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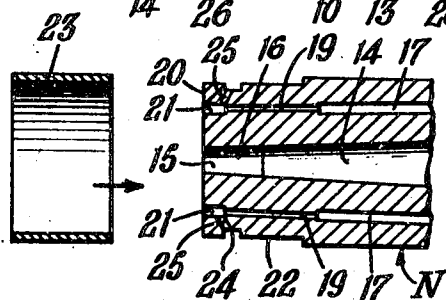
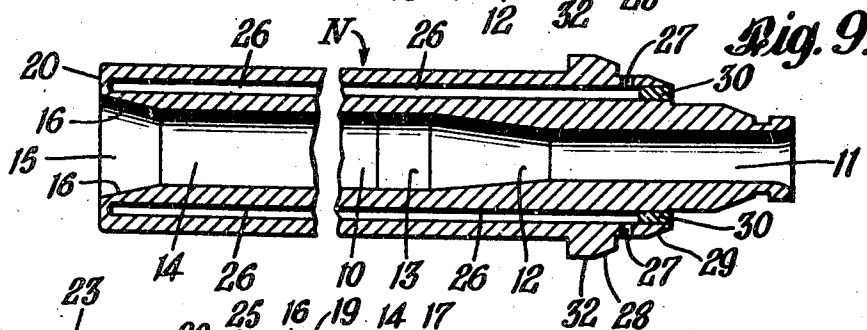
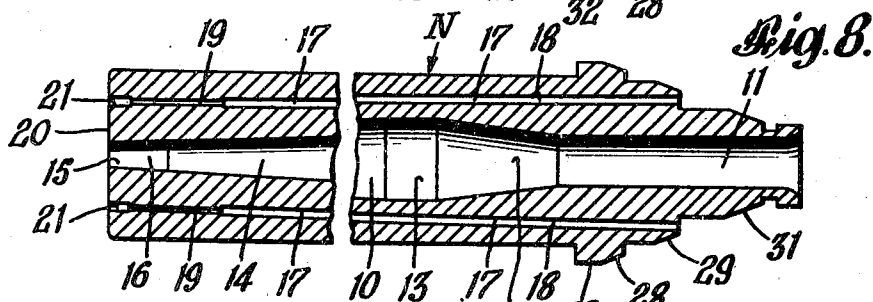
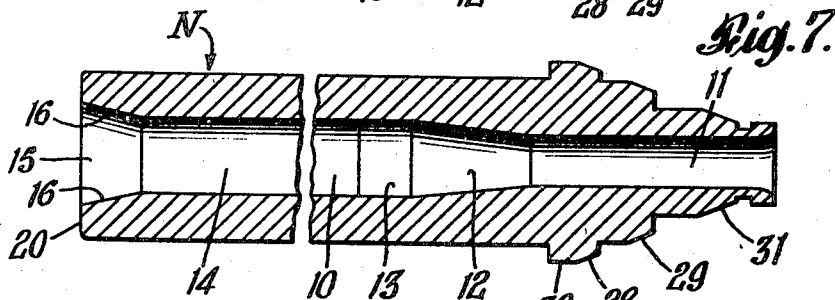
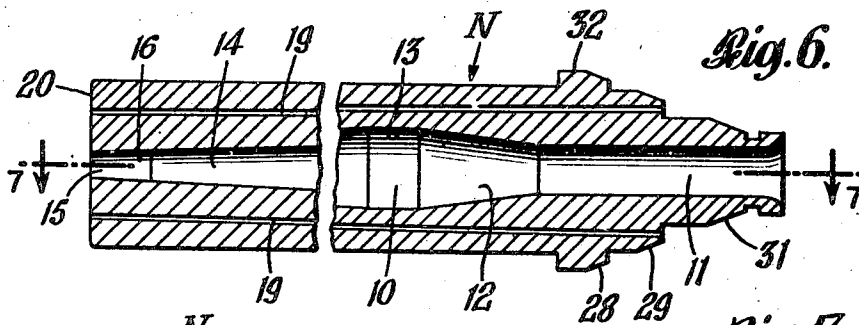
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BLOWPIPE NOZZLE

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BLOWPIPE NOZZLE

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This invention relates to blowpipe nozzles and more particularly to flame machining nozzles.

