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F. C. GEIBIG ET AL

2,148,936

FLAME MACHINING NOZZLE

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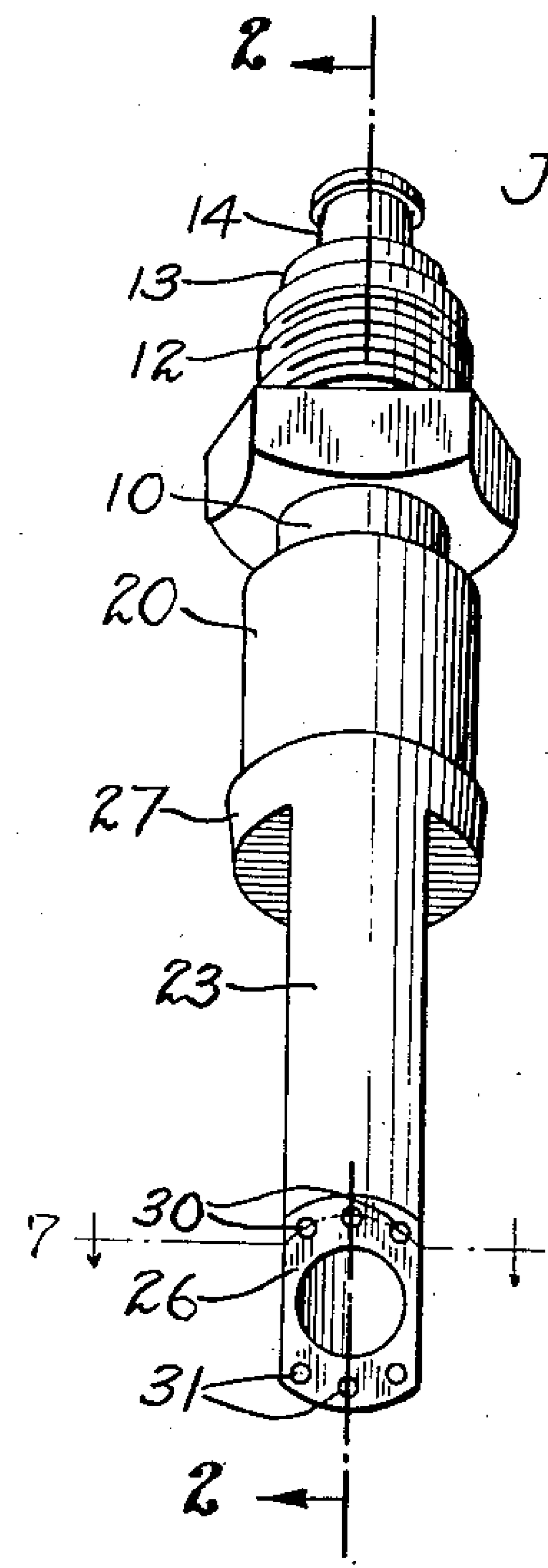

