Nov. 5, 1940. H. W. JONES ET AL 2,220,245

BLOWPIPE

Filed Sept. 23, 1937 3 Sheets-Sheet 1

Fig. 1.

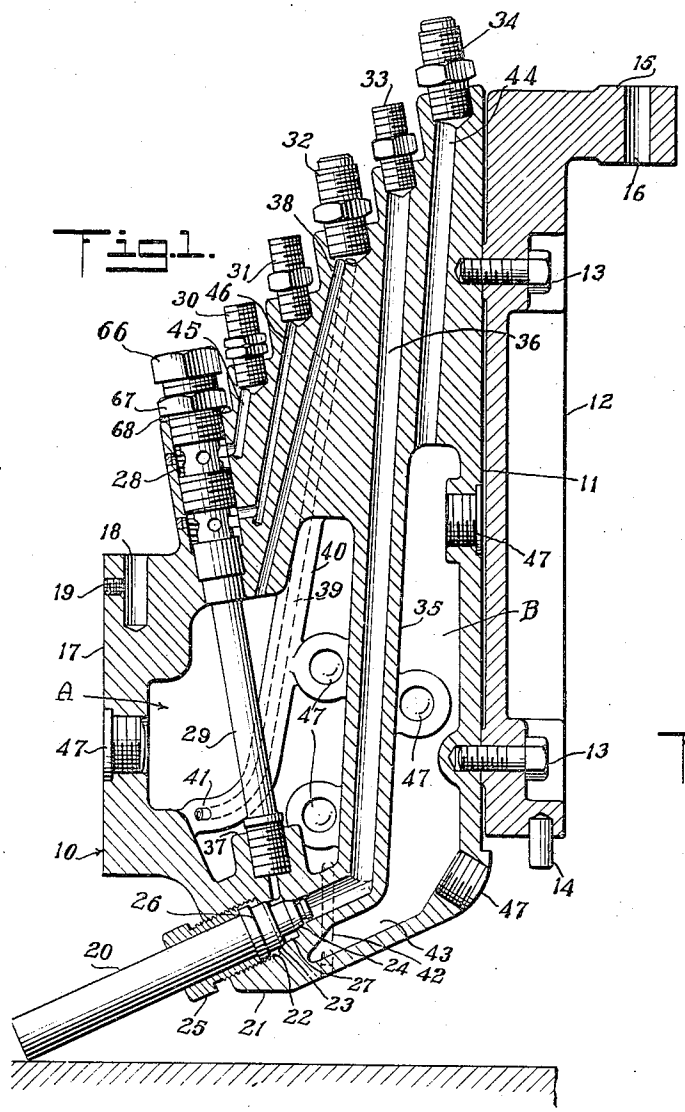


Fig. 2.

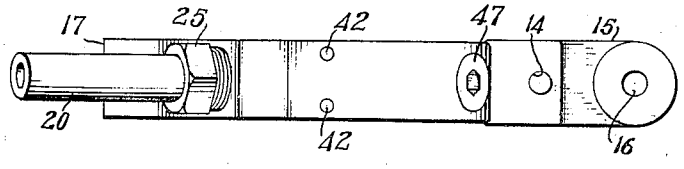
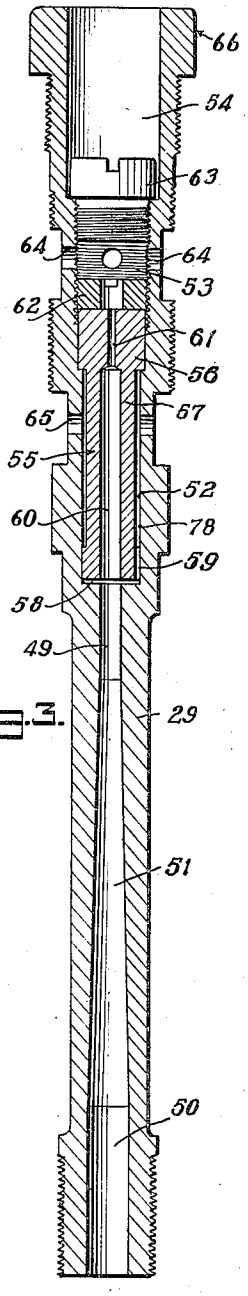


Fig. 3.



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Fig. 4.