Above a red heat, iron combines with pure oxygen so rapidly that it actually burns. Thus, if a spot on a piece of iron or steel is heated to the kindling temperature, and a jet of oxygen directed at the heated spot, the iron will burn vigorously with the generation of heat. Although the result of such combination of iron and oxygen is the formation of iron oxide, a product that is solid at ordinary temperatures, the iron oxide melts at a temperature somewhat below the melting point of iron or steel. During flame machining, the heat generated by the burning iron is sufficient to melt the iron oxide so that it runs off as a molten slag, not only exposing more iron to the action of the oxygen stream, but also carrying away with it some iron that has become molten at the temperature of the operation, but which has not actually become oxidized. The result of this combination of circumstances makes it possible to flame machine iron and steel.

In flame machining, radiation at the surface, pieces of dirt, paint or scale on the metal, and the fact that heat is conducted away from the relatively cold metal beside the cut make it necessary for additional heat to be supplied or the reaction will stop. Therefore, the flame machining blowpipe nozzle is provided with a number of small orifices for oxy-fuel gas heating flames surrounding a central opening that supplies the oxygen stream. Such preheat flames are used to heat a spot on the work to a red heat. The machining operation is then started by opening a valve controlling the oxygen stream and directing such stream at the heated spot. The preheating flames remain burning while cutting is in progress to make up for the heat that is lost during the operation.

Flame machining includes cutting, gouging, and surface conditioning. Since flame cutting is based on a chemical reaction, the thickness of the metal to be cut imposes relatively little difficulty. Flame cutting thus provides a rapid and economical method for severing steel, wrought iron and cast iron. Special techniques have been developed for flame cutting cast iron and certain alloy steels as well as for certain special cutting operations such as removing rivets, preparation of plate edges for welding, and cutting heavy sections. Flame gouging provides a means for quickly and accurately removing a narrow strip of surface metal from steel plates, forgings, and castings. The principle of flame gouging is based on the fact that the nozzle is designed to deliver

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a relatively large stream of oxygen at low velocity. By proper manipulation of the nozzle, a smooth, accurately defined groove can be gouged out of the surface of the metal.

The removal of surface defects in steel during its manufacture is accomplished by a process which is quite similar to flame gouging. Such process is variously known as deseaming, scarfing, or conditioning. Generally, however, the term "deseaming," i. e., the removal of seams or cracks, is used when the operation is performed with a hand blowpipe. In such case, only those defects that are visible are removed. In mechanized steel conditioning the entire surface of the billet, bloom or slab is removed by a flame conditioning machine set into the rolling mill line. Such machine is adapted to remove thermochemically a thin layer containing surface defects from one, two, or all sides of the body simultaneously, the operation being performed while the metal is still hot and without interrupting the rolling operation. Secondary conditioning involving the removal of deeper defects may be performed by hand deseaming after the work has cooled down. It has been customary in the past to supply the preheating flames in flame machining with a fuel gas such as acetylene and a combustion-supporting gas such as oxygen, through a blowpipe or nozzle equipped with internal means for mixing such gases before the gas mixture is delivered to the nozzle or a mixed-gas passage in the nozzle. In any case the combustible gas mixture is highly explosive and such premixed blowpipe apparatus is subject to backfire and flashback. Either phenomenon is highly undesirable, because the internal passages of the apparatus become fouled with carbon in the case of backfire, and burned in the case of flashback, necessitating costly repair and dismantling of the entire apparatus for cleaning. A premixed flame or nozzle is one wherein the combustible mixture for the flame is formed by mixing a fuel gas and a combustion-supporting gas before these gases are discharged from a nozzle.

