SINET: Ethiop. J. Sci., 24(1):133–138, 2001
 ISSN: 0379–2897

Feature article

TWIN CARBON ARC TORCH

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ABSTRACT: A simple twin carbon arc torch has been manufactured for the developing world from local materials and applied to brazing and heating in order to offer an alternative to the much more expensive oxyacetylene torch and to the usually environmentally degrading use of charcoal.

Key words/phrases: Arc, brazing, carbon electrode, plasma, torch

DESCRIPTION

The twin carbon-arc torch has been known and used for some time (Brumbaugh, 1976; Nippes, 1985), but in countries of widespread higher technology its predominate applications in heating, brazing, and welding have been supplanted by the highly developed oxyacetylene torch. As seen in Fig. 1, the twin carbon arc torch (henceforth referred to in this article as simply the carbon-arc torch) consists of a hand held apparatus made of two ('twin') carbon or graphite electrodes whose distance from each other (so its arc) is operator controlled. The power of this type of torch comes from an AC or DC arc welder - quite common throughout most of the developing world. The disassembly Fig. 2, shows the simple construction of the locally manufactured carbon arc torch. Welding cables are attached to copper tubing conductors which pass through an insulating asbestos sheet handle and terminate in carbon electrodes. There are finger operated control mechanisms: one which initiates the arc and another which maintains the arc by adjusting the distance between the electrode tips.

Fig. 1. Operator holding a twin carbon-arc torch made from locally available materials.

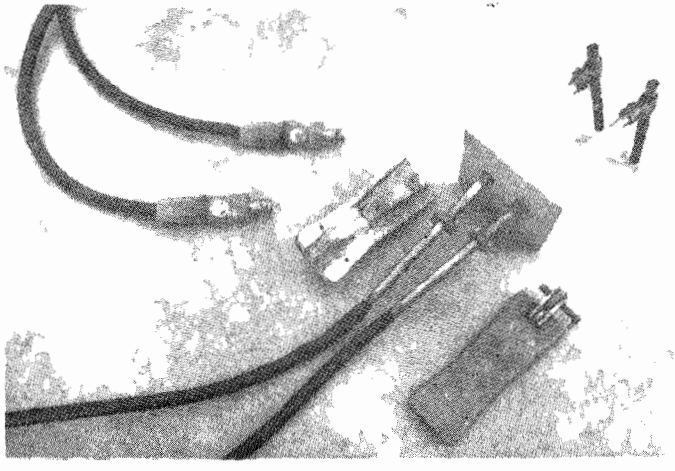

Fig. 2 Twin carbon-arc torch disassembled. Basic materials used for parts are 25 mm^2 multi-strand copper cable, 10 mm in diameter copper tubing, brass rod, asbestos sheet, plastic sheet, and carbon electrodes.

A main attraction of this simple torch is its use of 'freely' available carbon electrodes. This torch uses the anodes (positive electrodes each with a diameter of 8 mm and a length of 55 mm) of used/spent D size dry cells abundant throughout the developing world (see Fig. 3). It is the heat generated by the electric arc between the twin carbon electrode tips that is the heart of the apparatus. A pair of these carbon electrodes will last about 15 minutes while brazing at a typical current of 70 amperes. The carbon electrodes are not to be considered here as consumable electrodes (becoming part of the material heated); because of the high temperatures attained by the arc the carbon electrodes slowly vaporize. The arc is a plasma attaining a temperature of thousands of degrees centigrade depending on the exact region of the plasma. The radiant heat produced by the arc is what the operator of the carbon-arc torch must put to use. Thus it is the skill of its operator that is the prime definer of the applications of the carbon-arc torch.

Fig. 3. The carbon electrodes used by the twin carbon-arc torch come from spent/used D sized dry cell batteries.

USES

Heating

Many smaller metal working shop needs involve the heating of metal in order to bend it or to forge it. Figure 4 shows examples of metals that were heated by the carbon arc torch and then simply bent in the common bench vise. Both where the use of the oxyacetylene torch is prohibitively expensive and where the use of charcoal is not only expensive but environmentally damaging the carbon arc torch may offer a more appropriate alternative method of heating.