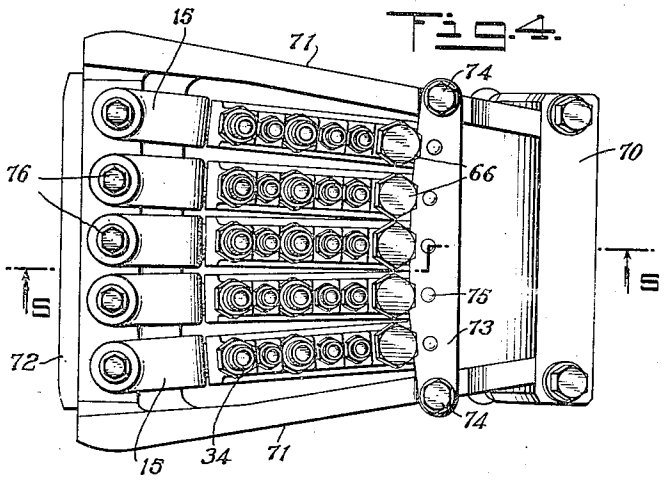
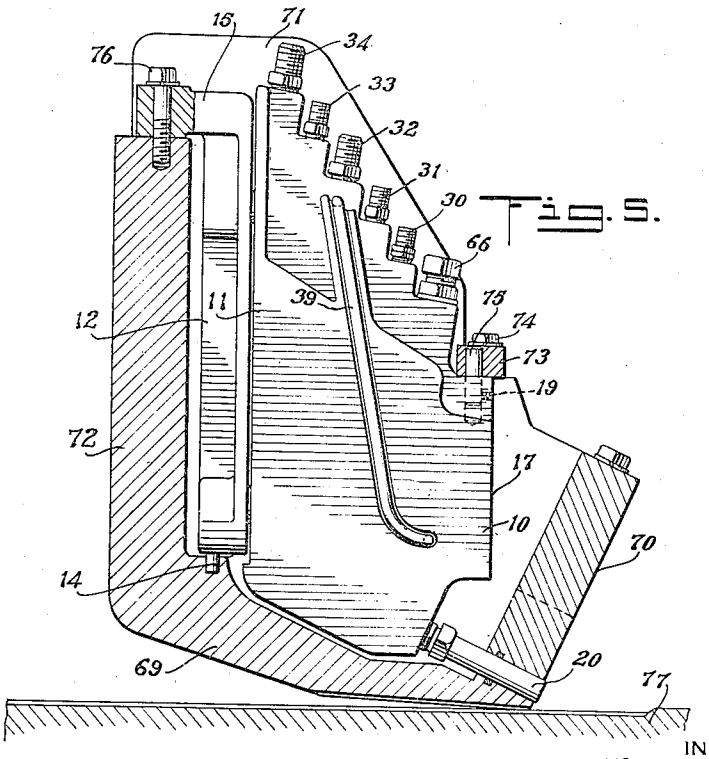


Fig. 5.



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Fig. 6.

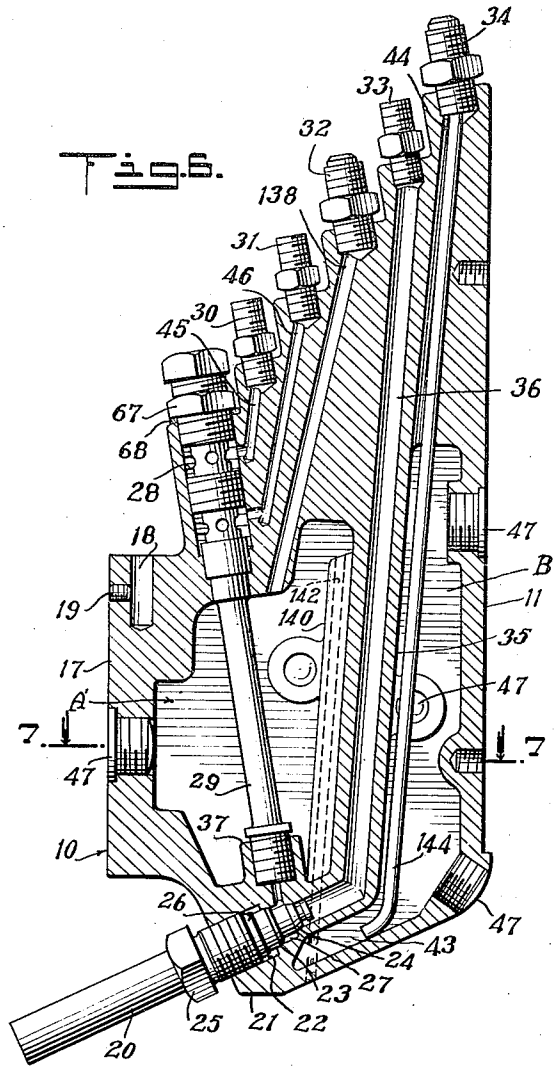
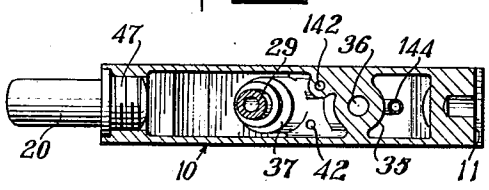


Fig. 7



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UNITED STATES PATENT OFFICE

2,220,245

BLOWPIPE

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Application September 23, 1937, Serial No. 165,264

10 Claims. (Cl. 158—27.4)

This invention relates to blowpipes, and particularly to blowpipes for thermo-chemically removing surface metal from either hot or cold metal bodies such as steel slabs, blooms, and billets.