Fig 1

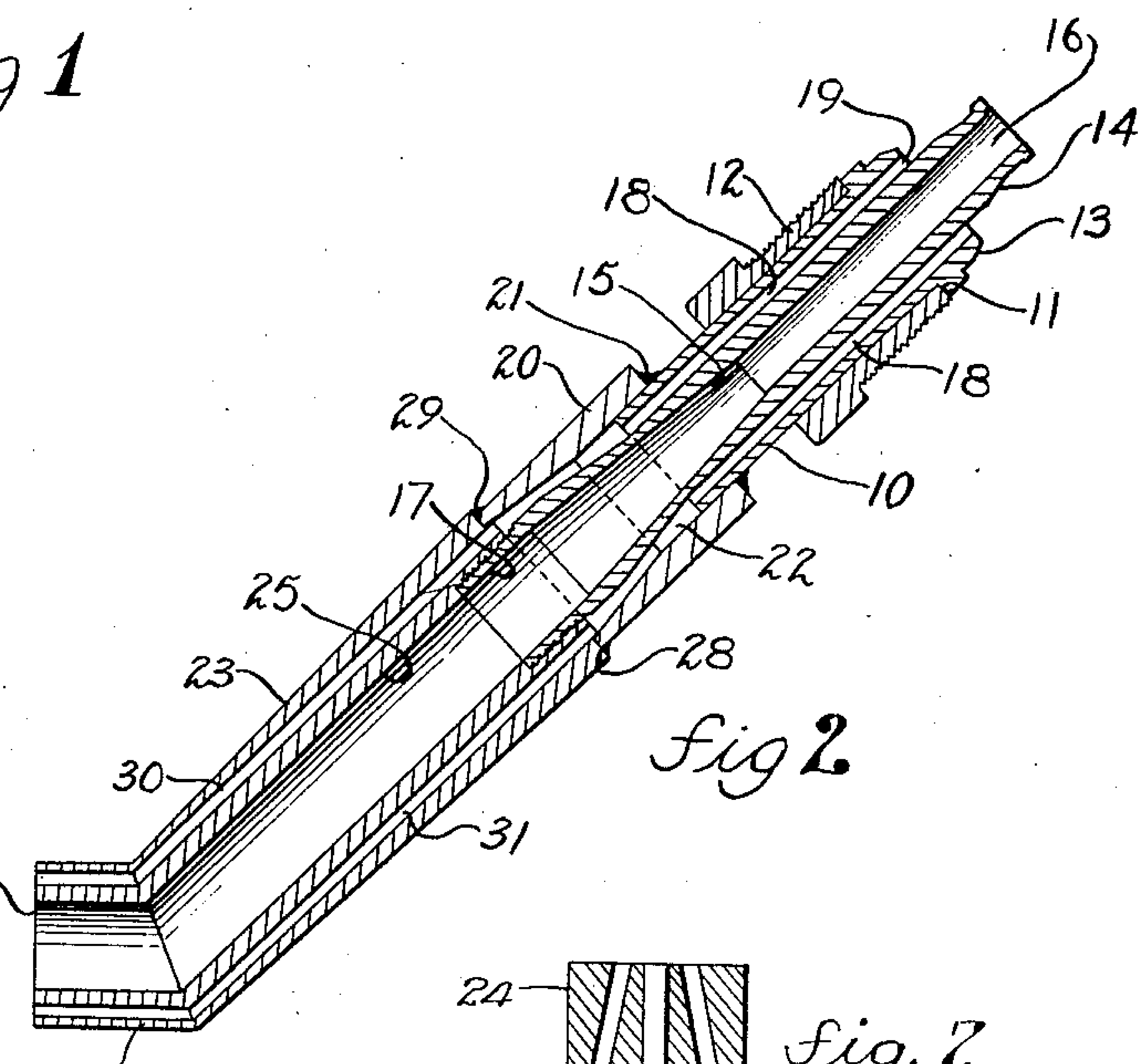

Fig 2

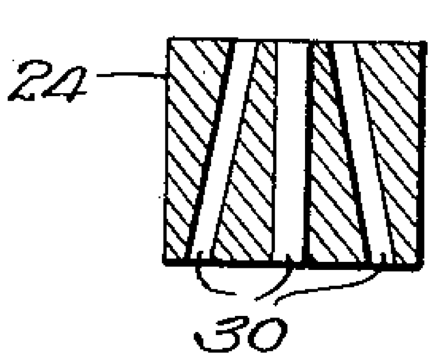

Fig. 7

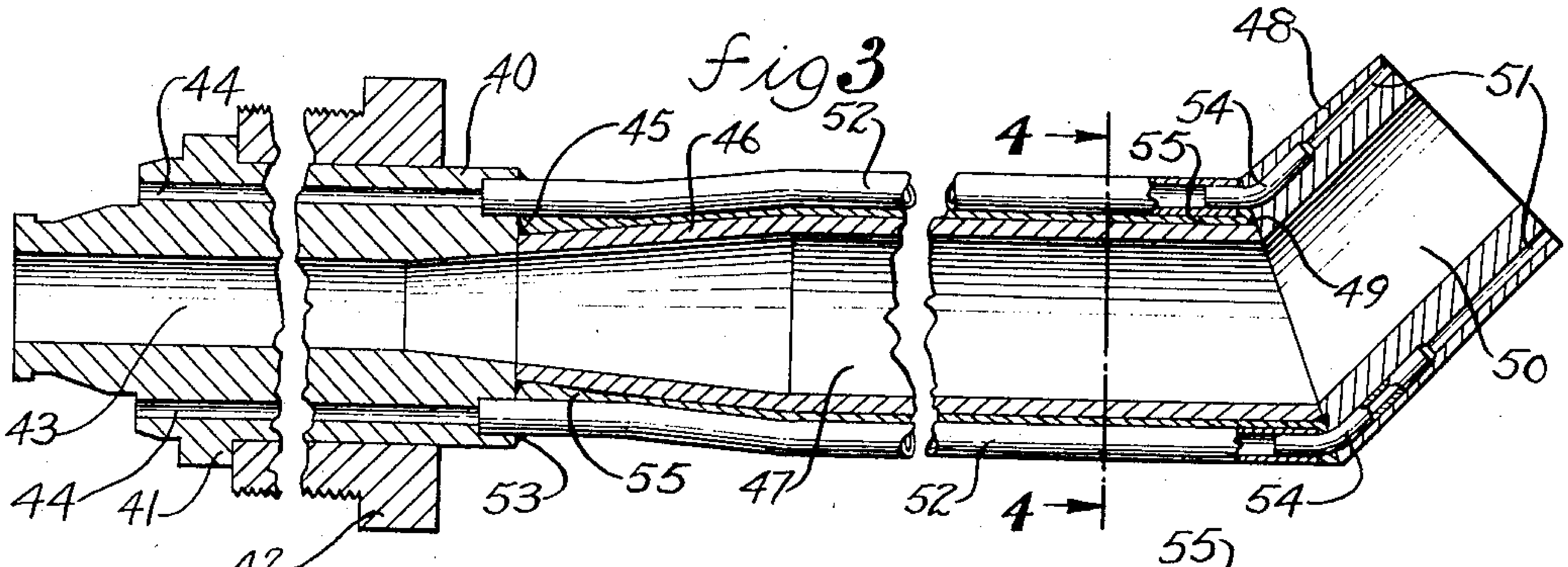

Fig 3

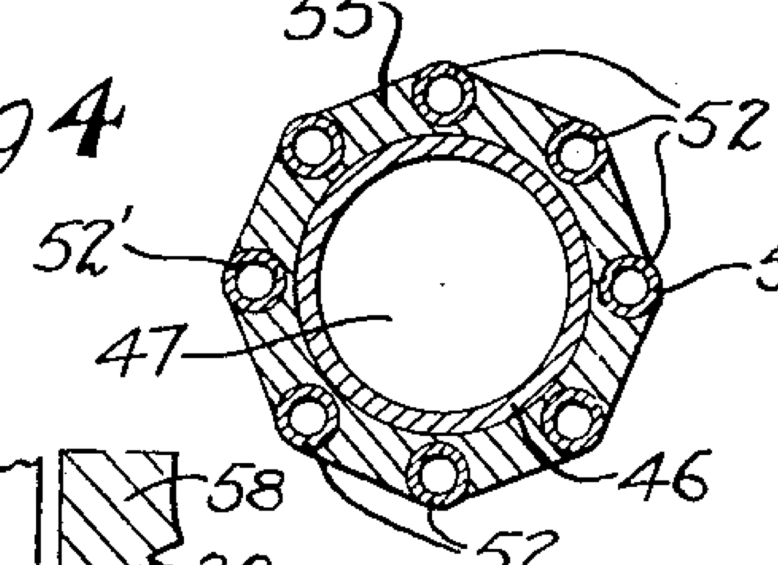

Fig 4

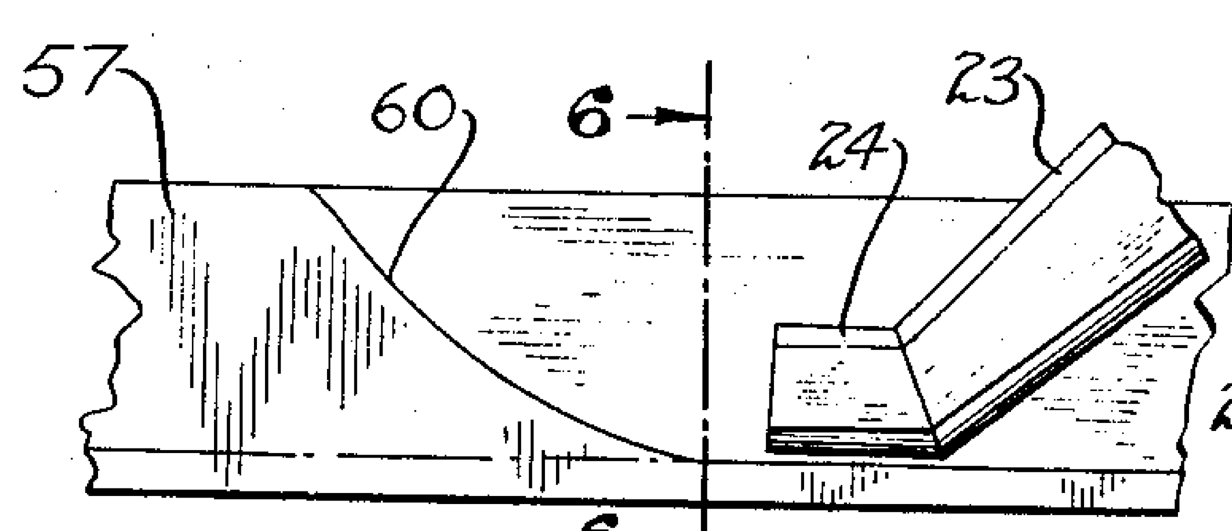

Fig 5