In order to overcome such difficulty it has been proposed in the past to mix the fuel gas and combustion-supporting gas externally of the nozzle to form post-mixed preheating flames. A post-mixed flame or nozzle is one wherein the combustible mixture for the flame is formed by mixing a fuel gas and a combustion supporting gas substantially upon discharge or after these gases are discharged from a nozzle. However, post-mixed nozzles which have been made in the past, especially nozzles for flame machining, are diffi-

cult and expensive to manufacture, because of the accuracy with which the various passages must be formed, and the exact relation which they must have with respect to each other. In other types of proposed flame machining nozzles which depend upon the post-mixed principle, the flame pattern is not entirely satisfactory, because the preheat flame becomes dispersed and the acetylene tends to fan out so as to become fairly ineffective. Another disadvantage of prior post-mixed nozzles is present by virtue of the fact that it is possible to force oxygen back into the acetylene discharge passages. This happens, for example, when a piece of slag or scale plugs up the end of the nozzle. It is also possible, when the oxygen flow is great enough, to cause a pressure on the external opening of the preheat orifice which is greater than the acetylene pressure. It can be readily understood that this causes a burning back or flashback in the acetylene supply passages. It has also been found that a soft carbon deposit is formed on the seats of some prior post-mixed nozzles which causes such nozzles to plug up and become ineffective.

The main objects of this invention are to provide an improved blowpipe nozzle which overcomes the difficulties and disadvantages of the prior art, which nozzle is adapted to be used efficiently for scarfing, cutting, gouging and similar functions involving the thermochemical working or machining of ferrous metals and the like with oxy-fuel gas flame and oxygen, such improved nozzle being simple and economical to manufacture, not subject to flashback or backfire, readily separable for internal cleaning, and remaining clean internally notwithstanding severe usage at high temperatures.

According to the invention, a blowpipe nozzle is provided which may be adapted for cutting as well as desurfacing or descaling, in which flashbacks and backfires of the preheating flames are inhibited by introducing the preheat oxygen at an inclination to the wall of a recess or counterbore through which the fuel gas is discharged. The dimensions of such recess are critical, being such that burning of the mixed gases takes place at the extreme outlet of the recess.

More particularly, there is provided according to the invention a desurfacing nozzle having an axial oxidizing gas discharge passage, a group of acetylene discharge passages disposed on each side of such oxidizing gas passage in arcs concentric with the longitudinal axis of the nozzle and terminating in counterbores the depth of which is of the order of twice the diameter thereof. The cross-sectional area of each counterbore is of the order of twice that of the acetylene discharge passage. Each counterbore is provided with a relatively short inclined preheat oxygen discharge passage terminating in the side wall adjacent the bottom of the counterbore. Communicating with the preheat oxygen discharge passages is an annular preheat oxygen distributing channel or passage to which preheat oxygen is supplied by a pair of preheat oxygen supply passages which extend longitudinally of the nozzle. A removable cover is provided for the preheat oxygen distributing channel, providing ready access to such channel and all of the preheat oxygen discharge passages.

In the accompanying drawing:

Fig. 1 is a fragmentary longitudinal cross-sectional view taken on line 1—1 of Fig. 3 of a desurfacing blowpipe nozzle exemplifying the invention;

Fig. 2 is a similar view of the nozzle taken on line 2—2 of Fig. 3;

Fig. 3 is a view in front end elevation of the nozzle;

Fig. 4 is a cross-sectional view taken on line 4—4 of Fig. 1;

Fig. 5 is a rear elevational view of the nozzle, a portion of which is broken away and shown in cross section;

Fig. 6 is a longitudinal cross-sectional view of a conventional premixed oxy-fuel gas preheat descaling nozzle;

Fig. 7 is a view in longitudinal section taken on line 7—7 of Fig. 6;

Fig. 8 is a view similar to Fig. 6 of the nozzle after the preheating gas passages have been modified;

Fig. 9 is a view similar to Fig. 7 after the two longitudinal preheating oxygen passages have been formed in the nozzle; and

Fig. 10 is a fragmentary view similar to Fig. 8, showing the discharge end portion of the nozzle after the annular recess, the preheat oxygen distribution channel, and the inclined preheat oxygen outlet passages have been formed, and a cross-sectional view of the cover about to be telescoped in position on the nozzle.

