July 6, 1948. E. MEINCKE ET AL 2,444,899

BLOWPIPE APPARATUS FOR THERMOCHEMICALLY REMOVING METALS

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Fig. 1.

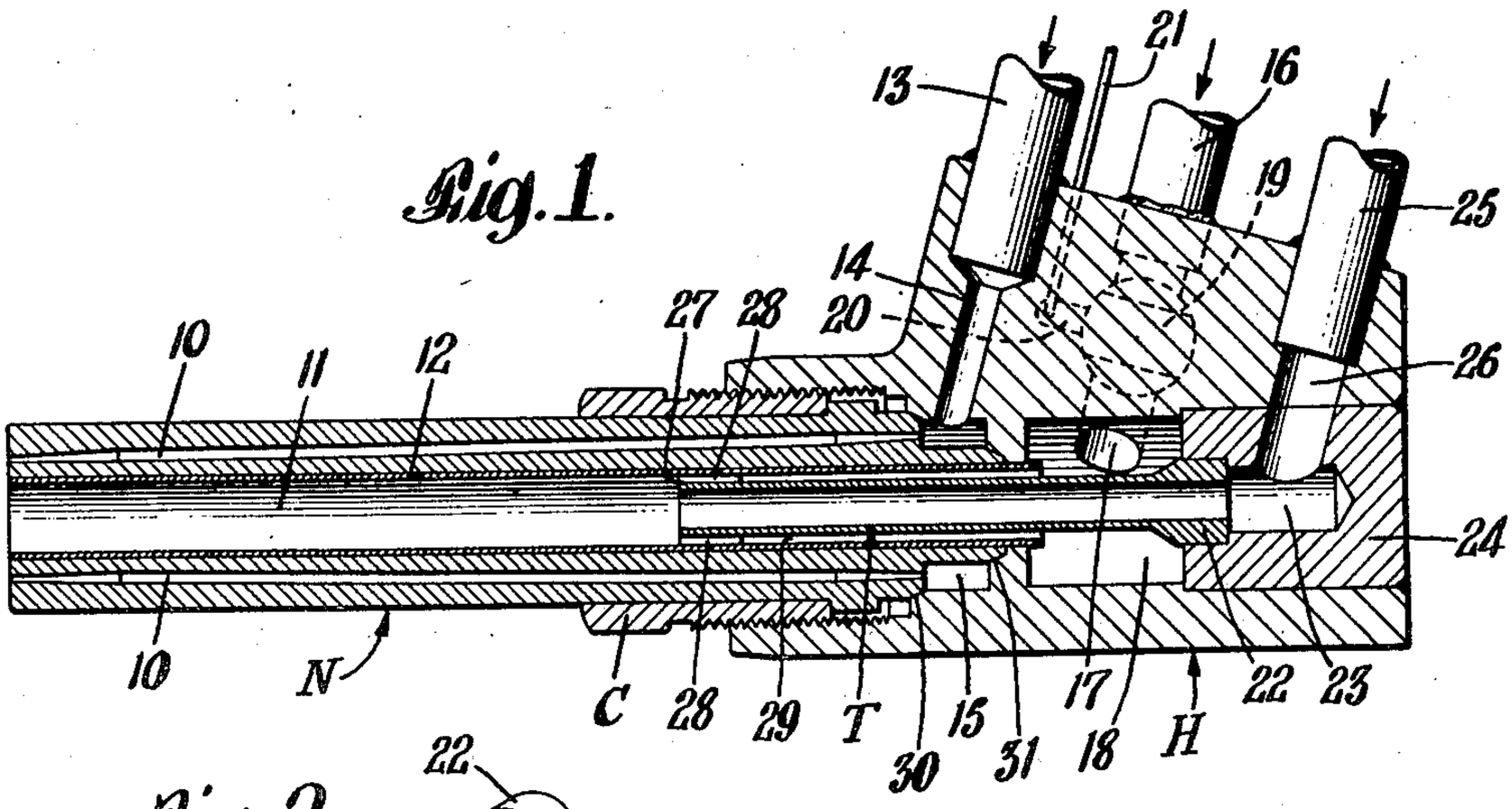

Fig. 2.