The principal objects of the present invention are to provide blowpipes for applying oxidizing gas streams and heating flames to surface metal which is to be removed from metal bodies, which blowpipes are transversely narrow so that a plurality of such blowpipes may be arranged in a row with their nozzles closely adjacent each other; which are also relatively short and compact; which are highly resistant to flashback; which have gas passages for conducting gas to the nozzle and cooling liquid chambers adjacent the gas passages with cooling liquid inlets and outlets so arranged that air or gas is vented therefrom when the blowpipe is in any position; which are provided with a unitary, quickly removable device for mixing combustible gas and combustion supporting gas and supplying the resulting mixture to the heating flame passages of the nozzle; and which are provided with means for supporting and mounting in a desired angular relation to adjacent blowpipes in a multiple blowpipe holder and protector.

The above and other objects and the novel features of the invention will become apparent from the following description in connection with the accompanying drawings, in which:

Fig. 1 is a sectional view of a blowpipe constructed according to the present invention, the section being taken through the principal medial plane of the blowpipe;

Fig. 2 is a bottom view of the blowpipe;

Fig. 3 is an enlarged longitudinal sectional view of the heating gas mixing and supplying device of the blowpipe;

Fig. 4 is a plan view of a row of the blowpipes mounted in a holding and protecting shoe;

Fig. 5 is a view of a section taken on the line 5—5 of Fig. 4 showing a blowpipe in position in the shoe;

Fig. 6 is a section of a blowpipe similar to that shown in Fig. 1 but having a different arrangement of passages for conducting cooling water; and

Fig. 7 is a view of a cross section taken on the line 7—7 of Fig. 6.

In steel rolling mill operations, the ingots, from which billets, blooms, slabs, and other steel shapes are rolled, have surface imperfections, such as cracks, scabs, and the like, which are rolled into the metal. It has been found advantageous to eliminate such defects by thermochemically removing, between rolling operations, a layer of surface metal from the metal bodies. Such surface metal removal is accomplished by impinging a number of adjacent oxygen streams extending in a row transversely across the entire surface thereof. The streams are directed obliquely on the surface toward surface portions to be removed and are advanced longitudinally at a desired uniform rate of speed toward succeeding portions of preheated surface metal to be removed. The oxygen streams react thermo-chemically with the portions of surface metal that have been heated to the ignition temperature, the products of the reaction being a metal oxide in the form of a liquid slag that is mixed with metal that has been melted by the heat of the reaction. The slag is washed ahead of the oxygen streams onto the succeeding surface portions to be so removed to which it imparts heat and assists the preheating gas in raising such metal to the ignition temperature so that the reaction can proceed faster and with greater efficiency of metal removal. Each oxygen stream produces a shallow channel on the surface, the row of streams producing contiguous parallel channels with low ridges between.

To reduce the ridges, which might contain an incompletely removed defect, the oxygen streams are caused to overlap and it has been found that despite the overlapping, the efficiency of metal removal is greater than that obtained with a single stream. To still further reduce the height of the ridges with increased efficiency, it is desirable that the oxygen streams be smaller in diameter and still closer together in the row, more streams being used to span a given width of surface. It has also been found that the height of the ridges are reduced if the streams in the row are oriented at small lateral angles toward each other. Such orientation is preferably toward the central stream or streams of the row so that the slag wave is maintained centrally ahead of the streams for greater efficiency, although in some instances it may be desirable to orient the streams all to one side and thus project the slag away from a previously conditioned surface.

According to the present invention, a blowpipe is provided which, when mounted with others in a row, permits the oxygen streams projected by the blowpipes to be arranged relatively close together and at a desired angular relation to each other, and also permits the use of a greater num-

ber of smaller streams for desurfacing a given width of surface.

Since it is also desirable to desurface two sides or all sides of a billet simultaneously when passing from one roll stand to another at the hot rolling temperature, the streams are applied on the side surfaces and bottom surface as well as on the top surface of the billet. The blowpipe, according to the present invention therefore, is constructed to operate in any position between and including the upright and upside down positions. In any of these positions, the blowpipe is efficiently cooled by cooling fluid to protect it against the effects of the high temperature reaction and the heat of the billet.

The blowpipes of the present invention are also highly resistant to flashback. This is an important advantage where many blowpipes are operated simultaneously, for any tendency to flashback is multiplied by the number of blowpipes in use and a flashback in any one blowpipe makes it necessary to stop the operation of all the blowpipes until the condition is corrected, thus seriously interfering with the desurfacing operation.

