

Air-carbon arc cutting and gouging torch

This invention relates to an air-carbon arc cutting and gouging torch suitable for use in a metal foundry for cleaning riser pads, sprues, fins and other excess or unwanted surface material or defects from large metal castings.

An air-carbon arc cutting and gouging torch operates by providing means to position a carbonaceous electrode (e.g. graphite) relative to a workpiece so that an electric arc can be struck and maintained between the electrode and the workpiece. As metal melts under the influence of the arc a stream of high pressure air directed along the electrode forcibly removes the molten metal from the influence of the arc. Thus, in the hands of a skilled operator unwanted metal or nonmetallic substances entrapped in the surface of a casting or metal object can be removed.

The Air-Carbon Arc Cutting and Gouging process was first described in US-A-2,706,236.

After the basic process was discovered a special torch for use in the foundry was developed and is disclosed in US-A-2,726,309. The torch disclosed in the '309 patent is of the fixed-head design suitable for positioning large diameter electrodes in relation to a workpiece. Air flow through the torch to ports on either side of the electrode is controlled through a spring loaded valve which is opened by insertion of the electrode. The valve element includes a hemispherical end for contacting the electrode. In common with all air-carbon arc cutting and gouging torches air and electric current are brought to the torch by means of a coaxial cable, comprising an inner cable carrying electrical energy and an outer insulating coating (e.g. rubber) with a space between the inner cable and outer cable to carry air under pressure. In the torch of the '309 patent current is carried through the valve plunger to the electrode. A torch according to the '309 patent required air having a source pressure of at least 5.5 bars (80 psi) and preferably 6.9 bars (100 psi) in order to operate efficiently. In view of the large diameter electrode used for cleaning heavy castings, large current was required to operate the process efficiently. Because of large current densities the torch frequently overheated thus causing operator fatigue and loss of process efficiency because of frequent work stoppages to allow the torch to cool.

In order to provide a more efficient fixed-head Air-Carbon Cutting and Gouging Torch it was discovered that providing the torch head with a chamber so that the air could equalize in pressure around the electrode before beginning its aerial path outside of the torch head and positioning the exit passages in an angular relationship to the torch body, a more efficient torch capable of operating at reduced air

pressure was achieved. Reducing the operating air pressure tends to reduce the operating noise level of the process thus increasing worker comfort. In addition, it was discovered that by creating an extended contact surface for the valve plunger current carrying efficiency was also increased. A redesign of the torch handle coupled with the new process air flow pattern, shortening of the valve stem, and decrease of the number of internal parts has lead to a torch that operates at lower temperature, tends to overheat less, and thus, increased operator comfort and overall process efficiency. Lastly, fixing the torch head at a maximum angle of 35° to the torch body promotes optimum process efficiency by positioning the electrode to the workpiece at the preferred angle when the torch is being used.

According to the present invention there is provided a fixed head air-carbon arc cutting and gouging torch which comprises an elongate torch body and a head assembly rigidly connected to said torch body, wherein said torch body is connectable to an electric cable and an air supply conduit, and said head assembly comprises a bore which, in use, receives and positions an electrode relative to said torch body, an air inlet passage, two air outlet passages which communicate with said air inlet passage and extend substantially parallel to the longitudinal axis of said bore, one to either side of a first plane which passes through the longitudinal axis of said bore and the longitudinal axis of said torch body, and a plunger valve which is biased to inhibit air flow through said inlet passage and said outlet passages but which has a contact surface which, on insertion of said electrode in said bore unseats said plunger valve and permits air to flow through said air inlet passage and said air outlet passages, characterized in that the longitudinal axis of said bore and the longitudinal axis of said torch body intersect at an acute angle no greater than 35°, said head assembly is provided with an annular chamber which extends circumjacent said longitudinal bore and communicates with said air inlet passage and said air outlet passages, and said air outlet passages are both positioned between said torch body and a second plane which passes through the longitudinal axis of said bore perpendicular to said first plane.

Preferably, said contact surface is generally thumb-shaped.

For a better understanding of the invention reference will now be made, by way of example, to the accompanying drawings in which:

Figure 1 is the longitudinal section through a torch according to the present invention; and Figure 2 is a bottom plan view of the torch of

the present invention with a portion of the handle broken away for clarity.