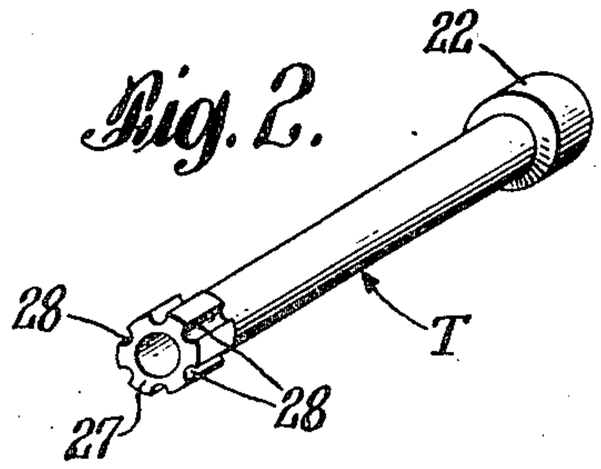

Fig. 3.

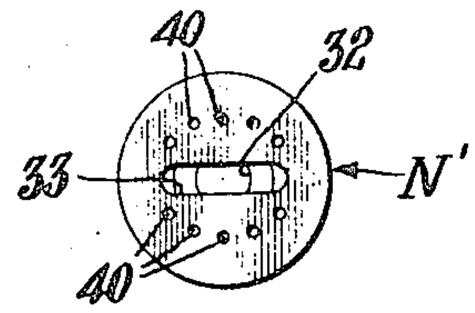

Fig. 5.

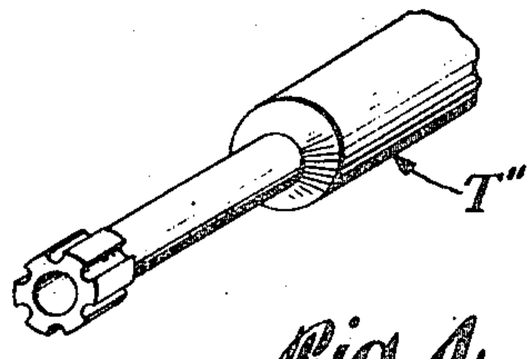

Fig. 4.

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BLOWPIPE APPARATUS FOR THERMO-CHEMICALLY REMOVING METAL

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5 Claims. (Cl. 110—22)

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This invention relates to apparatus for thermochemically removing metal by a stream or jet of oxygen, from metal bodies having a composition which resists the normal thermochemical action of a stream or jet of oxygen, such resistance being sufficient to hinder or substantially prevent such normal removal of metal. Examples of such metal bodies are ferrous metals, such as chromium-containing stainless steels, cast iron, and the like, and non-ferrous metals, such as copper, aluminum, nickel and various alloys. Such metal bodies are difficult or impossible to cut, deseam, desurface, or the like, by the normal impingement of a stream of oxygen upon successive portions heated to their ignition temperature, or by heating flames which would provide sufficient heat for the removal of metal from plain carbon steel by melting.

There has recently been developed a method for thermochemically removing metal from such resistant metal bodies by introducing a finely-divided oxidizable material such as powdered iron into the zone of action of the oxygen stream or jet in order to produce reaction products sufficiently fluid that successive portions of the metal body may be thermochemically removed when a relative movement is effected between the body and the oxygen stream or jet. There are indications that the material acts as a flux, but it appears more proper to describe it as an adjuvant material, or assistant or promoter in the reaction, since in some instances it is believed there may be no chemical reaction or alloy formation. Preferably, the powdered adjuvant material is carried directly into the reaction zone by the stream or jet of cutting or metal-removing oxygen.

It is an object of the present invention to provide improved blowpipe apparatus for introducing finely divided adjuvant material into a stream of metal-removing oxygen which carries the adjuvant material into the reaction zone. Among other objects of this invention are to provide such apparatus for introducing finely-divided adjuvant material into a stream of metal-removing oxygen in such manner that the material will be substantially uniformly distributed in the stream of oxygen, and the metal-removing effectiveness of the oxygen stream or jet will be rendered more uniform across the width thereof; and to provide such apparatus wherein the finely divided adjuvant material is introduced into an oxygen stream within a passage of a blowpipe nozzle in such a way that the possibility

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of a powder flash within the blowpipe is minimized.

