United States Patent [19]

Miller

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[54] **OXY-OIL BURNER**

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[52] **U.S. Cl.** **431/354;** 239/132.3; 239/424.5

[51] **Int. Cl.²** **B05B 15/00;** F23D 15/02

[58] **Field of Search**.............. 239/132.1, 132.3, 424, 239/425, 424.5, 132; 431/354

[56] **References Cited**

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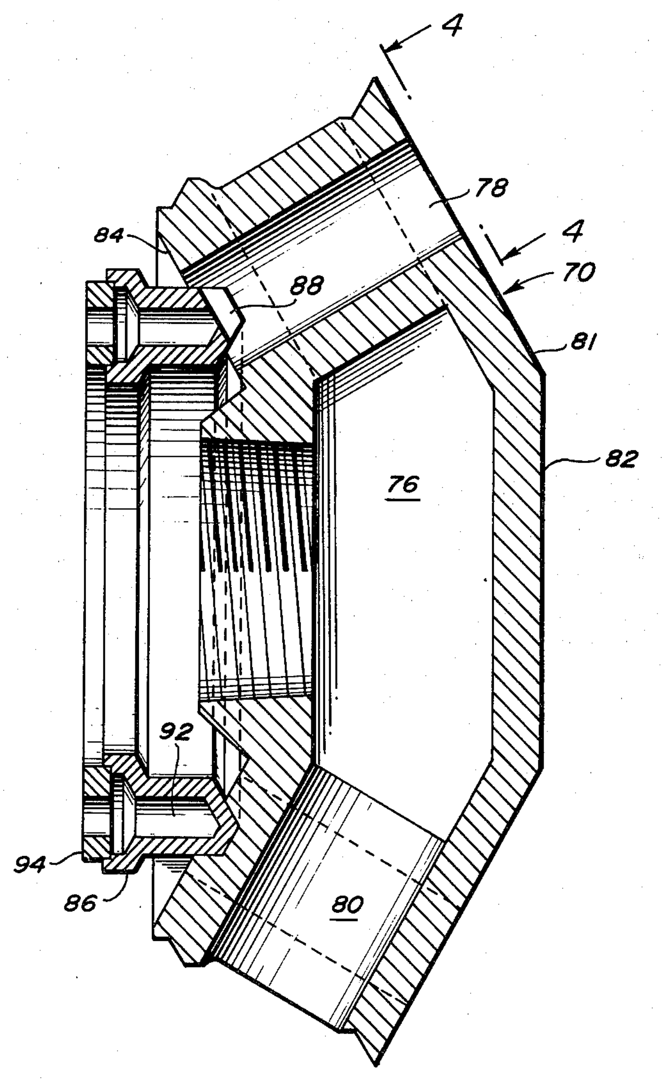
3,220,716	11/1965	Armstrong et al.	239/132.3
3,266,552	8/1966	Denis	239/132.3
3,644,076	2/1972	Bagge	239/132.3
3,680,785	8/1972	Miller	239/132.3
3,685,740	8/1972	Shepherd	239/132.3

Primary Examiner—John J. Camby
Assistant Examiner—Henry C. Yuen
Attorney, Agent, or Firm—James C. Simmons; Barry Moyerman

[57] **ABSTRACT**

A burner having a nozzle end for producing a flame by combustion of oil and an oxidizing fluid. The burner nozzle contains a plurality of mixing ports wherein the oil and oxidizing fluid are combined to effect atomization of the oil and mixing of the oil and oxidizing fluid. Control of the ratio of the cross-sectional area of the oxidizing fluid passage to the cross-sectional area of the oil passage and the length-to-diameter ratio of the mixing ports assure combustion at or inwardly of the mouth of the ports in order to minimize operating noise level of the burner. Further features of the burner include fluid cooling means for rapidly replacing the nozzle end of the burner.