Referring to Figure 1, there is shown a fixed-head air-carbon arc cutting and gouging torch 10 which includes a head assembly 12 and a handle 14 which is connected to the head assembly via a handle adapter 26. The head assembly 12 includes a first generally cylindrical head portion 16 having a bore 18 adapted to receive a graphite electrode such as commonly used in the air-carbon arc cutting and gouging process.

The cylindrical head portion 16 is provided with a circumferential passage 22 which is isolated from the bore 18 by a sleeve 19. Circumferential passage 22 communicates with an air passage 24 in handle adapter 26 and with air passages 28 and 30 which extend with their longitudinal axis parallel to the longitudinal axis of bore 18 and open onto end 20 of the cylindrical head portion 16 as shown in Figure 2.

Handle adapter 26 includes an air passage 32.

A plunger valve 40 projects into bore 18 through an opening in sleeve 19 and has a valve closure element 42 and a contact surface 44. Contact surface 44 is extended by utilizing a truncated cylinder or a curved surface to facilitate entry of the electrode into bore 18. The extended surface 44 of valve element 40 provides a better contact with the electrode (not shown) to thus increase the current carrying efficiency of the torch by causing better contact of the electrode with current carrying portions of head 16, lower resistance and provides for cooler operation of the torch.

Plunger valve 40 is normally biased to a closed position by means of spring 50 positioned between valve closure element 42 and current tube adapter 36.

Current tube adapter 36 has affixed thereto an elongated current tube 60 terminating in a cable adapter 62. Cable adapter 62 can contain an internal threaded surface 64 to receive a convention air-carbon arc cutting and gouging torch coaxial cable (not shown) such as disclosed in US-A-3,324,317. The coaxial cable comprises a braided conductor (e.g. copper wire) having a threaded fitting or pressure fitting adapted to mate in surface 64 covered by concentric insulating tube (e.g. rubber) for carrying air between the conductor and the covering. The braided conductor fitting (not shown) mating with current tube 60 includes a series of apertures so that air can pass through the fitting into adapter 62 through tube 60 into current tube adapter 36 past the valve element 40 and into the torch passages 22, 28 and 30. A current tube insulator 66 covers that portion of the torch head assembly including current tube adapter 36 and extends rearwardly and terminates at the cable assembly adapter 62. A larger diameter insulator in the form of handle 14 is placed over

current tube insulator 62 and spaced therefrom by a plurality of spacers 68 which are in the form of insulating rings. Handle 14 is fixed to the current tube insulator 66 by oval head screws 70. Handle 14 extends rearwardly a sufficient distance so that it covers cable adapter 62 to prevent the operator from touching any current carrying portions of the torch.

Head assembly 12 is covered with an outer insulating coating 72 to inhibit inadvertent contact of the current carrying portions of the torch with the metal workpiece or any surrounding object. The insulating coating 72 is itself covered by a shield 74.

In operation of the torch the combined current and air cable is attached by means of cable adapter 62. An electrode designated by arrow E is inserted into the bore 18 of torch head 16 in the direction shown by the arrow. As the electrode is forced into the bore valve plunger 40 is caused to move to the right thus unseating valve element 42. When the current and the air are turned on current flows from adapter 62 through current tube 60 through current tube adapter 36, handle adapter 26, head 16, spring 50, valve closure element 40 and valve plunger 40 to the electrode E. Air passes through the coaxial cable assembly through cable adapter 62 the interior of current tube 60 adapter 36 past valve seat 34 through passage 24 and simultaneously into groove 22 and outwardly through passages 28 and 30 in the direction of arrow A. The groove 22 acts as a plenum chamber to equalize air pressure and thus minimize turbulence of the air exiting through passages 28 and 30. Less turbulent air flow causes more uniformity of the arc and greater process efficiency. In view of the fact that the valve element is shortened over that of US-A-2,726,309 there is more air space in the torch thus providing for greater cooling of the torch by the air flowing in the torch. This enables the deletion of the shield which was unnecessary in the torch of the '309 patent.

The improved air flow permits the source air pressure to be decreased from 6.9 bars (100 psi) to 4.1 bars (60 psi) thus reducing the overall operating noise level of the process as the torch 10 is in use.