In accordance with this invention, finely-divided adjuvant material is introduced into a stream of metal-removing oxygen from a plurality of points spaced substantially equally about the periphery of the oxygen stream, within the discharge passage of a blowpipe nozzle. The adjuvant material is preferably introduced into the stream of oxygen at a point sufficiently remote from the discharge end of the passage to permit a uniform distribution of the material through the oxygen stream. It is also important that at the point of introduction of adjuvant material the velocity of the oxygen stream be maintained sufficiently rapid to minimize the possibility of the adjuvant material burning back within the nozzle.

Apparatus constructed in accordance with this invention is illustrated in the accompanying drawings, in which:

Fig. 1 is a longitudinal sectional view of the head end of a blowpipe constructed in accordance with this invention;

Fig. 2 is a perspective view of a part of the blowpipe of Fig. 1;

Fig. 3 is a longitudinal sectional view illustrating a modification of the apparatus of the invention;

Fig. 4 is a perspective view of a modified form of a part of the blowpipe of Fig. 3; and

Fig. 5 is an end view of the apparatus illustrated in Fig. 3.

In general, the apparatus illustrated in Figs. 1 and 2 comprises a blowpipe having a head H carrying an elongated nozzle N secured thereto by a coupling nut C. The nozzle N has a central longitudinally extending oxygen discharge passage or bore into the rear portion of which extends an oxygen supply tube T spaced from the wall of the passage. The nozzle N also has passage means adjacent to the central oxygen passage, for discharging a fluid medium for preheating flames. The head H', nozzle N', tube T', and coupling nut C' of the blowpipe illustrated in Fig. 3 are somewhat similar to the corresponding parts of the blowpipe illustrated in Figs. 1 and 2, with certain differences which will appear in the more detailed description which follows. The tube T'' of Fig. 4 is alternative to the tube T' of Fig. 3, but embodies certain features of the tube T of Figs. 1 and 2, as are more fully described hereinafter.

In a preferred embodiment of the apparatus of this invention, as illustrated in Figs. 1 and 2,

the nozzle N is a deseaming nozzle having a front end surface, a plurality of passages 10 for combustible preheating gas, such as an oxy-acetylene mixture, having outlets in the front end surface encircling a central oxygen passage 11 of circular cross section which has a discharge orifice in the front end surface adjacent to but spaced from the preheating gas outlets. The passage 11 has extending the full length thereof an abrasion-resistant liner 12 of chrome plating. Combustible gas, such as a mixture of oxygen and acetylene, is supplied through tube 13 and connecting drilling 14 to annular distributing chamber 15 in the head H. Finely-divided adjuvant material is supplied from a suitable hopper (not shown) through a tube 16 and a connecting drilling 17 to a chamber 18 in head H surrounding tube T. A valve 19 in the head H, such as a rotatable plug valve, controls the flow of powdered adjuvant material through the drilling 17. The valve 19 may be operated by a lever 20 coupled to a rod 21.

Tube T is provided at the rear end with a flange 22 fitting friction tight into an enlarged end of a chamber 23 drilled into plug 24, which closes the rear end of chamber 18. A conduit 25 is secured in a drilling 26 in the head H for supplying oxygen to the chamber 23 and the open rear end of tube T. The tube T extends through chamber 18 into passage 11 in spaced relation to the walls thereof to form an annular powder passage in non-communicative relation to the preheating gas passage 10. Tube T terminates at a point which is nearer the rear end than the front end of passage 11 and is sufficiently remote from the discharge end of the passage to insure uniform mixing of oxygen with adjuvant material aspirated around the outside of the tube T by the suction effect produced as the oxygen expands from the tube T adjacent and circumferentially of the end thereof into passage 11 and enters the elongated unobstructed oxygen-powder mixing chamber within the passage.

In order to insure uniform distribution of the adjuvant material in the oxygen stream, the forward end of tube T is provided with a partitioning and centering flange 27 machined to fit within the liner 12 closely adjacent the wall of the passage 11, and having a plurality of grooves 28 spaced substantially equally about the periphery of the flange. Grooves 28 provide a plurality of small passages or ducts spaced from one another circumferentially, through which the adjuvant material is drawn in a plurality of small streams by aspiration from the annular passage or conduit 29 surrounding the tube T into oxygen passage 11. The provision of the small passages formed by grooves 28 has been found to minimize the tendency for the adjuvant material to burn or flash back within the nozzle into annular conduit 29.