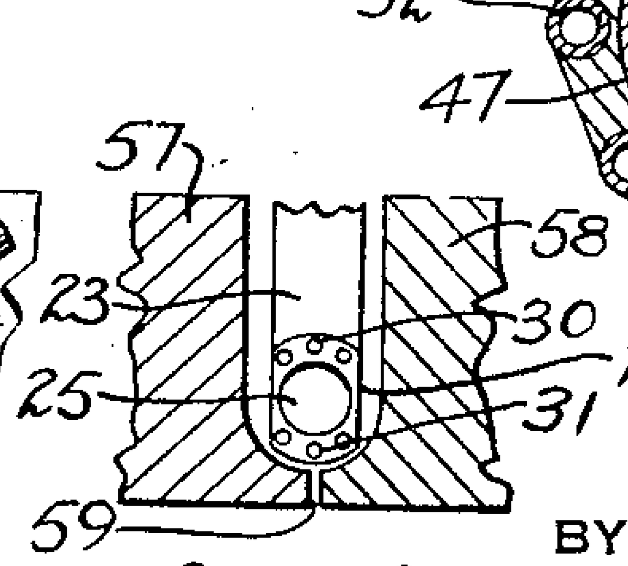

Fig 6

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FLAME MACHINING NOZZLE

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Application January 12, 1935, Serial No. 1,493

5 Claims. (Cl. 158—27.4)

This invention relates to the art of flame machining in which surface metal at an ignition or kindling temperature is removed by applying an oxidizing gas stream on such metal and relatively moving such gas stream and the surface and more particularly to a nozzle for flame machining a relatively deep groove.