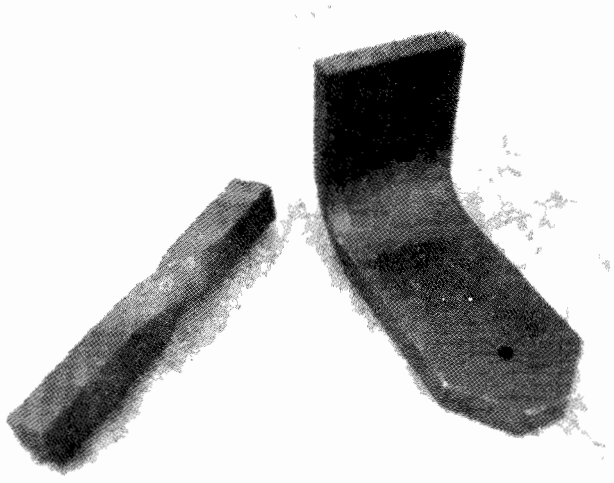

Fig. 4. Steel bars (12 mm x 12 mm, and 8 mm x 40 mm) bent after heating with the twin carbon-arc torch.

Brazing

The main purpose for which this carbon arc torch was developed was simple brazing and braze welding. Figure 5 illustrates sheet metal brazed together using the carbon-arc torch and a pipe fixture braze welded. With care even delicate brazing of small copper tubing can be accomplished with this torch (see Figure 6).

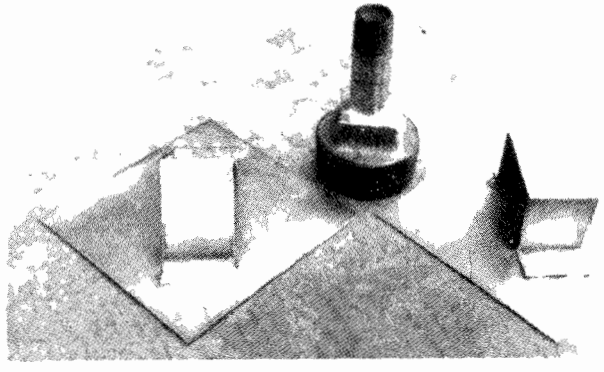

Fig. 5. Sheet steel (0.8 mm thick) brazed together and a piece of ⅜" pipe braze welded into a 1½" plug using the twin carbon-arc torch.

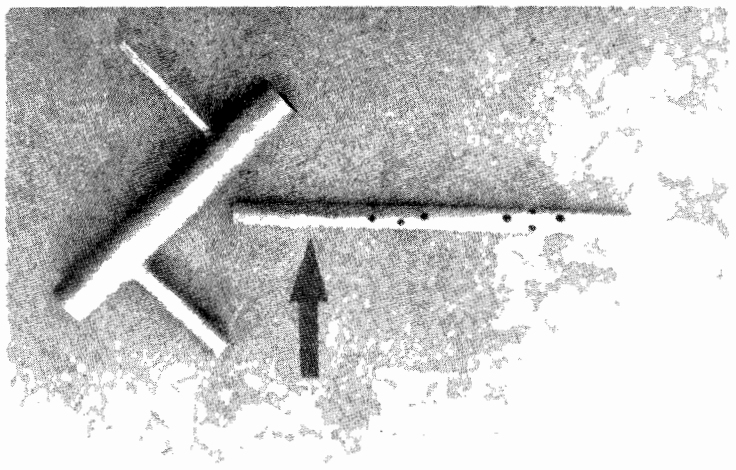

Fig. 6. Using the twin carbon-arc torch pieces of 10 mm diameter and 5 mm diameter copper tubing were brazed at right angles to a piece of 16 mm diameter copper tubing. At the point of the arrow the 10 mm diameter copper tubes were brazed end to end.

ECONOMICS

In the country (Ethiopia) in which this torch was designed the alternative, the oxyacetylene torch, was essentially unavailable on the town level and found in less than 25% of the metal working shops on the city level. A strong argument for the use of the carbon-arc torch is its low cost. Assuming the ownership of a modest electric arc welder, the initial cost of our carbon-arc torch was twenty times less than the simplest oxyacetylene torch apparatus (more than 50% of the cost of the carbon-arc torch consisted in the retail price of 12 meters of welding cable). When considering that for ongoing maintenance there are not the problems of gas tank refills and transportation costs, the carbon-arc torch is vastly cheaper.

As any technical tool the carbon-arc torch needs a bit of patience in the development of skill in its use. The proper setting of the arc welder current comes quickly, but ability to direct the radiant heat of the arc onto the area to be heated comes only with skill and experience. We judge that a determined and competent metal worker/artisan can easily meet such a challenge especially when attracted by the economic benefits.

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