For sealing purposes, tapered shoulders 30 and 31 on the rear end of nozzle N cooperate with corresponding tapered shoulders formed in head H to seal off the combustible gas distributing chamber 15. In addition, tubes 13, 16, and 25 may be sealed gas-tightly to head H in any suitable manner, as by welding, brazing, or soldering.

In using the apparatus of Fig. 1, a portion of the metal body from which metal is to be removed is heated to the desired temperature by flames formed by the burning of combustible gas discharged from longitudinal passages 10 in nozzle N. When the heated portion of the metal body has reached the desired temperature, a jet

of oxygen is discharged thereagainst from the central longitudinal passage 11 in nozzle N, which is surrounded by the combustible mixture passages 10. Concurrently therewith a stream of finely-divided adjuvant material, such as iron, steel, or ferromanganese is introduced into the oxygen stream within nozzle N and thence into the reaction zone, whereby a thermochemical action producing intense heat occurs. Under these conditions a metal removing action results, when a relative movement between the nozzle and the stainless steel body is effected, which closely approximates that of the removal of metal from low carbon steel. The mechanism of powder introduction into the central oxygen stream is as follows: as the oxygen stream leaves tube T it expands in passage 11, which has a greater cross-sectional area than the orifice of tube T, producing a suction effect within the space 29 surrounding tube T and aspirating finely-divided adjuvant material into the oxygen stream from chamber 18. Chamber 18 is preferably sufficiently large so that an evenly distributed flow of powder through the annular passage 29 will be assured; and the discharge end of tube T is spaced a sufficient distance rearwardly from the discharge end of passage 11 so that a thorough, intimate and homogeneous mixing of the adjuvant material and oxygen occurs.

If desired, the adjuvant material may be passed through tube T and the oxygen supplied through the annular passage 29, although such arrangement tends to produce a concentration or core of the powder in the center of the oxygen jet, and is therefore not particularly desirable for deseaming or desurfacing operations, wherein as large an area as possible on the surface of the metal body is to be removed. However, for cutting operations it is advantageous to concentrate the material in the center of the cutting oxygen jet, since this tends to reduce the width of the kerf produced and thereby produces an increase in the permissible rate of traverse.

The modification shown in Figs. 3 and 5 differs from the apparatus of Figs. 1 and 2 in several relatively minor respects. For example, the central oxygen passage 32 of the nozzle N' is circular at its rear end but tapers forwardly to a wide thin slot-like orifice 33, adapted to discharge a relatively wide ribbon-like jet of oxygen for removing metal effectively from a wide area on a surface of a metal body.

Additionally, the oxygen is supplied through a tube T', which extends through the rear end of the head H' to the outside thereof through a seal provided by a body of packing material 34 compressed between a washer 35 and a gland nut 36 threaded into the head.

The tube T' has a relatively large internal diameter rear portion 37 tapering down rapidly to a relatively small internal diameter front portion 38, which increases the velocity of the oxygen considerably before it is discharged into the passage 32. No powder distributing flange is provided on the front of the tube T'. However, a tube T'' having such a flange, as shown in Fig. 4, may be used in the blowpipe of Fig. 3, if desired. As previously mentioned, the use of a longitudinally slotted flange on the front of the tube T'' gives improved powder distribution and materially lessens the possibility of a powder flash within the blowpipe.

As in the blowpipe of Fig. 1, the combustible gas, such as an oxy-acetylene mixture, enters the head H' through a tube 39 and is discharged from

the nozzle N' through a plurality of passages 40 arranged around the oxygen passage 32. Also, the powdered adjuvant material enters through the tube 41 and passes through the valve 42 into the chamber 43 surrounding the tube T'.

Although several embodiments of this invention have been described, it will be understood that various changes in the apparatus can be made, and that the principles of this invention are applicable to the removal of metal from metal bodies other than those described, and to the use of materials other than those mentioned. Furthermore, although a premixed oxy-acetylene gas mixture has been mentioned for the preheat flames, it is evident that other preheating materials may be used, and that the combustible gas mixture also may be formed externally of the blowpipe after discharge of the gases from the nozzle. In addition, other changes may be made without departing from the spirit and scope of the invention as defined in the appended claims.

