219-121 CROSS REFERENCE SEARCH ROOM

Aug. 31, 1965 J. A. BROWNING 3,204,075

ELECTRIC ARC TORCH

Filed Oct. 4, 1962

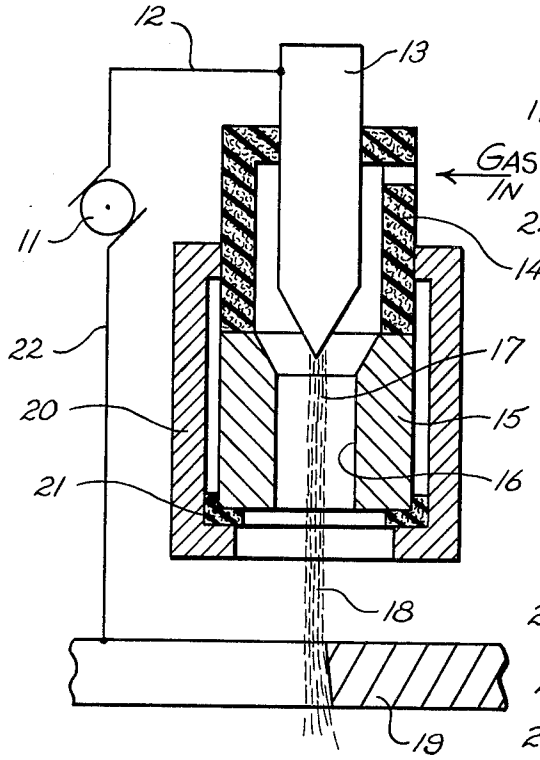


Fig. 1

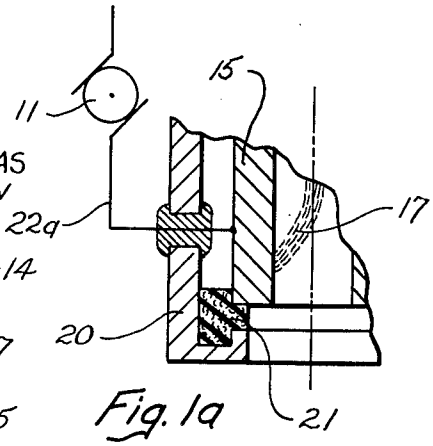


Fig. 1a

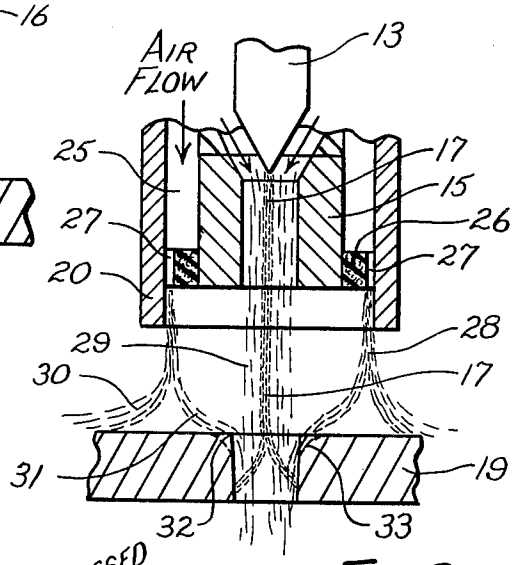
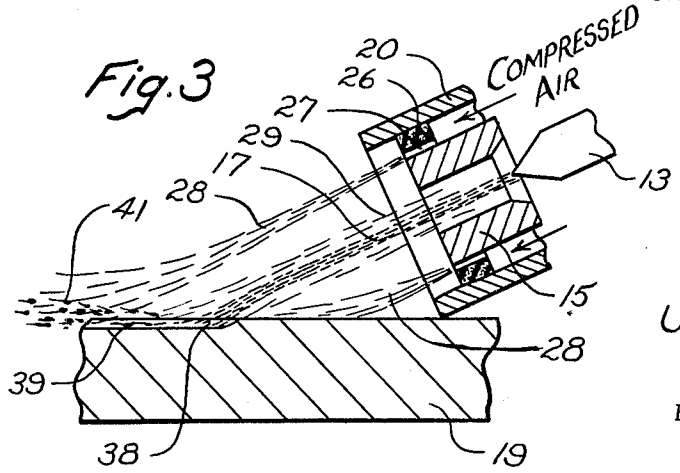


Fig. 2

Fig. 3



JAMES A. BROWNING
INVENTOR.
BY W. W. Morser

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ELECTRIC ARC TORCH

James A. Browning, Hanover, N.H., assignor to Thermal Dynamics Corporation, Lebanon, N.H., a corporation of New Hampshire

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My invention relates to electric arc torches and relates more particularly to an improved torch construction which reduces danger to operators and eliminates electrical shorting between nozzle and work, while at the same time increasing torch effectiveness under normal operating conditions.

Electric arc torches of the plasma forming gas type generally develop an arc between two electrodes. This arc is employed to reduce a gas, introduced along the arc stream, to a plasma state. While this "fourth state of matter" is not yet completely understood, extremely high effluent temperatures are developed and may be employed in a wide variety of commercial and scientific applications.

In accordance with this invention, I provide an electrically neutral shell to protect the torch nozzle and to prevent the arc from finding unwanted alternate paths from the cathode of the torch back to the power supply. To prevent molten slag or metal vapor from grounding this protective shell to the nozzle, I also provide a flow of gas, preferably air (for economic reasons) in the nozzle exit region.

For a complete understanding of my invention and the principles underlying its use, reference is now made to the following description and accompanying drawing, in which like reference characters denote like elements and in which:

FIGURE 1 is a simplified view, in cross section, of an arc torch embodying the improvements described herein;

FIGURE 1*a* is a detailed view of a circuit variation of the torch of FIGURE 1.