It has generally been the practice to employ substantially straight nozzles for applying an oxidizing gas stream or streams at an acute angle to the surface from which metal is to be removed, as shown and described in United States Letters Patent No. 1,957,351, granted May 1, 1934, to Samuel R. Oldham. This method of removing surface metal is not entirely satisfactory for cutting a deep groove, and particularly where it is desired to produce a cut or groove at a seam formed by two metallic bodies arranged adjacent to each other with a space therebetween. When a cut or groove is made along such a seam with the oxidizing gas stream applied at an acute angle to the surface of the adjacent metallic bodies, the greater portion of the oxidizing gas passes through the space between the adjacent bodies without effecting any removal of metal. Moreover, the slight amount of cutting that is accomplished at the seam is very irregular and not uniform. Removing metal in this manner at a seam is further objectionable because, when the tip of the nozzle is below the surface of the body in a groove or cut it is producing, an insufficient amount of metal is removed to provide clearance for the nozzle as it is moved relatively to the metallic body.

In accordance with the present invention the above objections are overcome by providing a nozzle comprising a straight body portion and a short outer portion at an angle thereto, the nozzle having an oxidizing gas passage extending therethrough which bends at the juncture of the straight body portion and the short outer portion.

When surface metal at a seam between adjacent metallic bodies is removed with such a nozzle, the short outer section is positioned substantially parallel to the surface and near the bottom of the cut that is produced. The oxidizing gas stream discharged from the tip of the nozzle is also substantially parallel to the surface, so that substantially all of the oxidizing gas is effectively utilized to remove metal with only a negligible amount passing through the space at the seam.

The objects of the present invention, therefore, are: to provide an improved nozzle particularly suitable for many applications of flame machining; to provide such a nozzle provided with an oxidizing gas passage having an angle to change the direction of flow of the oxidizing gas; to provide an abrupt bend in an oxidizing gas passage near the discharge end of the nozzle to insure a rapid expansion of the gas as it is discharged from the passage; to provide such a nozzle having an oxidizing gas passage with a larger outlet than an inlet so that a relatively large volume of oxidizing gas is discharged from the nozzle; and to provide a nozzle having the outer portion thereof substantially rectangular-shaped in transverse section.

These and other objects and advantages of this invention will become apparent from the following description and accompanying drawing, in which:

Fig. 1 is an end view, in elevation, of a nozzle embodying the principles of our invention;

Fig. 2 is a longitudinal view, in section, taken at line 2—2 of Fig. 1;

Fig. 3 is a longitudinal view, in section, of a nozzle illustrating another embodiment of this invention;

Fig. 4 is a view, in section, taken at line 4—4 of Fig. 3;

Fig. 5 diagrammatically illustrates the relation of the nozzle of Fig. 1 with respect to a metallic surface in order to produce a flame machining cut;

Fig. 6 is a view, in section, taken at line 6—6 of Fig. 5; and

Fig. 7 is a view, in section, taken at line 7—7 of Fig. 1.

Referring to Figs. 1 and 2 of the drawing, a nozzle embodying the principles of our invention may comprise a body 10 having a shoulder 11 at its inner end. An externally threaded clamping nut 12 disposed about the body 10 and bearing against the shoulder 11 is provided for securing the nozzle to a blowpipe head or adaptor (not shown), so that the tapered seating surfaces 13 and 14 will engage and form a gas-tight seal with similar seating surfaces in the blowpipe head, which supplies the oxidizing gas, such as oxygen or a mixture of oxygen and air, and a combustible gas, such as a mixture of oxygen and acetylene, to the nozzle.

An oxidizing gas passage 15, having an inlet 16 communicating with an outlet in the head, extends longitudinally through the body 10. For a short distance at its inlet end the passage 15 is substantially constant in area and non-expanding. From this non-expanding section the passage 15 gradually expands toward its outlet 17, at which outlet is formed a short non-expanding section that is externally threaded.

