

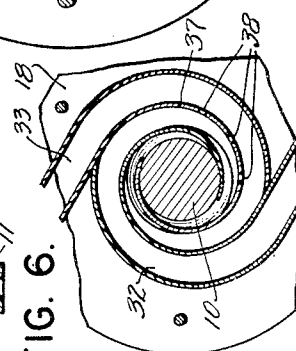
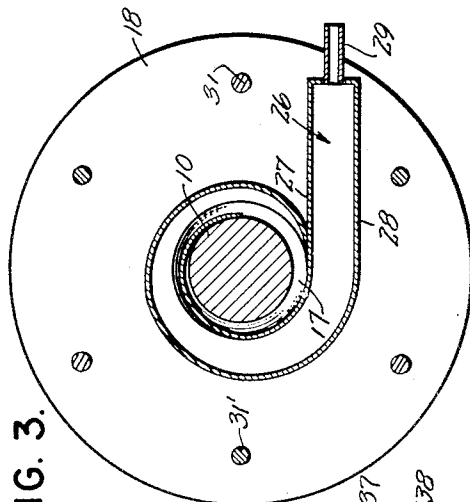
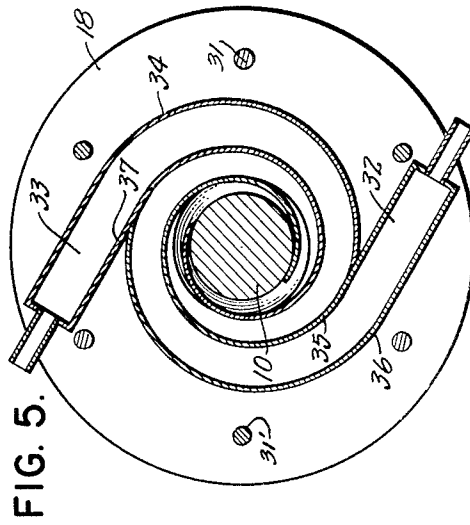
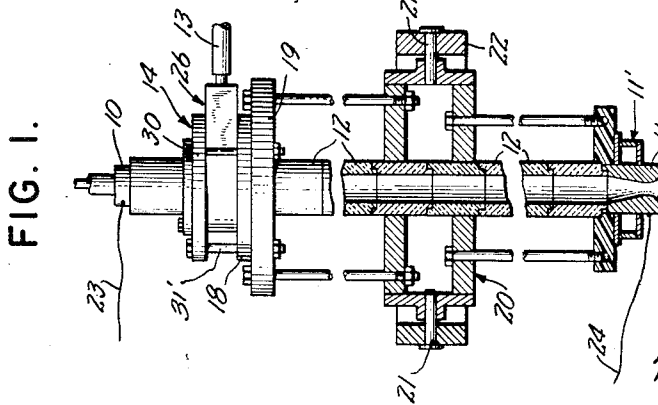
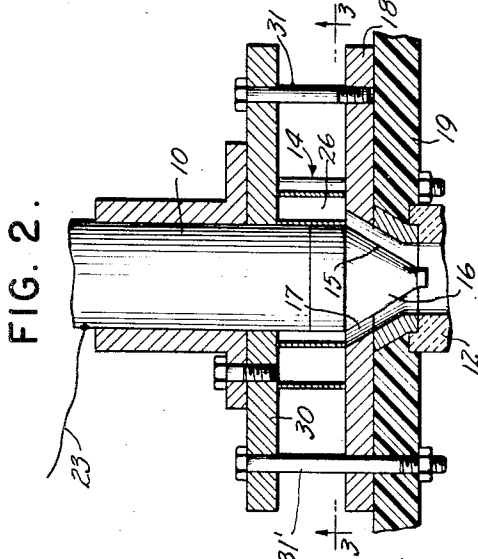
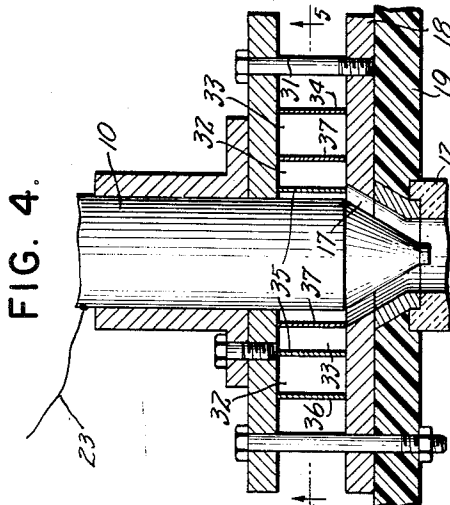
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2,769,079

HIGH-TEMPERATURE ELECTRIC TORCH

Filed Sept. 21, 1954



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HIGH-TEMPERATURE ELECTRIC TORCH

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14 Claims. (Cl. 219—75)

My invention relates to an improved high-temperature electric-arc torch construction, and the present disclosure incorporates certain refinements over those disclosed in copending patent application Serial No. 482,513, filed January 18, 1955, in the name of Dr. Alexander Rava.