Referring now to the drawings and particularly to Fig. 1, the blowpipe comprises a unitary body 10, preferably of cast metal. The body is wide in the principal plane through which the section is taken but relatively very narrow in a direction perpendicular to this plane. The two side walls of the body are substantially flat and parallel to the principal plane. The peripheral edge portions of the body are therefore narrow. The rear narrow edge portion 11 is straight and relatively long and has secured thereto a mounting bracket 12 by means of two cap screws 13. A pin 14 depends from the lower end of the bracket, while the upper end of the bracket is provided with a rearwardly extending arm 15 provided with a hole 16 for securing the blowpipe to a holder. The forward edge 17 of the blowpipe is parallel to the rear edge but much shorter. The upper end of the forward edge is provided with a drilled hole 18 adapted to receive a mounting pin, a small threaded hole being also provided for receiving a set screw 19 for locking the mounting pin in place.

The nozzle 20 of the blowpipe is secured to an angular projection 21 of the bottom of the body. This projection has a forward edge sloping obliquely toward the rear and a bottom edge substantially perpendicular to the forward edge and sloping upwardly to the rear edge. The nozzle is secured within a bore 22 having two successively smaller conical seating surfaces 23 and 24. The bore 22 is threaded to receive a ring-shaped nut 25 which bears against a collar 26 formed on the nozzle. The nozzle 20 is provided with two corresponding conical seating surfaces seating against the surfaces 23 and 24, an annular chamber 27 being provided between the seating surfaces 23 and 24. The axis of the nozzle 20 is arranged to make a desired oblique angle with the horizontal work surface. This angle is selected to lie between the values of 10° and 35° and is chosen to give the desired groove or channel with predetermined correlated values of gas velocity and speed of advance of the blowpipe.

The upper edge of the body is provided with a series of six steps rising from the forward edge to the rearward edge. A relatively large bore hole 28 extends downwardly from the top of the first step and inclines so that its axis intersects with the axis of the nozzle bore 22 at a point between the seats 23 and 24. The bore 28 is threaded for a substantial distance downward for engagement with the external thread of a gas mixing device 29 disposed therein. Each of the other five steps have threaded tube connections projecting from their upper faces. Thus, the second step is provided with a connection 30 which receives a supply of fuel gas, such as acetylene. The third step has a connection 31 for receiving oxidizing gas to be mixed with the fuel gas for providing the heating flame. The fourth step has a connection 32 which provides an inlet for the cooling fluid or cooling water. The fifth step has a connection 33 for receiving the supply of desurfacing oxygen. The last step is provided with a connection 34 for conducting water away from the blowpipe.

Within the interior of the body are formed two cooling chambers A and B divided by a thick wall of metal 35. A drilled passage 36 passes lengthwise through the wall 35 and connects the connection 33 directly with the central opening of the nozzle 20. The chamber A completely surrounds the discharge portion of the mixing device 29 which is threadedly secured to a boss 37 in the bottom of the chamber A. Two passages are provided to conduct water from the connection 32 to the chamber A. One passage 38 is drilled through the metal from connection 32 and enters into the chamber A in a direction to project water diagonally against the surface of the mixing device 29. The other passage is formed by a tube 39 which lies in a groove cast in one outside wall of the body, the adjacent wall of chamber A having a ridge 40 to provide a metal wall around this groove. The upper end of the tube 39 passes through a hole drilled into the side wall of the fourth step and into the bore in which connection 32 is secured. The lower end of the tube 39 passes through a hole 41 drilled through the side wall of the chamber A. The hole 41 is drilled at a forwardly directed angle so that the water introduced by tube 39 is projected toward the front wall of the chamber adjacent the nozzle 20. The ends of the tube 39 are secured to the side wall of the body in a water-tight manner by sweating or hard soldering.

The water led into chamber A passes over into chamber B through two holes 42 which are bored up through the partition 35 on both sides of the passage 36. The holes 42 intersect the forwardly extending lower end 43 of the chamber B, thus providing communication between the two chambers. The external ends of the passages 42 are sealed to prevent escape of water. Leading from the upper end of the chamber B to the connection 34 is a drilled passage 44. The water therefore flows out of chamber B through passage 44 and connection 34. A drilled passage 45 conducts the acetylene from connection 30 to the upper inlet of the mixing device 29. A similar drilled passage 46 conducts the heating oxygen from the connection 31 to the lower side inlet of the mixing device 29. The chambers A and B are preferably provided with suitable openings normally sealed by threaded plugs 47 which may be removed when it is desired to clean out any solid matter that may collect in the chambers during operation or to clean out chips during manufacture. Three such plugged openings located at suitable places in the walls of each chamber are provided. The plugs 47 are preferably of the headless variety.