Referring to the drawings, a nozzle N is shown which comprises an elongated body of metal, such as copper, the surface of which may be chromium plated if desired. Extending longitudinally through the nozzle N is a cutting oxygen or oxidizing gas passage 10 composed of an inlet section 11 of constant diameter, a frusto-conical section 12, a relatively short medial section 13 of constant diameter larger than that of said inlet section 12, a section 14 the cross-section of which changes gradually from circular to oblong shape, and an outlet section 15 having flared side walls 16, 16. The oxidizing gas passage 10 thus is adapted to discharge a characteristic stream of cutting oxygen which is suitable for descaling, desurfacing, scarfing, and the like. The shape of the oxygen discharge passage 10 may be changed, as desired, depending upon the work to be done.

In suitable arcs, concentric with the longitudinal axis of the nozzle N, above and below the oxidizing gas passage 10, a plurality of longitudinally extending fuel-gas passages 17 are provided in the nozzle N. Each fuel-gas passage 17 is composed of a relatively long inlet section 18 of constant diameter, and a relatively short outlet section 19 of substantially smaller constant diameter than that of the inlet section 18. By way of example, the inlet section 18 may be made with a No. 54 drill (0.055 inch in diameter), and the outlet section 19 with a No. 59 drill (0.041 inch in diameter). The end face 20 of the nozzle N is counterbored to provide a separate recess 21 in axial alignment with each of the fuel-gas passages 17. Where the fuel-gas discharge passage 19 is made with a No. 59 drill, the recess 21 is preferably made with a No. 54 drill, the depth of the recess being of the order of twice the diameter thereof, in this case, of the order of $\frac{3}{4}$ inch deep, since $\frac{3}{4}$ equals 0.0937, and 2 times 0.055 equals 0.110. The cross-sectional area of the recess 21 is of the order of twice that of the acetylene discharge passage 19.

A peripheral recess 22 of constant diameter extending rearwardly from the end face of the nozzle 20 is provided for receiving a ring or sleeve 23 which may be press-fitted in place, the rear edge of the ring engaging the shoulder provided by the recess 22 to prevent rearward displacement

of the ring when the nozzle is in use. Such ring constitutes a removable cover for an annular preheat oxygen distribution passage or channel 24 in the periphery of the nozzle N in the area of the recess 22. Extending from the channel 24 to the side wall of each recess 21 and adjacent the bottom thereof, is a slightly inclined preheat oxygen discharge passage 25. All of the passages 26 communicate with the channel 24.

Preheat oxygen is supplied to the annular channel 24 by at least two longitudinally extending preheat oxygen supply passages 26 which are disposed along opposite sides of the longitudinal axis of the nozzle N. These passages, in the illustrated example, are preferably made with a No. 42 drill. Radial inlets 27 of the same diameter are provided between frusto-conical seats 28 and 29 for feeding preheating oxygen to the inlet ends of the passages 26, the end portions of the passages 26 being hermetically sealed by plugs 30.

Thus, fuel gas, such as acetylene, may be fed to the inlet ends of the fuel-gas supply passages 17 between the frusto-conical seat 29 and a frusto-conical seat 31. Cutting oxygen is delivered to the inlet end of the oxidizing gas passage 10 by any suitable connection.