Disposed about the passage 15 and passing through the wall of the body 10 is a group of combustible gas passages 18 which are substantially equally spaced and which extend longitudinally thereof from an inlet 19 adjacent the seating surface 13 and terminate adjacent the expanding portion of the passage 15.

Arranged about the outer end of the body 10 and spaced therefrom is a bushing 20 having one end thereof secured at 21, as by silver soldering, to the outer wall of the body adjacent the outlets of the passages 18. The space between the outer end of the body 10 and the bushing 20 forms an annular chamber 22 into which the combustible gas passes from the group of passages 18.

The inner end of a tip 23 is adapted to be connected to the outer end of the body 10 and the bushing 20. As shown, the straight body portion of the tip 23 is rectangular-shaped with flat side walls longer than the arcuate-shaped top and bottom walls. At its outer end the tip is provided with a short section 24 which is also rectangular-shaped in cross section and forms an obtuse angle bend with the straight body portion.

A circular passage 25 of constant area extends longitudinally of the tip from its inlet to the discharge orifice at the end or discharge face 26, bending at the juncture of the short section 24 and the main portion of the tip. At its inlet the passage 25 is threaded for securing the tip 23 to the externally threaded outer section of the body 10. The extreme end of the threaded outer section of the body 10 is adapted to bear against a shoulder at the inlet of the passage 25, so that the cross sectional area of the passage 25 will be the same as that of the non-expanding outer section of the passage 15 with which it communicates. The inner end 27 of the tip is enlarged and circular and provided with a shoulder 28 adapted to bear against the outer end of the bushing 20 to which it may be secured as by silver soldering, as indicated at 29.

Adjacent the short top and bottom sides of the tip 23 are two groups of passages 30 and 31, respectively, which extend longitudinally of the tip from its inlet to the discharge face 26, these passages bending in the same manner as the passage 25 at the juncture of the short section 24 and the main body portion of the tip. The combustible gas passes from the annular chamber 22 through the passages 30 and 31 to produce gaseous heating jets or heating flames to heat the metal to be removed to an ignition temperature. The passages 30 and 31 in the section 24 may be parallel to the oxidizing gas passage 25, or the outer combustible gas passages may diverge toward the walls of a cut as it is being made, as shown in Fig. 7.

In the above-described embodiment the tip 23 may be machined from a single metallic body, such as copper, for example, and the passages formed by drilling. In the embodiment illustrated in Figs. 3 and 4, considerable drilling is eliminated by employing a number of parts which are assembled to provide a nozzle similar to that shown in Figs. 1 and 2. The particular nozzle construction in Fig. 3 may comprise a connector 40 having a shoulder 41. A threaded clamping nut 42 fitted about the connector and bearing against the shoulder 41 is provided for securing the nozzle to a head or adaptor (not shown).

The connector 40 has a central oxidizing gas passage 43 and a plurality of combustible gas passages 44 disposed about its outer wall, the inlets of these passages communicating with an oxidizing gas passage and combustible gas passage in the head. To the outer end of the connector 40 and at the opening of the passage 43 is secured, as indicated at 45, the inner end of a sleeve 46 having a passage 47. The sleeve 46 forms the straight portion of the nozzle tip and its outer end is at an angle to its longitudinal axis. To increase the volume of oxidizing gas delivered by the nozzle and also reduce its velocity, the outer end of the passage 43 of the connector 40 is flared and the inner end of the sleeve 46 is tapered to provide a section of oxidizing gas passage which will permit the oxidizing gas to expand during its flow through the nozzle.

The outer end of the tip comprises a short annular member 48 secured to the outer end of the sleeve 46, as indicated at 49. The member 48 has a main passage 50 communicating with the passage 47 and a plurality of passages 51 disposed about its wall. The member 48 forms a short outer section of the tip which is at an angle to the straight sleeve portion 46 to provide an abrupt angular bend in the oxidizing gas passage of the nozzle.