The unitary removable mixing device 29, shown in detail in Fig. 3, has a central passage

bored axially therethrough. The axial passage is provided with a centrally disposed narrow throat portion 49 and a larger lower end portion 50. The portion 51 connecting the portions 49 and 50 is tapered having a small included angle and forms with the throat 49 a mixing or combining tube. Above the throat 49 there are three portions 52, 53, and 54 substantially equal in length but increasing successively in diameter, there being square shoulders at each junction between the portions. A mixing element 55 is disposed within the bores 52 and 53. The element has a head 56 in bore 53 which rests on the shoulder between bores 52 and 53. The mixing element is provided with a long shank portion 57 extending down through the bore 52 to a point very close to the bottom of the bore 52. The forward end of the shank 57 is a plane surface 58 transverse to the axis of the mixing element. A series of radial projections 59 are provided at the forward end of the shank to center it accurately in the bore 52. The mixing element is provided with an axial passage therethrough whose forward and longest portion has a diameter substantially equal to the diameter of the throat 49, the portion 61 of the bore 60 which passes through the head 56 being of a smaller size to provide a metering orifice for restricting the flow of gas therethrough to a desired rate. An externally threaded locking ring 62 is provided for engaging with the threads of the bore 53 and contacting with the end of the head 56. A threaded plug 63 seals the end of the bore 53. Four radial holes 64 through the side wall of the mixing device are provided to admit fuel gas to the space between the plug 63 and the ring 62. Similarly, four oxygen inlets 65 through the side wall of the mixing device connect with the space 78 surrounding the shank 57 of the mixing element below the head 56. The lower end of the mixing device 29 is threaded for engagement with the boss 37. The portion of the mixing device surrounding the bore 53 is of a larger diameter and threaded to engage with the thread of the bore 28. The upper end of the mixing device is provided with a hexagonal head 66 below which are threads of a still larger diameter for engagement with the threads of a lock nut 67 shown in Fig. 1. A gasket 68 is interposed between the body and the nut 67 to prevent the escape of gas at this point.

The form of mixing device here employed provides a blowpipe that may be very compact and yet exceedingly resistant to flashback or backfire. The acetylene supplied at connection 30 and the heating oxygen supplied at connection 31 have substantially equal pressures. The acetylene flows through the passage 45 and the holes 64 into the chamber above the head 56. The acetylene on passing through the metering orifice 61 is reduced in pressure by expansion into the passage 60. The expanded acetylene then passing forwardly through the passage 60 is projected axially across the gap between the end 58 and the bottom of the bore 52 toward the mixing throat 49. At the same time oxygen passes from passage 46 through the holes 65 into the narrow space 78 between the stem 57 and the bore 52, which space acts as a metering orifice for the heating oxygen, and then through the gap radially inwardly toward the column of acetylene. The oxygen thus impinges on the column of acetylene perpendicularly thereto, and on all sides thereof before the acetylene reaches the mixing throat. There is substantially no injector action but it is found that very effective mixing takes place. It is not required that either gas be at a higher pressure than the other and it is quite possible that both gases may mix effectively when they are of substantially the same pressure at the mixing point. Turbulence in the combining tube throat 49 and passage 51 causes a thorough mixing of the gases which then flow smoothly through the passage 50 to the chamber 27 at the inlet end of the nozzle from which the heating gases flow through the heating gas passages of the nozzle which are disposed about the central desurfacing oxygen passage therethrough.

The gases flowing from the heating gas orifices of the nozzle produce a very steady heating flame. However, should hot slag be projected against the end of the nozzle so as to cause a backfire, such backfire will first enter the passages 50 and 51 and the mixing throat 49. The high heat conductivity of the walls of the combining tube passage 51 which is surrounded by cooling water will extract and dissipate much of the backfire heat very rapidly. The force of the backfire may, however, then project gas up through the conduit 60 which is filled with pure acetylene, the acetylene being forced backward through the constriction 61. A wave of pressure may also react backward through the oxygen restriction. However, the gas cushion effect of the gas passages before these restrictions causes the backfire to be dissipated and to drive the burned gases forwardly out of the blowpipe orifices. If a backfire should pass through either restriction, it would meet with an excess of the pure gas and therefore no combustible mixture would be present.

When the blowpipe is operating in the upright position as shown in Fig. 1, a large portion of the heat which may reach the blowpipe is conducted by the nozzle 20. This heat is effectively dissipated by the provision of the water-cooling passages which are very close to the rear end of the nozzle. It will be seen that the cold water entering passage 38 is projected against and thoroughly cools the mixing device 29 by washing away a steam film that may form thereon. The passage 39 projects water against and thoroughly cools the lower forward portion of the chamber A close to the nozzle. Air in chamber A is forced out through passages 42 into the chamber B from which it is vented with the water through the passage 44. When the nozzle is mounted in the upside down position for desurfacing the under side of a billet, the passages 42 are in the highest part of the chamber A which fills with water so that the mixing device 29 is surrounded by water and the water is in close contact with the chamber walls which are nearest the end of the nozzle.