This invention constitutes an improvement on the apparatus disclosed and claimed in application Serial No. 584,715, which was filed March 24, 1945, as a continuation-in-part of abandoned application Serial No. 456,667, filed August 29, 1942, both of which applications are assigned to The Linde Air Products Company.

What is claimed is:

1. Blowpipe apparatus comprising a nozzle having a front end surface, an oxygen passage having a discharge orifice in said front end surface for discharging a jet of oxygen laden with adjuvant powder, and preheat passage means having outlet means adjacent to but spaced from said discharge orifice for discharging combustible fluid; said apparatus also comprising a tube extending forwardly into said oxygen passage and having a front end located within said passage at a position spaced rearwardly from said discharge orifice, at least a forward portion of said tube being spaced from the wall of said oxygen passage to provide an annular conduit around said tube, said tube being adapted to discharge a stream of oxygen centrally into said oxygen passage, partition means dividing a portion of said annular conduit into a plurality of small longitudinally extending ducts spaced from one another circumferentially adjacent the discharge end of said tube, said partition means being carried by said tube and being arranged closely adjacent said wall, oxygen and combustible fluid supply conduits in communication with said tube and said passage means, respectively, and an adjuvant powder supply conduit in communication with said annular conduit in back of said partition means, said small ducts acting to distribute adjuvant powder uniformly into said oxygen stream in a plurality of small streams, and to minimize flashbacks into said annular conduit.

2. A blowpipe comprising a head: a nozzle secured at its rear end in said head and having a front end surface, a longitudinal passage extending through said nozzle having a discharge orifice in said front end surface for discharging a jet of oxygen laden with adjuvant powder, and preheat passage means having outlet means adjacent said discharge orifice for discharging combustible fluid; said blowpipe also comprising a tube having an open rear end secured to said head at a position spaced from the rear end of said nozzle, extending forwardly into said longitudinal passage, and having a front end located within said oxygen passage at a position spaced

rearwardly from said discharge orifice, said tube being spaced from the wall of said oxygen passage to provide an annular powder conduit around said tube, said tube being adapted to inject a stream of oxygen centrally into said oxygen passage; partition means dividing a portion of said annular conduit into a plurality of small longitudinally extending ducts spaced from one another circumferentially adjacent the discharge end of said tube, said partition means being carried by said tube and being arranged closely adjacent said wall, said small ducts acting to distribute powder uniformly into said oxygen stream in a plurality of small streams, and to minimize flashbacks into said annular conduit; said head having a combustible fluid supply passage in communication with said preheat passage means, an adjuvant powder supply passage in communication with the rear end of said annular conduit in back of said partition means, and an oxygen supply passage in communication with the open rear end of said tube.

3. A metal-removing blowpipe apparatus comprising, in combination, an elongated nozzle having a front end and a rear end, a bore extending longitudinally through said nozzle and having its outlet in said front end, a plurality of preheating gas passages spaced around and extending longitudinally of said bore and having their outlets at said front end adjacent to but spaced from such bore outlet; an oxygen supply tube extending into the rear end of said bore and terminating within said bore at a point nearer the rear end than the front end of said bore to provide an elongated oxygen-powder mixing chamber within the bore of said nozzle, said tube having at least a portion thereof spaced from the interior surface of said bore to provide an annular powder passage in non-communicative relation to said preheating gas passages but communicating with said elongated mixing chamber adjacent and circumferentially of the end of said tube within said bore; said bore being free from obstruction to the flow of powder-laden oxygen between the front of said tube and the outlet of said bore; and a blowpipe head secured to the rear end of said nozzle and having means cooperating therewith to provide preheating gas supply means communicating with said preheating gas passages, an annular powder distributing chamber communicating with said powder passage, and an oxygen supply conduit communicating with said tube.

4. Blowpipe apparatus as claimed in claim 3 wherein the outside of said tube adjacent its end within said bore has a plurality of grooves extending lengthwise of said tube and connecting said annular passage to said mixing chamber and serving to deliver streams of powder into said mixing chamber and into the oxygen stream discharging into the latter from said tube, to intimately mix the oxygen and powder within said nozzle, and to minimize flashbacks into said annular passage.

5. Apparatus in accordance with claim 1, also comprising a blowpipe head engaging said nozzle, said tube extending rearwardly through said head to the outside thereof, said apparatus also including means providing a seal between said tube and said head.

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