8 Claims, 4 Drawing Figures



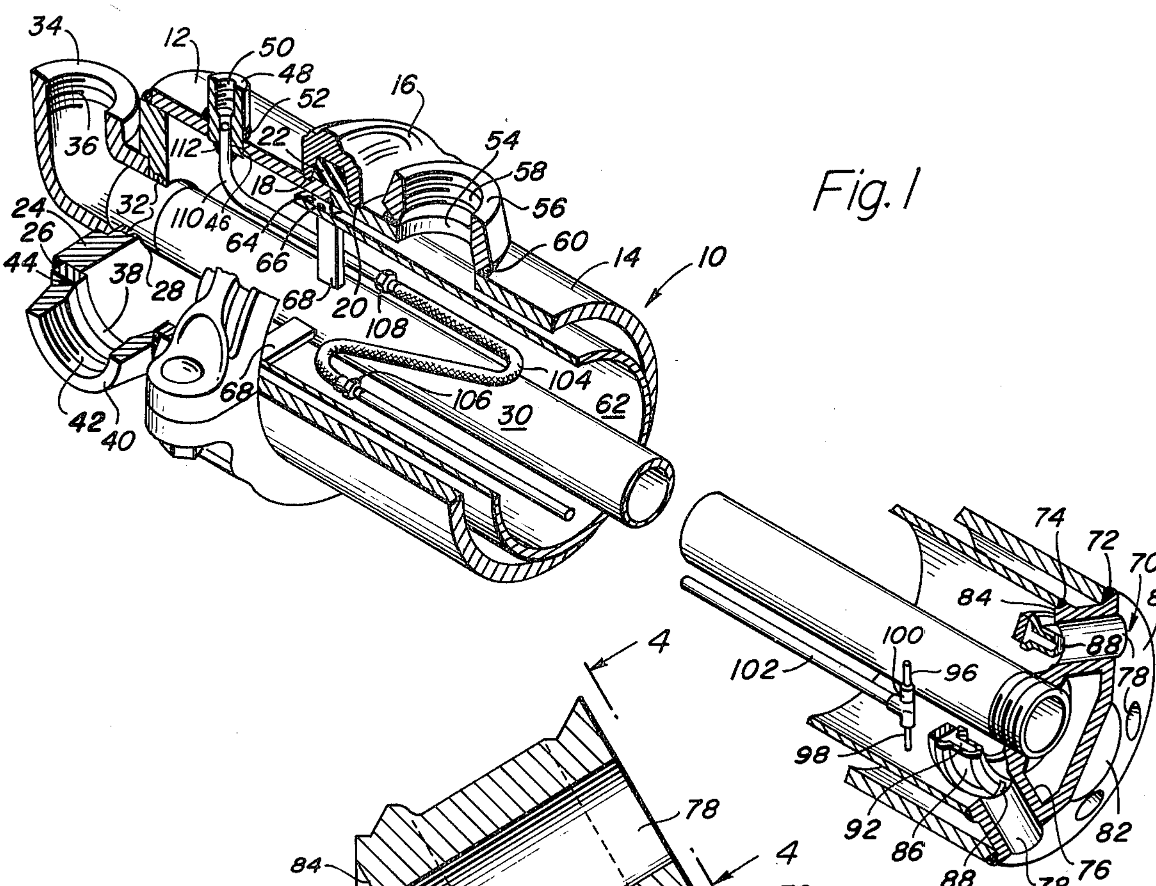

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Fig. 1

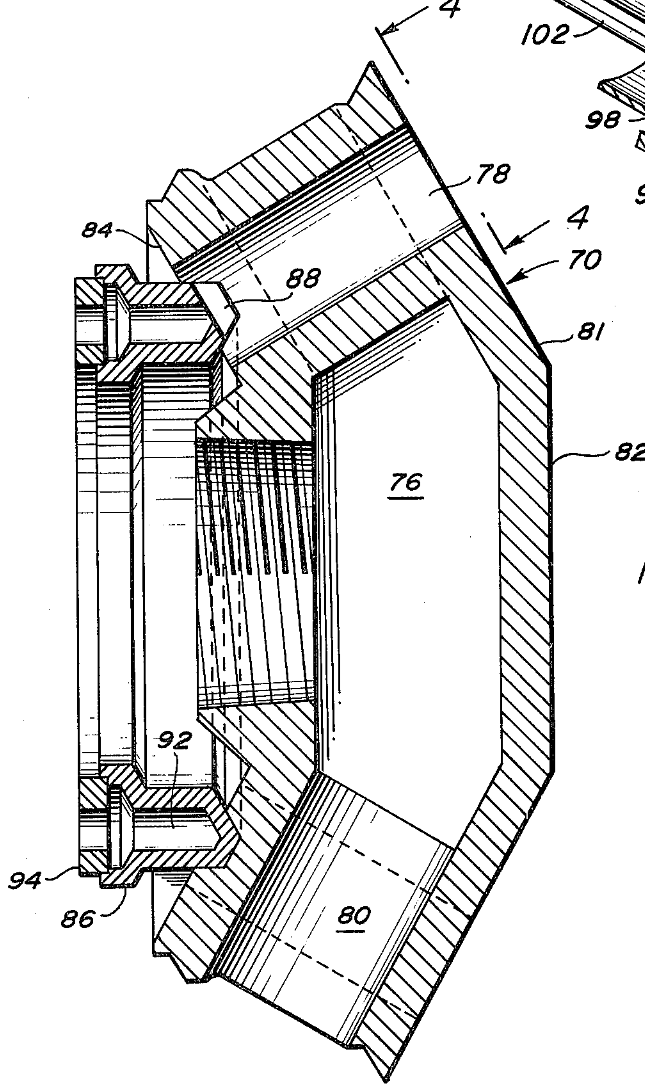
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Fig. 3