In operation, preheat oxygen and acetylene are delivered to the passages 26 and 17, respectively, at suitable pressures, so that the recesses 21 discharge streams of combustible gas mixture composed of oxygen and acetylene, which streams, when ignited, produce work-preheating flames of high efficiency. The nozzle N is positioned so that such oxy-acetylene flames heat the work to the ignition temperature, whereupon oxygen is supplied to the oxidizing gas passage 10 of the nozzle, being discharged from the nozzle at a suitable velocity for thermochemical reaction with the heated work. The nozzle N is then moved with respect to the surface of the work so as to thermochemically condition or remove a layer of surface metal therefrom in the usual way.

The preheat flames of the present nozzle simulate those of a standard premixed type of nozzle, but such flames do not have the unsatisfactory flame pattern produced by prior post-mixed nozzles. Prior post-mixed nozzles do not work satisfactorily on high alloy steels due to the lack of preheat. When it is necessary to increase the oxygen flow through such prior post-mixed nozzles, the preheat flame becomes dispersed and the acetylene fans out so as to become fairly ineffective. With the nozzle of the present invention, however, the preheat flame pattern may be adjusted to conform to any satisfactory arrangement.

Furthermore, some prior post-mixed nozzles have another disadvantage in that it is possible to force oxygen up the acetylene orifices. This is possible when a piece of slag or scale plugs up the end of the nozzle. It is also possible when the oxygen flow is great enough to cause a pressure on the external opening of the preheat orifice which is greater than the acetylene pressure. It can be readily understood that this causes a burning back in the acetylene supply. It has been further found that a soft carbon deposition is left on the seats of some prior post-mixed nozzles which causes them to plug up.

Although, in the present nozzle, which may be designated an open mixed nozzle to distinguish it from prior post-mixed nozzles, no carbon is deposited at any point in the nozzle, it can be readily seen that should such condition occur, the carbon may be removed by simply drilling it out, 75

as would be the case should slag adhere to the nozzle. Due to the velocity of the gases discharged from the preheat passages, the deposition of carbon is inhibited as is any tendency of the passages to become plugged with slag. Still further, there is no possibility of preheat oxygen being forced back up the acetylene discharge passages because the preheat oxygen and acetylene are supplied at very nearly equal pressures.

The depth of the counterbores or recesses 21 constituting the preheat orifices in the front end of the nozzle N is very important. If such counterbore is too deep, the preheat acetylene and oxygen tend to burn within the counterbore and cause overheating of the nozzle. In the preferred example, it is necessary to limit such counterbore to a depth of $\frac{1}{2}$ inch since this just permits the burning of the mixed gas at the extreme outlet of the counterbore. The cross-sectional area of each of the heating flame recesses is also critical, being less than that of the sum of the cross-sectional areas of the preheat oxygen and acetylene discharge passages 25 and 19, but greater than the cross-sectional area of either one of such two passages. The cross-sectional area of the recess 21 should be of the order of twice that of the fuel-gas discharge passage 19 for good results.

Nozzles may be made embodying the principles of this invention, by converting a standard premixed type of nozzle having standard preheat drillings, to the present type. This may be accomplished by a back drilling with a No. 54 drill and a front drilling with a No. 59 drill to form the inlet section 18 and outlet section 19, respectively, of the fuel-gas passages 17. The preheat oxygen supply passages 26 are drilled through their entire length with the largest size drill permissible without damaging the seat 29, which in the present example is a No. 54 drill. Such two drilled holes 26, which are used for the preheat oxygen, are closed adjacent the seat 29 with plugs 30. The cross drillings 27 are then made 180° apart with a No. 54 drill between the preheat seating surface 29 of the nozzle N and a nozzle nut ring or flange 32. The front ends of the remaining open preheat drillings 19 are then counterbored with a No. 54 drill, to a depth of the order of $\frac{1}{2}$ inch, to provide the recesses 21. The nozzle is turned down to provide the annular recess 22 and the channel 24. The preheat oxygen discharge passages 25 are then made with a No. 60 drill so as to join the preheat oxygen distribution channel 24 with each of the ten preheat flame recesses 21. All exterior holes are then plugged with copper. Any suitable block or head may be used to deliver preheating oxygen and acetylene, as well as the cutting oxygen, to their respective inlets at the rear end of the nozzle.