It is an object of the invention to provide an improved torch construction of the character indicated.

It is another object to provide an electric-arc torch lending itself to the development of high heat intensities without too substantially elevating the temperature of the physical parts of the torch.

It is also an object to provide an improved torch construction wherein powdered material may be introduced into the gas stream without impairing swirling action in the gas stream.

It is a specific object to provide improved means for developing and maintaining swirling action in a gas stream in an electric-arc torch so as thereby to confine the arc path primarily to the center or axis of the arc chamber.

A further object is to provide a unit-handling gas-supply chamber for detachable assembly to a torch of the character indicated, whereby the same torch may be readily adapted to different uses by selective attachment of one of several such gas-supply chambers thereto.

Still another object is to provide means for the selective introduction of one or more gases independently and yet simultaneously into the gas-stream flow within an electric-arc torch, without promoting flow interaction between the separate gas flows.

Other objects and various further features of novelty and invention will be pointed out or will occur to those skilled in the art from a reading of the following specification in conjunction with the accompanying drawings. In said drawings, which show, for illustrative purposes only, preferred forms of the invention:

Fig. 1 is a simplified view in elevation, partly broken away and in section, and showing an overall torch construction in which my invention has been embodied;

Fig. 2 is an enlarged fragmentary vertical sectional view showing a gas chamber for supplying the torch of Fig. 1 and incorporating features of the invention;

Fig. 3 is a sectional view in the plane 3—3 of Fig. 2;

Fig. 4 is a view similar to Fig. 2 but showing a modification;

Fig. 5 is a sectional view in the plane 5—5 of Fig. 4; and

Fig. 6 is a fragmentary sectional view similar to Fig. 5 but illustrating further modification.

Briefly stated, my invention contemplates an improved gas-chamber construction, or rather an improved means for supplying gas under pressure, to the arc chamber of a torch of the character indicated. The invention features the supply of gas under pressure at an annular inlet to the arc chamber in the vicinity of the upstream electrode, and the arrangement is such that swirling action in the inlet gas is promoted and enhanced. Initial swirling action results from passage through an inlet gas conduit developed spirally about the upstream electrode and dis-

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charging tangentially into the annular passage communicating with the arc chamber. Gas velocity is increased with decreasing radius by having the conduit cross-section decrease to the point of discharge into the arc chamber.

Depending upon the particular applications, the inlet-gas conduit may comprise but a single passage, or separate passages, interlaced and converging to the same annular inlet to the arc chamber. With separate passages, it is possible to achieve selectively controlled introduction of two gases to be mixed only at or near the arc chamber, or gas-suspended powdered material may be conveyed for mixing with the main gas stream at or near the arc chamber. If desired, mixing openings through adjacent walls of the interlaced passages or conduits may promote preliminary mixing of gases or of powders before exposure to the arc chamber.

Referring to Figs. 1 to 3 of the drawings, my invention is shown in application to a torch of the character disclosed in greater detail in my copending application Serial No. 457,343, filed September 21, 1954. The torch may thus comprise an upstream electrode 10, spaced from a hollow downstream electrode 11 by an elongated passage 12 defining the arc chamber; electrode 11 may be of tungsten and water-cooled, as suggested by the jacket 11'. Gas may be introduced under pressure at an inlet 13 to a gas chamber 14 communicating with the arc chamber 12 at an annular inlet opening 15. In the form shown, opening 15 is defined between spaced frusto-conical surfaces, at 16 on the base of the upstream electrode 10, and at 17 in a plate 18 secured to frame means 19. The assembly may be retained with respect to a central frame 20, supported as by pin means 21 on a gimbal yoke 22 for flexible manipulation in use.

The process of starting the torch involves, first, supplying air or other gas at the passage 17 to the arc chamber 12, and then applying a strong electrical field, as by exciting leads 23—24 to the respective electrodes. Various means may be employed to establish a conductive path for initially striking the arc, as, for example, introducing ionized gas, radioactive material, conductive powder or the like, by way of the gas chamber 14. In operation, the electric discharge will maintain itself, once started, and if the gas supply is characterized by sufficient flow, a high-temperature projecting arc discharge will be created beyond the downstream end of the downstream electrode 11.