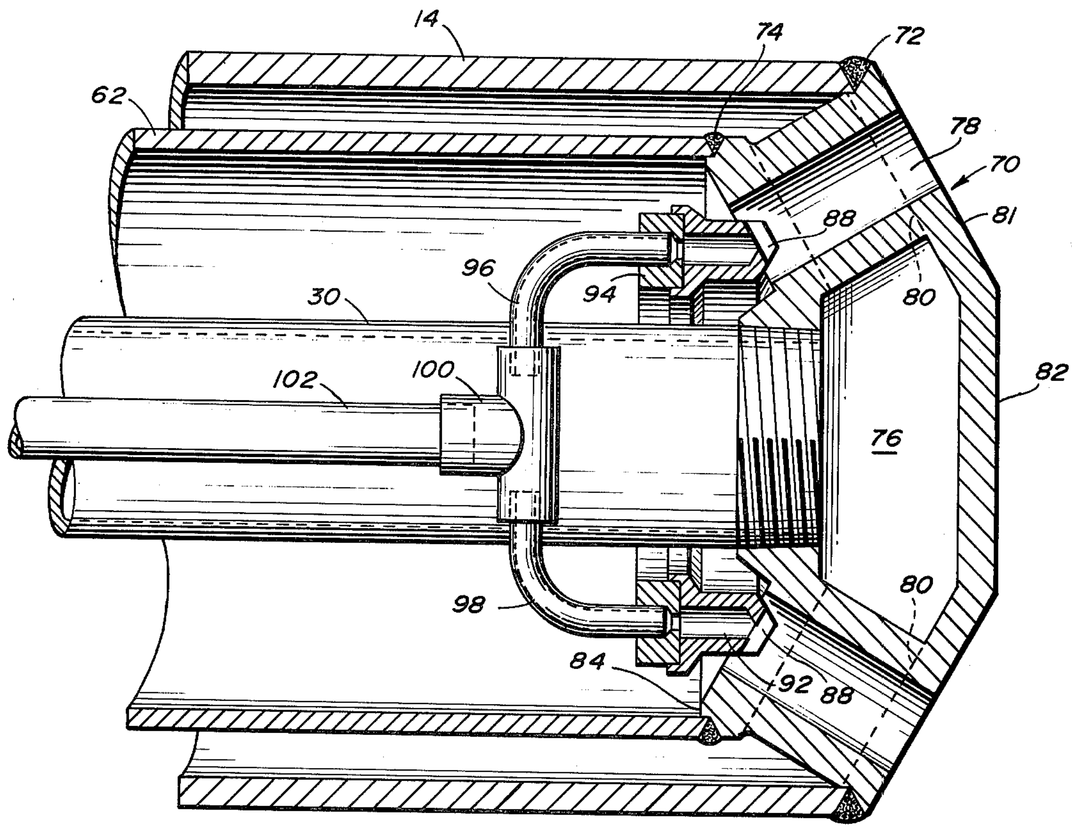
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Fig. 2

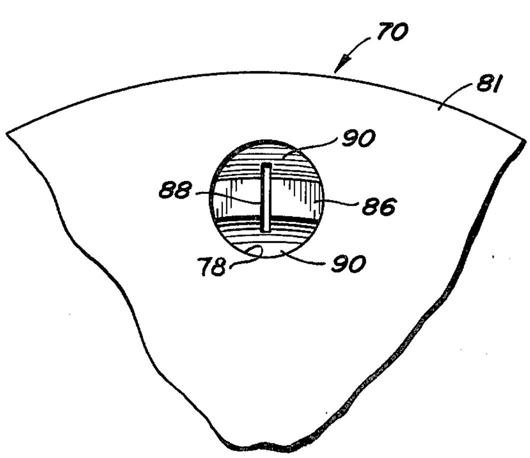
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Fig. 4