The cover 23 for the annular preheat oxygen distribution passage 24 is preferably in the nature of a slip ring or sleeve which is adapted frictionally to engage the annular recess 22 at opposite sides of the channel 24 so as to prevent any leakage of the preheat oxygen. It is not necessary to solder or weld such ring to the nozzle, it being preferably press-fitted in place. The preheat oxygen orifices or passages 25 are preferably large enough to permit the passage of enough oxygen to produce a neutral flame. The length and diameter of the preheat flames are dependent upon the diameter of the counterbores 21.

The open mixed nozzle of the present invention has a great many advantages over prior post-mixed nozzles. Such advantages include the novel method of introducing preheat oxygen to

the flame end of the nozzle. This makes it easier to manufacture the nozzle than prior post-mixed nozzles, and provides a nozzle the internal passages of which can be readily cleaned. It will be understood that this advantage is equally applicable to cutting nozzles, as well as desurfacing nozzles. The recessed flame ports 21 require less precision from a manufacturing standpoint than where the oxygen and acetylene ports intersect at a surface of the nozzle as in prior post-mixed nozzles. Nozzles of the present invention also have substantially the same operating characteristics as premixed nozzles, without being subject to backfire or flashback difficulties.

The shape of the oxidizing gas passage may be changed to adapt the stream of oxygen discharged from the nozzle for any desired use, such as cutting or gouging, or such passage may be omitted in which case one or any number of the oxy-fuel gas flames may be used for welding or any other function involving high temperature flames.

What is claimed is:

1. A flame machining blowpipe nozzle having an end face, a work oxidizing gas discharge passage terminating in said end face, a work preheating flame recess spaced from said oxidizing gas discharge passage in said end face, a fuel gas discharge passage terminating in the bottom of said recess, and a combustion-supporting gas discharge passage terminating in the side wall of said recess adjacent the bottom of said recess, the shape of said recess being such that, when fuel gas and combustion-supporting gas are discharged into said recess from said fuel-gas and combustion-supporting gas discharge passages, a highly combustible gas mixture is formed within and discharged in the form of a stream from said recess, such stream, when ignited, being adapted to produce a work preheating flame which is not subject to flashback or backfire, said recess having an annular side wall concentric with a prolongation of the longitudinal axis of said fuel-gas discharge passage, the cross-sectional area of said recess in a plane at right angles to said axis being equal to a value which is less than the sum of the cross-sectional areas of said fuel-gas discharge passage and said combustion-supporting gas passage, but greater than the cross-sectional area of either one of such two passages, being of the order of twice that of the fuel-gas discharge passage, and the depth of said recess being of the order of twice the diameter of said recess.

2. A flame machining blowpipe nozzle having an end face, a work oxidizing gas discharge passage terminating in said end face, a plurality of work preheating flame recesses spaced from and disposed about said oxidizing gas discharge passage in said end face, a fuel-gas discharge passage terminating in the bottom of each recess, and a combustion-supporting gas discharge passage terminating in the side wall of each recess adjacent the bottom of said recess, the shape of each recess being such that, when fuel-gas and combustion-supporting gas are discharged into said recess from the fuel-gas and combustion-supporting gas discharge passages, a highly combustible gas mixture is formed within and discharged in the form of a stream from said recess, such stream, when ignited, being adapted to produce a work preheating flame which is not subject to flashback or backfire, each recess having an annular side wall concentric with a prolongation of the longitudinal axis of the fuel-gas discharge passage, the cross-sectional area of each recess in a plane at right

angles to said axis being of the order of twice the cross-sectional area of said fuel-gas discharge passage, and the depth of each recess being of the order of twice the diameter of such recess.