A torch according to the drawing was constructed and operated in a comparative test with a fixed head foundry torch sold by the Arcair Company of Lancaster, Ohio as a Model M-6 and one that is representative of a prior art torch.

The test procedure involved the following steps:

- 1) The New Foundry Torch was checked for air consumption on a rotometer, a standard M-6 Foundry Torch was also tested.
- 2) Five $\frac{3}{4}$ " (19 mm) jointed electrodes were weighed and the lengths measured for use with the New Foundry Torch. A second set of

five $\frac{3}{8}$ " (19 mm) electrodes were prepared for use with the M-6 Torch:

- 3) Two pads were weighted for pad washing use with the two torches.
- 4) Each torch was used with five electrodes on pad washing. The amperage was recorded on a Heath Company Strip Chart. The arctime and noise level were noted for each torch.

- 5) The temperature of the jaws of each torch was measured immediately after gouging was completed.
- 6) The pads and electrodes were reweighed and the metal removal computed for each torch.

The results are set forth in Table I.

TABLE I

Torch	Amps	Volts	Kg/cm	Kg/min	Jaw temp.
M-6	1600	40	1.69	1.5	(390°F) 199°C
Foundry torch Model J2	1600	40	1.98	1.65	(380°F) 193°C

Referring to Table I it will be seen that the Foundry Torch according to the invention shows improved metal (EN7046) removal. While the jaw temperature for the torch according to the invention (measured by an optical pyrometer) was only 6°C (10°F) lower, the operator had to stop using the M-6 torch before the pad washing was complete because the torch handle overheated. Actual handle temperature could not be read with an optical pyrometer because the handle material is insulating in nature. The torch according to the invention permitted about 20% more air by volume to flow through the torch than did the M-6 torch, resulting in more metal removal and cooler operating temperatures.

In constructing a torch according to the present invention it was found that fixing the head 16 at a maximum angle of 35° to the center line of the torch handle 14 provided maximum operator efficiency by fixing the angle of the electrode toward the workplace when the torch is being operated.

Claims

1. A fixed head air-carbon arc cutting and gouging torch (10) which comprises an elongate torch body (14) and a head assembly (12) rigidly connected to said torch body (14), wherein said torch body (14) is connectable to an electric cable and an air supply conduit, and said head assembly (12) comprises a bore (18) which, in use, receives and positions an electrode relative to said torch body (14), an air inlet passage (24), two air outlet passages (28, 30) which communicate with said air inlet passage (24) and extend substantially parallel to the longitudinal axis of said bore (18), one to either side of a first plane which passes through the longitudinal axis of said bore (18) and the longitudinal axis of said torch body (14), and a plunger valve (40) which is biased to inhibit air flow through said inlet passage (24) and said outlet passages (28, 30) but, which has a contact surface (44) which, on insertion of said

electrode in said bore (18) unseats said plunger valve (40) and permits air to flow through said air inlet passage (24) and said air outlet passages (28, 30), characterized in that the longitudinal axis of said bore (18) and the longitudinal axis of said torch body (14) intersect at an acute angle no greater than 35°, said head assembly (12) is provided with an annular chamber (22) which extends circumjacent said longitudinal bore (18) and communicates with said air inlet passage (24) and said air outlet passages (28, 30), and said air outlet passages (28, 30) are both positioned between said torch body (14) and a second plane which passes through the longitudinal axis of said bore (18) perpendicular to said first plane.

2. A fixed head air-carbon arc cutting and gouging torch as claimed in Claim 1, characterized in that said contact surface (44) is generally thumb-shaped.