OXY-OIL BURNER

BACKGROUND OF THE INVENTION

This invention pertains to an oxy-oil burner of the type used in melting vessels for melting primary metals and nonmetallic materials, such as glass and ceramics. Such burners are commonly employed to melt large volumes of a metallurgical material, such as copper or copper-bearing ore, that is to be subsequently refined. The burners are normally placed in the wall or in the roof of a furnace and employ an oxy-oil mixture that is combusted and directed at the metals being heated.

Oxy-oil burners that have found acceptance in the metallurgical industry are shown in U.S. Pat. Nos. 3,224,679, 3,644,076, and 3,663,153. These patents show generally a single orifice burner wherein an oxidizing fluid, e.g oxygen, is combined with a hydrocarbon liquid, e.g. oil, to produce a flame. The flame is directed outwardly of the burner and towards the articles to be heated. The burners are characterized in that the mixing of the oxidizing fluid and the oil is accomplished by a bluff body or doorknob-type affair at the discharge end of the burner to assure that atomization of the oil and mixing of the oil and oxygen take place. Burners of this type generally have significant cooling problems because of the projecting bluff body and tend to operate at high noise levels and provide only a limited size of flame envelope.

SUMMARY OF THE INVENTION

The present invention relates to an oxy-oil burner that can produce melting temperatures for primary metal refining vessels using oil and an oxidizing fluid to provide a flame. The burners according to the present invention are fluid cooled and provided with a plurality of mixing ports on the outward end of the burner nozzle to significantly decrease the operating noise level of the burners. The mixing ports together with a novel method of introducing the oil to the ports provide for rapid atomization of the oil and mixing of the oil and oxidizing fluid, with the net effect being to help retain the base of the flame front at or inwardly of the mouth of the ports, and, thus the flame appears to be on the front surface of the nozzle to minimize operating noise levels. Burners according to the present invention are readily fabricated and can be made in two sections with a quick-change capability so that the nozzle end can be replaced.

Therefore, it is the primary object of this invention to provide an improved oxy-oil burner.

It is a further object of this invention to provide an oxy-oil burner for primary melting that operates at significantly reduced noise levels.

It is still another object of this invention to provide a burner of the oxy-oil type that is fluid cooled so that it can survive its operating environment.

It is still a further object of this invention to provide a metallurgical burner of the oxy-oil type that is fluid cooled and it can be quickly disassembled to replace the nozzle end thereof.

It is yet another object of this invention to provide an oxy-oil burner containing a nozzle end with means for assuring intimate mixing of the oxygen and the oil by breaking up the oil and intimately mixing the oil with the oxygen to assure combustion.

BRIEF DESCRIPTION OF THE DRAWING

FIG. 1 is an isometric drawing of a burner according to the present invention with portions cut away to reveal the interior details thereof.

FIG. 2 is an enlarged partial longitudinal section of the nozzle end of the burner of FIG. 1.

FIG. 3 is an enlarged longitudinal section of the burner nozzle with the oil ring in place.

FIG. 4 is a fragmentary view taken at lines 4—4 of FIG. 3.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring to FIG. 1, there is shown a burner **10** having a two-piece housing **12** and **14**. The housing sections **12–14** are secured together by a quick-disconnect coupling **16** such as manufactured and sold under the trademark VICTAULIC by the Victaulic Company of America. Such couplings **16** are well known in the industry and which lock the two sections **12–14** together by means of a pair of circumferential grooves **18** and **20** disposed in housing sections **12–14**. As an integral part of the coupling, there is a gasket or sealing member **22** to prevent fluid leaks from the burner.