For desurfacing an entire side of a steel billet, the blowpipes are preferably mounted in a protecting holder as shown in Figs. 4 and 5. The holder or shoe is open at the top, and has a bottom 69 adapted to ride on the surface of the billet, and a forward wall 70 through which the nozzles 20 of the blowpipes project at the corner between the bottom 69 and the forward wall 70. The shoe also has side walls 71 and a back wall 72 adapted to be secured to supporting and moving mechanisms. The blowpipes are mounted in a row with their forward edges substantially touching so that the nozzles 20 are closely adjacent to each other. The rear edges 11 of the blowpipes are separated from each other so that the blowpipes and nozzles are arranged at an angle to the central blowpipes, the outer blow-

pipes being at a larger angle. The forward edges 17 of the blowpipes are maintained in the desired position by a cross bar 73 whose ends are secured to the wall 71 by screws 74. Pins 75 pass through the bar 73 and rest in the sockets 18 of the front wall 17 of the blowpipe. The set screws 19 hold the pins 75 in place. The rear edges of the blowpipes are held in place by the engagement of the pins 14 with corresponding sockets in the bottom 69 of the shoe and by cap screws 76 which pass through the holes in the arm 15 to secure the arm to the upper edge of the back wall 72.

Another arrangement of passages for conducting cooling water through the blowpipe so as to eliminate substantially entirely all air pockets from the chambers A and B is employed in the form of the invention illustrated in Figs. 6 and 7. The construction is similar to that of Fig. 1 and like parts are designated by the same numbers. The chamber A' however is provided with a thickening of the wall or fillet 140 along one corner adjacent to the partition 35. The fillet extends from the bottom of the chamber A' to a point close to the highest portion of the chamber. A passage 142 is drilled lengthwise through the fillet so as to provide communication between the upper part of chamber A' and the portion 43 of chamber B. On the opposite side of passage 36, the short passage 42 is provided as in the blowpipe of Fig. 1.

Only one water inlet passage is provided by the bore 138 which connects the inlet connection 32 with chamber A' and directs water against the mixing device 29. The cross sectional area of the passage 138 should be equal to the combined cross sectional areas of passages 42 and 142. In operation, water will enter through passage 138 at a rate faster than it can pass from chamber A' to chamber B through passage 42 alone. Therefore, chamber A' will fill to the level of the end of passage 142, and air will be forced down passage 142 into chamber B from whence it will be vented with the water through passage 44 and outlet connection 34.

When the blowpipe is upside down, air in chamber A' is vented through hole 42 into chamber B where some of the air may remain trapped. If desired, such trapped air may be vented by inserting a tube 144 through passage 44. The tube 144 should reach to a point in the portion 43 of chamber B. The tube 144 should not fill the passage 44 but a space between the wall of passage 44 and the outside of the tube should be provided for venting air when the blowpipe is upright. It is preferable that the sum of the cross sectional area of the tube passage and the cross sectional area of the space between the tube and the wall of passage 44 should be substantially equal to the cross sectional area of passage 138. When the blowpipe is in the inverted position, the water will rise in chamber B and force all air out through the tube 144. It will be seen therefore that the chambers A' and B are maintained substantially filled with cooling water when the blowpipe is used in any position.

When it is desired to desurface the top surface of a square steel billet, the row of blowpipes in the supporting shoe are maintained in the upright position shown in Fig. 5 where the billet is indicated at 77. The rear wall 72 of the shoe is secured to and supported by suitable mechanism so that the nozzles 20 are maintained in the oblique position shown, while the billet and shoe move relatively to each other and longitudinally along the surface. Either the shoe moves to the right at uniform speed when the billet is supported stationarily or the billet alone moves to the left. During such movement, the shoe 69 is preferably maintained in contact with the surface of the billet.

With the blowpipes of the present invention, the bottom surface of a billet may be desurfaced by similarly supporting and moving the shoe and blowpipes with respect to the surface in the inverted position. For desurfacing the side surfaces of the horizontal billet, the shoe and blowpipes are supported so that the principal plane of the central blowpipe is horizontal. When it is desired to desurface all four sides of a square billet simultaneously, the billet is preferably supported in the "diamond" position and four shoes with blowpipes are supported in the operative relation to the surfaces with the principal planes of the center blowpipes making substantially a 45 degree dihedral angle with a horizontal plane through the axis of the billet.