In accordance with the invention, I so contour the gas chamber 14 that swirling action is promoted to the utmost in the gas introduced under pressure at the upstream end of the arc chamber. If the inlet gas is admitted to the annular converging passage 17 in a tangential direction, the mere fact of the decreasing cross-sectional area of the passage 17 (in the direction of flow to the arc chamber) will accentuate swirling action. However, I prefer to employ further means to promote such swirling action and show, in Figs. 2 and 3, a single conduit 26 defined between spaced walls 27—28 and formed with an outer tangential inlet 29 for connection to suitable gas-supply means.

In the construction shown, the conduit 26 is further defined by spaced plates 18—30 and, therefore, the walls 27—28 need only be suitably contoured strips secured or sealed to the end plates 18—30. Bolts 31 may secure the walls 27—28 into a rigid assembly defining a radially inwardly converging spiral, so that vortex action of the inlet gas is promoted not only by the spiralling conduit, but also by the decreasing conduit cross-section. I prefer that the radial pitch or lead of the inner wall 27 shall be such as substantially circumferentially to distribute the discharge of inlet gas to the annular opening 17. In the form shown in Fig. 3, the discharge of inlet gas from the

conduit 26 extends for substantially the full circumference of the opening 17.

In Figs. 4 and 5, I show a modification in which two interlaced spiral conduits 32—33 constitute the gas chamber for admission of gas under pressure to the arc chamber 12. The separate conduits 32—33 may be defined in substantially the same manner as described for Figs. 2 and 3, except that, of course, additional strips are needed to establish the independence of the plural conduits 32—33. Thus, in Fig. 5 a first strip 34 defines the outer wall for one inlet conduit (33) until juncture with a second strip 35, defining the inner wall of the second conduit (32). Also, a third strip 36, defining the outer wall of the conduit 32, may extend to juncture with a fourth strip 37, defining the inner wall of the conduit 33. Once the two conduits 32—33 have overlapped, walls 35—37 may be common to both conduits. Both conduits 32—34 converge in cross-section in the direction of discharge into passage 17, and both substantially circumferentially overlap said passage 17, in order to promote smooth swirling action and minimum interaction between gases separately introduced by means of the separate conduits.

In Fig. 6, I show a slight modification of Fig. 5, in which one or more openings or perforations 38 between one or more walls (37) common to both conduits 32—33 may permit preliminary mixing of gases simultaneously introduced into the respective conduits 32—33, prior to introduction to the arc chamber.

The described construction will be seen to provide substantial promotion of swirling action in one or more gases introduced into the arc chamber. The intense swirling action is promoted at all times in the same direction and, therefore, with minimum interaction between separately introduced gases, thereby assuring maximum protection of the arc-chamber walls 12 from excessive heat development. I have particularly described my invention in language indicating that gases are separately introduced in the respective plural conduits or passages, but, of course, it will be understood that these gases may include suspensions of solid material or of ionized or radioactive material. In certain cases, it is convenient to employ selective on-off valve control for the flow in the respective plural conduits, whereby an ionized or otherwise conductive gas is initially introduced to the arc chamber, so as to establish the conductive path needed for starting the arc. Once the arc has been established, the conductive gas may be shut off and the torch allowed to operate solely on the basis of gas supplied in the other conduit. Alternatively, the conduit employed for ionized-gas introduction may be shifted by means of appropriate valve-control means (not shown) to accommodate the introduction of gas suspensions of powder to be heated along the length of the arc in the torch, as for spraying a surface to be coated.

Quite aside from the improved operation available from intensified swirl action, it will be noted that my gas-chamber construction is basically unit-handling. In other words, the gas chamber 14 of Fig. 2 may comprise a subassembly of plates 18—30 and strips 27—28, tied by bolts 31; this subassembly may be quickly detached, at bolts 31', from the base 19, thus permitting substitution of the gas chamber of Fig. 4 or any other special-purpose gas chamber.

While I have described the invention in detail for the preferred forms shown, it will be understood that modifications may be made within the scope of the invention as defined in the claims which follow.