The upper section **12** of the burner **10** has an end cap **24** affixed thereto as by a circumferential weld **26.** The cap **24** contains a central opening **28** for receiving a longitudinal conduit **30**, the purpose of which will be explained hereinafter. A recess on surface **28** contains an O-ring-type sealing member **32** to insure fluidtight sealing of the cap **24** to the conduit **30.** Cap **24** has attached thereto a fitting **34**, such as an elbow, which fitting is suitable for receiving a threaded connection as by threads **36.**

Housing section **12** contains a large circular opening **38** over which is fastened a coupling **40** for receiving a mating threaded fluid conduit not shown. Coupling **40** contains suitable threads **42** and can be flange welded to housing section **12** as by circumferential weld **44.**

Housing section **12** of burner **10,** also called the service end of the burner **10,** includes a second smaller diameter aperture **46.** Aperture **46** has in communication outwardly of the housing a coupling **48** which coupling has a series of threads **50** for receiving a fluid conduit not shown. Coupling **48** can be flange welded to housing section **12** as by a circumferential weld **52.**

Housing section **14** contains an aperture **54** and a suitable mating coupling **56.** Coupling **56** has a series of threads **58** for receiving a fluid conduit and can be flange welded to housing section **14** as by weld **60.** Disposed inwardly from housing section **14** and concentrically thereto is an annular sleeve **62.** The annular sleeve **62** is spaced apart at the service end of the housing from the housing section **14** by a spacer ring member **64**; ring member **64** is regidly affixed to housing section **12.** Spacer ring **64** contains an annular groove facing sleeve **62,** the annular groove containing a suitable sealing member such as O-ring **66.** The spacer ring **64** and O-ring seal **66** provide means by which the burner can be readily disassembled and also assures a fluidtight seal between the annulus defined by the sleeve **62** and housing section **14** at the service end of the burner. Near the service end of the burner, a plurality of spacers **68** position the central conduit **30** and hold it rigidly in place.

The forward end of housing section **14** of burner **10** has a nozzle **70**. The nozzle **70** is rigidly fixed to housing **14** and sleeve **62** as by circumferential welds **72, 74** respectively and helps space sleeve **62** from the housing section **14** at the nozzle end of the burner. As shown in FIG. **3,** the nozzle **70** has a central chamber **76** which chamber communicates with the projecting end of conduit **30.** Nozzle **70** includes a plurality of cylindrical ports **78** and between the ports **78** radial passages **80.** The radial passages **80** are made to communicate with the annulus defined by the outer surface of sleeve **62** and the inner surface of housing section **14** thereby defining a continuous passage between conduit **30,** nozzle **70,** the water jacket defined by the sleeve, and housing (**62–14** respectively), and coupling **56.**

The nozzle ports **78** open on the tapered conical portion **81** of the face (**81–82**) of the nozzle **70,** extending inwardly to the interior of the burner **10** which interior is a torus shaped (cross-section) passage extending the length of the burner and defined by the sleeve **62** and the conduit **30.** The end of the port **78** opening onto surface **81** is generally referred to as the mouth of the port. Mounted at the inward surface **84** of nozzle **70** is an oil ring **86.** The oil ring **86** contains a plurality of generally rectangular apertures **88** with one aperture for each port. The apertures **88,** as shown in FIG. **4,** are placed so that the center line of the long dimension of aperture **88** is aligned with the longitudinal axis of the port **78.** The placement of the ring **86** at the inward end of ports **78** defines two arcuate sections **90—90** that communicate with the interior passage of the burner.

The oil ring **86** has a central hollow portion **92** and is closed by a cap **94** in the shape of a flat washer. Cap **94** contains a pair of conduits **96, 98** which are fastened to the cap **94** and provide access to the interior **92** of the ring **86.** Conduits **96, 98** are connected to an adaptor such as the legs of a T-joint **100.** The depending leg of T-joint **100** is fixed to conduit **102** which in turn is connected to a length of flexible hose **104** by coupling **106,** the hose in turn through a suitable removable coupling **108** is affixed to a short length of conduit **110,** conduit **110** projecting into coupling **48** and being sealed to housing section **12** by circumferential weld **112.** Flexible hose **104** is included so that the burner can be readily taken apart for service.