In any of these positions, the water-cooling arrangement of the blowpipes is fully effective for cooling both the nozzle portion and the heating gas mixing device of the blowpipes. In any position, no air or gas will prevent water from contacting the surfaces to be cooled. Because of such cooling, the blowpipe construction employed may be relatively compact; the gas passages of the heating gas mixing device may be short; and the flashback resistance of the mixing device employed is thus increased.

It will be understood, of course, that fuel gas, other than acetylene, may be employed and where the word "acetylene" is used in this specification, it is intended to include any appropriate fuel gas. Similarly, it will be understood that the expressions "preheating oxygen" and "desurfacing oxygen" are employed for convenience and because oxygen is ordinarily used for preheating and desurfacing. However, it is not intended to exclude other fluids which might be similarly employed. Finally, the expression "cooling water" is employed herein because this is the cooling fluid now contemplated as applicable to the apparatus. However, it is not intended to exclude other cooling fluids by the use of this expression.

The particular embodiment, here described and illustrated in the accompanying drawings, is presented to indicate how the invention may be applied. Other forms, differing in detail but not in principle, from that here disclosed will, of course, suggest themselves to those skilled in the art.

We claim:

1. In a blowpipe, a relatively flat and narrow body having a nozzle for projecting a heating flame and an oxidizing gas stream toward a metal surface portion to be removed; a mixing device removably secured within said body, said mixing device having an axial bore therethrough, said bore having a throat portion and a combining tube portion below said throat portion; a mixer within said bore above said throat, said mixer having a head closing off said bore, a shank portion of smaller diameter than said bore between said head and a point adjacent said throat, and

an axial passage therethrough; means sealing the upper end of said bore and providing a chamber above said head; passage means within said body connecting said combining tube portion with said nozzle; passage means within said body for conducting fuel gas to the chamber above said mixer; and separate passage means within said body for conducting oxidizing gas to the space between said mixer and said bore.

2. A blowpipe as claimed in claim 1 in which said combining tube portion is provided with a relatively thick wall, and means is provided in said body for maintaining the outer surface of said wall in contact with a cooling fluid.

3. A blowpipe having a flat and narrow body; a nozzle projecting obliquely from the lower portion of said body, said nozzle having therein an axial oxidizing gas passage and heating gas passages adjacent said oxidizing gas passage; connections for heating oxygen, fuel gas and oxidizing gas disposed at the upper end of said body; a removable mixing device disposed within said body having one end projecting externally thereof and having a discharge end communicating with said heating gas passages; passages connecting said heating oxygen and said fuel gas connections with respective portions of said mixing device within the body; two chambers for cooling fluid in said body, one of said chambers surrounding the discharge portion of said mixing device, and a partition between said chambers; a passage through said partition for conducting oxidizing gas to said oxidizing gas passage of the nozzle; an inlet passage for conducting cooling fluid into the upper portion of one of said chambers; an outlet passage for conducting cooling fluid out of the upper portion of the other of said chambers; passage means connecting the upper portion of said first-mentioned chamber with the lower portion of said second-mentioned chamber; and other passage means connecting the lower portions of said chambers whereby entrapped air may be vented from said first-mentioned chamber in any position of the blowpipe.

4. A blowpipe comprising a unitary body having substantially flat parallel side surfaces, and narrow edge portions, the rear edge portion being long for connection to a mounting bracket, and the forward edge being shorter; said body having an angular bottom projection provided with an inclined bore; a nozzle mounted in said bore and disposed in inclined relation to said body, the axis of said nozzle being in the principal plane of said body; said body having a series of six steps in its upper edge; a mixing device associated with the first step for delivering heating gases to said blowpipe; a combustible gas inlet associated with the second step for delivery to said mixing device; a combustion supporting gas inlet associated with the third step for delivery to said mixing device; a cooling fluid inlet associated with the fourth step; a cutting oxygen inlet associated with the fifth step for delivering cutting oxygen to said nozzle; and a cooling fluid outlet associated with the sixth step; said gas mixing device comprising a tube exposed to a cooling fluid inlet chamber in said body so that the inlet cooling fluid is directed against said tube; and said cutting oxygen inlet comprising a bore through a partition integral with said body and separating said cooling fluid chamber from a cooling fluid outlet chamber so that the incoming cutting oxygen is also cooled.

5. A blowpipe comprising a unitary body having substantially flat parallel side surfaces, and narrow edge portions, the rear edge portion being long for connection to a mounting bracket, and the forward edge being shorter; said body having an angular bottom projection provided with an inclined bore; a nozzle mounted in said bore and disposed in inclined relation to said body, the axis of said nozzle being in the principal plane of said body; said body having a series of steps in its upper edge; a mixing device associated with one step for delivering heating gases to said blowpipe; a combustible gas inlet associated with another step for delivery to said mixing device; a combustion supporting gas inlet associated with another step for delivery to said mixing device; a cooling fluid inlet associated with another step; a cutting oxygen inlet associated with another step for delivering cutting oxygen to said nozzle; and a cooling fluid outlet associated with another step.