Revendications

1. Torche à l'arc air-carbone (10), à tête fixe, de découpage et de décriquage qui comporte un corps de torche allongé (14) et un bloc de tête (12) couplé rigidement audit corps de torche, dans laquelle ledit corps de torche (14) peut être couplé à un câble électrique et à une conduite d'alimentation en air, et ledit bloc de tête (12) comporte un perçage (18) qui, en utilisation, reçoit et positionne une électrode par rapport audit corps de torche (14), un passage d'entrée d'air (24), deux passages de sortie d'air (28, 30) qui communiquent avec ledit passage d'entrée d'air (24) et s'étendent sensiblement parallèlement à l'axe longitudinal dudit perçage (18), un de chaque côté d'un premier plan qui passe par l'axe longitudinal dudit corps de torche (14), et une soupape à piston plongeur (40) qui est chargée pour interdire la circulation d'air dans ledit passage d'entrée (24) et lesdits passages de sortie (28, 30) mais qui possède une surface de contact (44) qui, lors de l'insertion de ladite électrode

- five $\frac{3}{4}$ " (19 mm) electrodes were prepared for use with the M-6 Torch.
- 3) Two pads were weighted for pad washing use with the two torches.
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dans ledit perçage (18), ouvre ladite soupape à piston plongeur (40) et permet à l'air de circuler dans ledit passage d'entrée d'air (24) et lesdits passages de sortie d'air (28, 30), caractérisée en ce que l'axe longitudinal dudit perçage (18) et l'axe longitudinal dudit corps de torche (14) se coupant suivant un angle aigu qui n'est pas supérieur à 35°, que ledit bloc de tête (12) est muni d'une chambre annulaire (22) qui est circonjacente audit perçage longitudinal (18) et communique avec ledit passage d'entrée d'air (24) et lesdits passages de sortie d'air (28, 30), et que lesdits passages de sortie d'air (28, 30) sont tous deux positionnés entre ledit corps de torche (14) et un second plan qui passe par l'axe longitudinal dudit perçage (18), perpendiculaire audit premier plan.

2. Torche à l'arc air-carbone à tête fixe pour découpage et décriquage, caractérisée en ce que ladite surface de contact (44) a la forme générale d'un ponce.

Patentansprüche

1. Trenn- und Fugenschneidbrenner (10) mit festliegendem Kopf für Luft-Kohle-Lichtbogen, mit einem länglichen Brennergehäuse (14) und einer Kopfanordnung (12), welche starr mit dem Brennergehäuse (14) verbunden ist, wobei das Brennergehäuse (14) an ein elektrisches Kabel und eine Luft-Speiseleitung anschließbar ist, und wobei die Kopfanordnung (12) eine Bohrung (18) umfaßt, welche bei der Verwendung eine Elektrode aufnimmt und relativ zum Brennergehäuse (14) positioniert, einen Lufteinlaßkanal (24), zwei Luftaus-

laßkanäle (28, 30) welche mit dem Lufteinlaßkanal (24) in Verbindung stehen und sich im wesentlichen parallel zur Längsachse der Bohrung (18) erstrecken, und zwar jeweils eine auf jeder Seite einer ersten Ebene, welche durch die Längsachse der Bohrung (18) und die Längsachse des Brennergehäuses (14) hindurchtritt, und eine Stoßelventil (40), welches derart vorgespannt ist, daß es die Luftströmung durch den Einlaßkanal (24) und die Auslaßkanäle (28, 30) verhindert, aber eine Berührungsfläche (44) aufweist, welche nach dem Einführen der Elektrode in die Bohrung (18) das Stoßelventil (40) aus seinem Sitz löst und es Luft gestattet, durch den Lufteinlaßkanal (24) und die Luftauslaßkanäle (28, 30) hindurch zu strömen, dadurch gekennzeichnet, daß die Längsachse der Bohrung (18) und die Längsachse des Brennergehäuses (14) einander unter einem spitzen Winkel schneiden, der nicht größer ist als 35°, daß die Kopfanordnung (12) mit einer Ringkammer (22) versehen ist, welche sich rund um die Längsbohrung (18) erstreckt und mit dem Lufteinlaßkanal (24) und den Luftauslaßkanälen (28, 30) in Verbindung steht, und daß die Luftauslaßkanäle (28, 30) beide zwischen dem Brennergehäuse (14) und einer zweiten Ebene angeordnet sind, welche durch die Längsachse der Bohrung (18) hindurchläuft und senkrecht zur ersten Ebene steht.

2. Trenn- und Fugenschneidbrenner mit festliegendem Kopf für Luft-Kohle-Lichtbogen nach Anspruch 1, dadurch gekennzeichnet, daß die Berührungsfläche (44) allgemein daumenförmig ist.



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