objects of the present invention are achieved and other advantageous results have been attained.

As various changes could be made in the above constructions without departing from the scope of the invention, it should be understood that all matter contained in the above description or shown in the accompanying drawings shall be interpreted as illustrative and not in a limiting sense.

What is claimed is:

1. In a plasma arc cutting torch of the type having a generally cylindrical body enclosing an electrode, provided with means for generating an arc between said electrode and a workpiece and means for producing a high velocity flow of an inert gas around said electrode to generate a plasma, the plasma being projected as a high velocity jet from the torch to cut the workpiece, the method of reducing the noise generated by the torch which comprises:

providing, entirely around said cylindrical body, an annular downward flow of water which falls at an essentially minimal, relatively low velocity from said body to said workpiece as an essentially continuous and unbroken water curtain surrounding but not contacting said jet, said water curtain being in the order of one-eighth inch thick.

2. The method of claim 1 in which said flow is provided by a collar surrounding said torch body, said collar including a circumferential plenum opening downwardly into an annular nozzle having a relatively restricted entrance followed by a section of flaring cross-section for slowing the downward annular flow.

3. The method of claim 1 in which said flow is provided by a collar surrounding said torch body, said collar including a circumferential plenum opening into a downwardly directed annular channel, a screen being interposed between said plenum and said channel for restricting said flow and providing a uniform flow around said channel.

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