3. A blowpipe nozzle having an end face, an annular combustion-supporting gas distribution passage, a plurality of combustion-supporting gas supply passages communicating with said gas distribution passage, a plurality of recesses in said end face, a separate fuel-gas discharge passage terminating in the bottom of each recess, a separate inclined combustion-supporting gas discharge passage communicating with said gas distribution passage and terminating in the side wall adjacent the bottom of each recess, and a work-oxidizing gas discharge passage terminating in said end face, each recess being adapted to discharge a stream of combustible gas mixture composed of fuel gas and combustion-supporting gas, which streams, when ignited, produce work heating flames adapted to cooperate with the work-oxidizing gas discharged from said work-oxidizing gas discharge passage, each recess having a depth and a diameter such that flame flashback and backfire are prevented, the cross-sectional area of each recess being less than the sum of the cross-sectional areas of the fuel-gas passage and combustion-supporting gas passage, and greater than the cross-sectional area of either one of such two passages, and the depth of each recess being of the order of twice the diameter of such recess.

4. A blowpipe nozzle having an end face, an annular combustion-supporting gas distribution passage, a plurality of combustion-supporting gas supply passages communicating with said gas distribution passage, a plurality of heating flame recesses in said end face, a separate fuel gas discharge passage terminating in the bottom of each recess, a separate inclined combustion-supporting gas discharge passage communicating with said gas distribution passage and terminating in the side wall adjacent the bottom of each recess, each recess being adapted to discharge a stream of combustible gas mixture composed of fuel gas and combustion-supporting gas, which streams, when ignited, produce heating flames, each recess having a depth and a diameter such that flame flashback and backfire are prevented, the cross-sectional area of each recess being less than the sum of the cross-sectional areas of the fuel-gas passage and combustion-supporting gas passage, and greater than the cross-sectional area of either one of such two passages, and the depth of each recess being of the order of twice the diameter of such recess, and a removable cover for said annular combustion-supporting gas distribution channel comprising a ring embracing the periphery of the nozzle.

5. A blowpipe nozzle having an end face, an open recess in said end face, a fuel-gas discharge passage terminating in the bottom of said recess, and a combustion-supporting gas discharge passage terminating in the side wall adjacent the bottom of said recess, the cross-sectional area of said recess being of the order of twice that of said fuel-gas discharge passage, and the depth of said recess being of the order of twice the diameter of said recess.

6. A blowpipe nozzle having an end face, an open recess in said end face, a gas-discharge passage terminating in the bottom of said recess, and a gas-discharge passage terminating in the side wall adjacent the bottom of said recess, the cross-sectional area of said recess being of the order of twice that of said first-named discharge passage,

and the depth of said recess being of the order of twice the diameter of said recess, and gas-supply passage means for conducting oxygen to one of said gas-discharge passages and acetylene to the other of said gas-discharge passages, so that the oxygen and acetylene mix in said recess to form a combustible oxy-acetylene gas stream which, when ignited, produces a flame that is not subject to either backfire or flashback.

7. A blowpipe nozzle for cutting or descaling metal members, such nozzle comprising an elongated body having a longitudinal cutting or descaling oxygen passage provided with a discharge orifice in one face of said body, said body having a group of relatively short recesses arranged substantially parallel to the axis of said orifice and providing combustible mixture outlets in said face to produce oxy-fuel gas preheating flames substantially parallel to the cutting or descaling oxygen stream discharged from said orifice, fuel gas passages in said body having the discharge ends thereof severally opening axially into said recesses and of smaller cross-sectional area than said recesses, and combustion-supporting gas passages in said body severally opening into said recesses between said discharge ends of the fuel

gas passages and said outlets of the recesses, each gas discharge recess thus being provided with one central fuel gas inlet and one lateral combustion-supporting gas inlet.

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