I claim:

1. In an electric-arc torch, an upstream electrode, a hollow downstream electrode, an arc chamber defining a passage between said electrodes and electrically insulated therefrom, an inlet-gas chamber surrounding said upstream electrode and communicating with said arc chamber in the vicinity of said upstream electrode, there being an annular inlet opening between said gas chamber and

said arc chamber, and said gas chamber being internally contoured to create a swirling action in gas introduced into said chamber for conduct down such passage, and means for connecting an arc potential across said electrodes.

2. In an electric-arc torch, an elongated arc chamber defining a passage having an annular inlet at the upstream end thereof, said inlet being of progressively decreasing cross-sectional area in the direction of flow into said passage, whereby any swirling action of gas introduced at such inlet in accelerated and enhanced by virtue of the decreasing cross-sectional area, an upstream electrode concentric within said inlet, a hollow downstream electrode in said arc chamber and downstream from said inlet, gas-inlet means communicating tangentially with said annular inlet, and means for connecting an arc potential across said electrodes.

3. In an electric-arc torch, an upstream electrode, an arc chamber, and a hollow downstream electrode spaced by said chamber from said upstream electrode, said chamber being electrically insulated from said electrodes and having an annular inlet at said upstream electrode defined by concentric, radially spaced, axially overlapping, frusto-conical surfaces, whereby the cross-section of said inlet decreases in the downstream direction, means for separately and concurrently tangentially introducing separate gas flows into the upstream end of said annular inlet, and means for connecting an arcing potential across said electrodes.

4. In an electric-arc torch, of arc chamber of insulating material having an upstream inlet, an upstream electrode symmetrically positioned at said inlet, a hollow downstream electrode connected to the downstream end of said chamber, a gas chamber adapted to receive gas under pressure and internally contoured to develop a swirling action in gas flowing therein and having a discharge outlet communicating with said inlet, and means for connecting an arcing potential across said electrodes.

5. In an electric-arc torch, an arc chamber having an upstream inlet, an upstream electrode symmetrically positioned at said inlet, a hollow downstream electrode connected to the downstream end of said chamber, and a gas chamber surrounding said upstream electrode and adapted to receive gas under pressure, said chamber having a discharge outlet communicating with said inlet and being defined by walls converging spirally in the direction of flow into said inlet.

6. A torch according to claim 5, in which said gas chamber comprises two mutually isolated spiralling regions separately communicating with said inlet and converging in the direction of flow into said inlet.

7. A torch according to claim 6, in which said spiralling regions are radially interlaced.

8. A torch according to claim 7, in which adjacent walls of said regions have openings communicating between said regions at a location upstream from said inlet, whereby separate gases separately brought to the mixing region defined by said openings may be preliminarily mixed prior to discharge into said inlet.

9. In an electric-arc torch, a central upstream electrode, a hollow elongated arc chamber with means at the upstream end for supporting the same in spaced relation from said electrode, whereby an annular inlet opening at said electrode is defined, a hollow downstream electrode connected to the downstream end of said chamber, and a helically spiralling gas-supply conduit discharging into said annular opening and of progressively decreasing cross-section in the direction of flow to said inlet.

10. A torch according to claim 9, in which said conduit spirals radially inwardly for discharge into said inlet substantially at the location of minimum radius.

11. In an electric-arc torch, a central upstream electrode, two axially spaced opposed plates surrounding said electrode, one of said plates being radially spaced from said electrode and defining with said electrode an annular

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passage, an arc chamber communicating with said annular passage, annular electrode means in said chamber at a location downstream from said first-mentioned electrode, and inlet-gas supply means for said passage comprising two separately converging radially spaced strips extending axially between said plates and defining therebetween a converging conduit communicating with said passage at the inner radial limit thereof.

12. In an electric-arc torch, a central upstream electrode, two axially spaced opposed plates surrounding said electrode, one of said plates being radially spaced from said electrode and defining with said electrode an annular passage, an arc chamber communicating with said annular passage, annular electrode means in said chamber at a location downstream from said first-mentioned electrode, and inlet gas-supply means for said passage comprising three separately converging radially spaced strips extending axially between said plates and defining therebetween two converging gas conduits communicating with said passage at the inner radial limits thereof.

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13. A torch according to claim 12, in which the common wall between said conduits defined by an intermediate one of said strips is perforated near the discharge end thereof, whereby gas mixing may be promoted prior to discharge into the arc chamber.

14. An electric-arc torch, comprising an arc chamber, spaced electrodes in said chamber, annular gas-inlet means communicating with said chamber, and a unit-handling bodily detachable gas-supply chamber internally contoured to develop swirling action in gases passing there-through and communicating circumferentially with said gas-inlet means.

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