6. A blowpipe comprising a flat and narrow body; a nozzle projecting obliquely forwardly from the lower edge portion of said body, said nozzle having a longitudinal oxidizing gas passage and adjacent heating gas passages therein; connections for combustible gas and oxidizing gas disposed at an upper edge portion of said body; an oxidizing gas supply passage extending through said body for conducting oxidizing gas directly from one of said connections to the oxidizing gas passage of said nozzle; a unitary removable mixing device arranged to receive oxidizing and combustible gas from said connections and having a combining tube disposed within said body and positioned forwardly of said oxidizing gas supply passage and substantially in the same plane with said nozzle and said oxidizing gas supply passage, said combining tube having a discharge end communicating with said heating gas passages in said nozzle; a chamber for cooling fluid in said body and completely surrounding said combining tube, said chamber being disposed forwardly of said oxidizing gas supply passage; and cooling fluid inlet and outlet passages for circulating cooling fluid through said chamber and around said combining tube.

7. A blowpipe comprising a narrow body; a nozzle projecting obliquely and forwardly from the lower portion of said body, said nozzle having therein an axial oxidizing gas passage and heating gas passages adjacent said oxidizing gas passage; connections for heating oxygen, fuel gas, and oxidizing gas disposed at the upper edge portion of said body; a removable mixing device and combining tube disposed within said body having one end thereof externally exposed and having a discharge end communicating with said heating gas passages; passages connecting said heating oxygen and said fuel gas connections with portions of said mixing device within the body; two chambers for cooling fluid in said body, one of said chambers surrounding the combining tube portions of said mixing device; a partition between said chambers; a passage through said partition for conducting oxidizing gas directly to said oxidizing gas passage of the nozzle; an inlet passage for conducting cooling fluid into one of said chambers; an outlet passage for conducting fluid out of the other of said chambers; and passage means through said partition connecting both of said chambers for passing cooling fluid from one to the other.

8. A blowpipe comprising a relatively flat and narrow body having a nozzle holding portion with a nozzle therein adapted to project a heat-

ing flame and an oxidizing gas stream against a metal body; a gas mixing device removably secured in said body and having a combining tube portion within said body; means for supplying oxidizing gas and fuel gas to said mixing device; a passage in said nozzle holding portion connecting said combining tube with said nozzle; passage means in said body for supplying oxidizing gas to said nozzle; a cooling fluid chamber adjacent said nozzle holding portion and surrounding said combining tube portion; and cooling fluid inlet and outlet passages for circulating a cooling fluid through said chamber, said cooling fluid inlet passages being arranged to project cooling fluid directly against said combining tube portion and against a wall of said chamber adjacent said nozzle holding portion.

9. A blowpipe for applying gas to a surface of a metal body in any position, said blowpipe having a flat and narrow unitary body adapted for mounting it with other similar blowpipes to form a closely spaced bank of blowpipes; a nozzle projecting obliquely forwardly and downwardly from the lower portion of the forward edge of said body; gas supply connections along another edge of said body; at least one chamber for cooling liquid in said body; a combustible and oxidizing gas mixing device in said body having a combining tube portion passing through said chamber and arranged to receive combustible and oxidizing gas from said supply connections and conduct mixed gas to said nozzle, said combining tube portion being completely surrounded by the liquid holding space of said chamber; and liquid inlet and outlet passage means for conducting liquid into and from said chamber, said inlet passage means having a portion positioned and directed to impinge a jet of cooling fluid obliquely against and along said combining tube portion in the direction toward said nozzle.

10. A blowpipe comprising a flat and narrow body; a nozzle projecting forwardly from the lower edge portion of said body, said nozzle having a longitudinal oxidizing gas passage and adjacent heating gas passages extending therethrough; connections for combustible gas and oxidizing gas disposed along an upper edge of said body; an oxidizing gas supply passage extending through said body from one of said connections to the oxidizing gas passage in said nozzle; a unitarily removable mixing device arranged to receive oxidizing gas and combustible gas from said connections and having a combining tube disposed within said body and positioned directly forwardly of said oxidizing gas supply passage, said combining tube having a discharge end connected with the heating gas passages in said nozzle; a chamber in said body adjacent said nozzle and surrounding said combining tube, said chamber being disposed forwardly of said oxidizing gas supply passage; a second chamber in said body disposed rearwardly of said supply passage; passage means around said supply passage providing communication between said chambers; an inlet for cooling liquid to one of said chambers; and an outlet for used cooling liquid from the other of said chambers.

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