The combustible gas is conducted from the passages 44 in the connector 40 to the passages 51 in the annular member 48 through sections of tubing 52. The inner ends of the tubes 52 fit into recesses at the outlets of the passages 44 and are secured to the connector, as indicated at 53. The outer end of each tube 52 receives one end of a short tubular insert 54 which is bent intermediate its ends, the opposite end of which insert fits into a recess formed at the inner end of one of the passages 51.

In order to protect the sections of tubing 52, the spaces therebetween are filled with suitable material 55, such as copper or bronze, as shown in Fig. 4. If desired, the annular member 48 may also be rectangular-shaped to provide a nozzle similar to the embodiment shown in Figs. 1 and 2.

In Figs. 5 and 6 is shown the nozzle of Figs. 1 and 2 during a metal removing operation to produce a relatively deep groove at a seam formed by two plates 57 and 58 arranged adjacent to each other with a space 59 therebetween. The oxidizing gas stream discharging from the tip of the nozzle is applied in the direction of the successive portions from which metal is to be removed and is substantially parallel to the surface and near the bottom of the cut.

The combustible gas issuing from the passages 30 and 31 heats the metal directly ahead of the nozzle to an ignition temperature, such metal being indicated at 60. The oxidizing gas contacting the heated metal causes the same to ignite and burn. This burning or oxidation of the metal takes place in a definite manner to produce a smooth and even cut.

The oxidizing gas sweeps over the heated metal and is deflected upwardly to the surface of the plates 57 and 58. This deflection of the oxidizing gas is caused by the metal underneath the metal at an ignition temperature, such first-mentioned metal being in a solid state so that it acts as a baffle for the molten and burning or oxidized metal which is swept out of the cut and over the surfaces of the plates 57 and 58 by the force of the oxidizing gas stream. The foregoing action takes place about the entire end surface of the cut. In the particular shaped cut shown in Fig. 6, for example, the heating flames and oxidizing gas stream are applied on the side walls as well as to the metal directly ahead of the nozzle.

This burning or oxidation of surface metal takes place progressively as each successive portion of heated surface metal comes in contact with the oxidizing gas stream. When a cut is made in this manner at a seam, substantially all of the oxidizing gas is effectively utilized to remove metal with only a negligible amount passing through the space at the seam.

By employing either embodiment of the nozzles illustrated and described above, the passage of a relatively large volume of oxidizing gas is insured. This is effected by providing the expanding portions of the oxidizing gas passages to allow the oxidizing gas to expand as it flows through the nozzle. Such expansion of the oxidizing gas is at such a rate that it is accompanied by a reduction in its velocity which is desirable. The arrangement of the short outer section of the tip at an angle to the main straight portion thereof changes the direction of flow of oxidizing gas so that the oxidizing gas stream produced is applied substantially parallel to the surface with only a portion of the tip extending below the surface.

It has been found that the short outer section of the tip, which abruptly changes the direction of the stream, acts as a rapid expansion outlet for the oxidizing gas as it issues from the discharge orifice. This insures sufficient flaring of the oxidizing gas stream to produce a cut which will provide adequate clearance for the outer portion of the tip as it is moved relatively to the surface. By providing a tip having straight side walls instead of the usual circular nozzle tip (such side walls being formed by removing metal from diametrically opposite sides of a circular nozzle) sufficient clearance is insured for any cutting or flame machining operation encountered in practice.

Although a nozzle has been shown that provides heating flames to heat to an ignition temperature the metal to be removed, it should be understood that such metal can be heated in any other suitable manner. For example, an electric arc may be employed to preheat the surface metal to an ignition or kindling temperature, or the entire metallic body can be heated to an ignition temperature.

When employing nozzles that provide heating flames, some economy can be effected by shutting off the supply of combustible gas after a cut has been started. This is possible because it has been found that the oxidized metal or slag, as it is generally termed, has sufficient residual heat to heat to an ignition temperature successive surface portions subsequently exposed to the action of the oxidizing gas stream. In many instances, however, it is desirable to apply heating flames during an entire flame machining operation so as to remove a greater amount of metal per cubic foot of oxidizing gas.