FIGURE 2 is a more detailed view of the nozzle end of a torch similar to the one shown in FIGURE 1 and containing an additional feature; and

FIGURE 3 is a view, in section, of the torch of FIGURE 2 shown in use in a slotting or gouging operation.

Referring now more particularly to FIGURE 1, an arc torch of the general type described in U.S. Patent 3,027,446, issued March 27, 1962, to the present inventor, is illustrated having a cathode **13** held in an insulating holder **14**. The cathode **13** is held in spaced relation to a nozzle **15** having an arc passage **16** therein. An arc **17** emanates from the cathode **13** and travels through arc passage **16** to impinge on a workpiece **19** which acts as the anode in the circuit. Leads **12** and **22** complete the electrical path to a suitable power supply **11**. The arc **17** is stabilized and forced down the passage **16** by a gas, preferably a plasma forming gas, which is heated as it travels along with the arc stream.

FIGURE 1 shows this torch in what is called the transferred mode of operation; that is, the arc leaves the torch per se and an external work piece acts as the anode. In the nontransferred mode the nozzle **15** serves as the anode, the arc thus terminating down the passage **16** against the inner wall thereof. In such case the electrical circuit is completed by a lead **22***a* (FIGURE 1*a*) and the useful work of the torch is done solely by the plasma and hot gas effluent. Whether the mode is transferred or nontransferred the invention is equally applicable.

To return to FIGURE 1, an outer shell **20** completely surrounding the nozzle **15** is provided. This shell is anchored to the torch by being attached at insulated

holder **14** and at the exit end of the nozzle with an insulating counter-bored ring **21**. It will be seen that the shell **20** is electrically isolated from all other torch components.

The phenomenon of "arc shortage" can occur when the nozzle **15** makes inadvertent electrical contact with the work piece. An electrical path is then established by conduction through the nozzle material thus damaging the torch, or, at the least, rendering it ineffective as a working tool. My shell **20** prevents this action and is particularly useful in small hand-held torches where careless handling often causes unwanted arc shorting.

I have found that the effectiveness of protective shell **20** is further enhanced by the construction shown in FIGURE 2. Here is provided an insulating ring **26** as before. However, I have found in some types of work, particularly where the torch is in close proximity to the surface being operated on, that slag, molten droplets, and even metal vapor may contaminate the end of the torch, forming a metallic conducting bridge between the nozzle **15** and the shell **20**. This circumstance, of course, renders the shell **20** no longer electrically neutral and the disadvantages of unprotected torches are again experienced.

To prevent the formation of such conducting bridges, I form slots **27** in the insulating ring **26**. Then into the chamber **25** between the nozzle **15** and the shell **20** a gas is supplied under suitable pressure. It should be understod that this gas is separate and distinct from the arc stabilizing gas introduced at the cathode **13** and flowing in the arc passage **16**. Thus air may be employed as it is fully effective for this purpose and very inexpensive. The flow of air through slots **27** effectively scavenges the inner surface of the shell **20** in the area where metallic depositions, freezing on exposed portions of the torch, would otherwise connect the shell **20** electrically to the nozzle **15**.

This air flow, in addition to keeping the shell **20** neutral, also provides some unexpected benefits when using the torch for cutting, as in FIGURE 2. In cutting it is usually desirable to form straight sided kerfs. It has been common practice to make cuts in which a rounding of the work, as shown in the dotted lines **33**, is the inevitable, unwanted result. This is because the palsma effluent **29** tends to spread and the heating effect extends well beyond the desired zone of the cut.

In my device, the cold gases **28** flowing through slots **27** impringe on the surface of the work and divide as shown at **30** and **31**. The flow at **31** serves to cool the corner of the kerf at **32** and aid in keeping that corner sharp. Furthermore this flow at **31** tends to contain the plasma effluent **29**, and drive it deeper into the cut where the thermal energy invested in the gas is delivered to the work as desired. A further added advantage of the air flow is that it aids in sweeping the slag from the work piece **19**.

In FIGURE 3 I show the torch being used in a metal gouging operation. Here, because of the insulating protective shell, the torch body may actually touch the work piece **19**, in getting the effluent extremely close to the area to be treated. The flow of gas at **28** keeps the palsma directed in a coherent stream, while acting mechanically to remove the molten material and slag **41** produced.

In providing two separate gas flows, one essentially electro-stabilizing and palsma forming, and the other essentially mechanical in action, the operator can choose a flow in each case best suited to its respective purpose substantially without regard to the values of the other. Prior arc torches do to some extent rely on the mechanical action of the gas stream, but the particular advantages discussed herein are not realized. Further, the

electrically neutral shell acts as a protective shield, combining a very real safety factor with means for supplying an effective secondary gas flow as described.

Modifications within the spirit and scope of the following claims may occur to persons skilled in art.

I claim:

1. An electric arc torch adapted to cut a workpiece comprising an electrode; a nozzle having an arc passageway extending from said electrode; electrical power means for establishing an arc from said electrode; means providing a plasma-forming gas stream under pressure into said nozzle to stabilize and carry said arc through said passageway together with said stream and against said workpiece; and means providing a stream of reactive gas against said workpiece in a direction generally parallel to the axis of said passageway and displaced therefrom, such that said gas stream and said reactive gas remain substantially distinct, with said reactive gas impinging the work surface adjacent the kerf zone of said cut, said reactive gas stream being of sufficient magnitude to cool said work surface whereby the kerf walls are held substantially parallel.

2. An electric arc torch according to claim **1** in which said reactive gas is air.

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RICHARD M. WOOD, *Primary Examiner.*

JOSEPH V. TRUHE, *Examiner.*