Although the metal removed can be reduced completely to an oxidized form, considerable economy can be effected in the amount of oxidizing gas used by removing a substantial portion of the metal without completely oxidizing it. The metal removed comprising a mixture of oxidized metal and molten metal has been termed a "slag"; and such slag blown ahead of the nozzle as the cut is being made, is reduced substantially to a non-adherent granular state.

In practicing the present method of flame machining the plates or other structural shapes are preferably supported in a substantially horizontal plane, and the grooves or cuts may be produced on one or both sides of a plate. After a plate has once been suitably supported and it is desired to produce a groove or grooves on the under side thereof, such groove or grooves can readily be made by positioning the nozzle at the under side of the plate and moving the same relatively thereto.

Although it has been stated that the above-described nozzles are particularly suitable for producing cuts or grooves along seams formed by adjacent metallic bodies, it is to be understood that they are equally applicable to other flame machining applications where it is desired to remove metal from metallic bodies in the manner described above.

While we have shown particular embodiments of our invention, it will be apparent to those skilled in the art that modifications may be made without departing from the spirit and scope of our invention.

We claim:

1. A blowpipe nozzle for flame machining having an oxidizing gas passage extending therethrough terminating in a discharge orifice, said passage having a portion of constant cross sectional area extending back from said orifice with a short end section thereof adjacent the discharge orifice at an abrupt obtuse angle to the remainder of the passage, whereby the oxidizing gas leaving the orifice is caused to expand laterally a desired amount.

2. A blowpipe nozzle for flame machining deep grooves comprising a main body portion and a short end portion at an obtuse angle thereto, the axes of both portions lying in a plane and both portions being substantially symmetrical about their axes and having cross sections whose width in the direction perpendicular to said plane is smaller than the corresponding dimension in said plane, said nozzle having an oxidizing gas passage terminating in an end orifice and a plurality of combustible gas passages therethrough, all of said passages having an abrupt angular change of direction at the juncture of said main body portion and said end portion.

3. A blowpipe nozzle for flame machining deep grooves comprising a main body portion and a short end portion at an obtuse angle thereto, the axes of both portions lying in a vertical plane and both portions being substantially symmetrical about their axes and having cross sections whose width in the direction perpendicular to said plane is smaller than the corresponding dimension in said plane, said nozzle having an oxidizing gas passage terminating in an end orifice and a plurality of combustible gas passages therethrough, all of said passages being of circular cross section and having an abrupt angular change of direction at the juncture of said main body portion and said end portion, said combustible gas passages being divided into two groups having orifices disposed adjacent the upper and lower sides of the end orifice.

4. A blowpipe nozzle for flame machining having an oxidizing gas passage extending therethrough terminating in a discharge orifice, said passage having an inlet of smaller cross-sectional area than said orifice, an expanding portion be-

tween the inlet and the orifice, the expanding portion being proportioned to reduce the velocity of the gas passed therethrough, and a portion of substantially constant cross-sectional area between said expanding portion and the orifice, having a short end portion adjacent the orifice, arranged at an abrupt obtuse angle with the remainder of the portion of constant cross-sectional area.

5. A blowpipe nozzle for flame machining deep grooves comprising a main body portion and a short end portion at an obtuse angle thereto, the axes of both portions lying in a plane and both portions being substantially symmetrical about their axes and having cross sections whose width in the direction perpendicular to said plane is smaller than the corresponding dimension in said plane, said nozzle having an oxidizing gas passage terminating in an end orifice and a plurality of combustible gas passages therethrough, all of said passages having an angular change of direction at the juncture of said main body portion and said end portion, said combustible gas passages terminating in two groups of heating orifices disposed in rows adjacent the upper and lower sides of said end orifice respectively, the outer heating orifices in each row being inclined laterally to the plane so as to direct heating gas toward the sides of the groove.

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