The mixing ports **78** generally have a length-to-diameter ratio of between 0.4 to 1.4. This ratio was established and is shown in U.S. Pat. No. 3,680,785 owned by the Assignee of the present invention and filed in the name of the present Applicant and when observed for an oxy-fuel, e.g. natural gas burner, resulted in reduced operating noise level. This same technique used in an oxy-oil burner results in helping to anchor the flame front to the face (**81–82**) of nozzle **70** when the burner is in operation and thus minimizing the operating noise level of the oxy-oil burner. The ratio of the cross-sectional area (A_{ox}) of the oxidizing fluid passage (**90—90**) to the cross-sectional area (A_{oil}) of the oil fluid passage **88** (FIG. **4**) should be between **18** and **37** in order to achieve proper mixing of the oil and oxygen and further help to minimize operating noise levels of the burner. In practice, a burner constructed with a slot 0.025 inches wide having a ratio of 33.4 was found to operate efficiently at a reduced noise level. The configuration of oil passage and port shown in FIG. **4** provide a means by which the oxidizing fluid can aid in atomizing (breaking up) the oil and provide for adequate mixing of the oil and oxidizing fluid because the oil discharges in a fan-shaped pattern which aids in the intimate mixing of the oil and oxidizing fluid. The arrangement shown provides for high pressure oxidizing fluid, e.g. oxygen, operating at velocity on either side of the oil slot **88** so that the oxygen and oil are intimately mixed, thus providing more efficient combustion. Various A_{ox} (cross-sectional area of the oxidizing fluid passage) to A_{oil} (cross-sectional area of the oil passage) were investigated in the range of 6.15 to 36.9 representing oil apertures from 0.01 to 0.06 in width. Below 0.01, the oil tends to clog the slot and harden when the burner is not in service, thus making it necessary to clean the burner between each successive use. By observing the flame, it was decided that the best combination of flame characteristics, melting time, heating time, and radiation were achieved when the A_{ox}/A_{oil} ratio was between 18 and 37.

In operation, elbow **34** is connected to a source of coolant such as water. Coupling **56** is connected to a hose or other device for removing the fluid coolant and disposing thereof or causing the same to be cooled and recirculated. As is apparent from FIG. **1,** the fluid coolant entering adapter **34** flows down to conduit **30** through passages **80** in nozzle **70** then into the annulus defined by sleeve **62** and housing **14** and outwardly of the burner **10** through coupling **56.**

Coupling **48** is connected to a source of liquid hydrocarbon, such as oil under pressure, and the oil is conducted from coupling **48** through conduit **110** through flexible conduit **104** down through conduit **102** to the interior of ring **86** and outwardly through slots (fuel apertures) **88** into the ports **78.** Coupling **40** is connected to a source of oxidizing fluid under pressure such as oxygen and the oxidizing fluid is conducted down the burner through the passage defined by the inner surface of sleeve **62** and the outer surface of conduit **30,** past ring **86** into the ports **78.** As explained before, the high pressure flowing oxygen causes mixing and atomization of the oil in the ports **78** so that combustion takes place at or inwardly of the mouth of ports **78** of nozzle **70.** Maintaining the base of the flame front at or inwardly of the outer end of mixing cups **78** of nozzle **70** significantly reduces the operating noise level of the burner because the flame front has no aerial path between it and the face (**81–82**) of the burner nozzle **70.**

Another method of constructing the burner would be to provide the oil slots **88** along a diameter defined by the midpoint of the ring **86.** This construction is more difficult to achieve and adds to the cost of the burner.

As is known, an oil burner has advantages in that the available radiation is much greater than from an oxy-fuel (natural gas) burner because of the carbon particles present in the flame. With a bright luminous flame, there is more heat available to be directed at the furnace walls of the furnace charge.

It would also be within the scope of the invention to use a plurality of drilled holes in place of slot **88** or a ring orifice sized and shaped to discharge oil in an expanding pattern.

Having thus described my invention, what is desired to be secured by Letters Patent of the United States is set forth in the appended claims.

I claim:

1. An oxy-oil burner comprising in combination:

a generally cylindrical elongated housing having a covered service end and a nozzle end;

a fluid cooling jacket including inlet and outlet means attached to the housing for continuously cooling a major portion of the housing when the burner is in service;

a nozzle on the nozzle end of the housing containing a plurality of generally cylindrical ports extending inwardly from the outer surface of the nozzle and communicating with an internal passage defined by the inside of the housing;

means for introducing an oxidizing fluid into the internal passage in the housing;

means for admitting oil to the inward end of said ports communicating with the internal passage in the housing, said means comprising a ring-shaped member containing a plurality of oil discharge ports positioned on the center line of each of the ports so that oxidizing fluid can flow around the oil to vaporize the oil and mix with the oil for combustion at the outer surface of said nozzle; and

fluid tight passages in said nozzle between said ports and communicating with the fluid cooling jacket for cooling the nozzle with the cooling fluid used in the burner housing.

2. A burner according to claim **1** wherein the ports have a generally rectangular shape and are positioned on and perpendicular to the longitudinal center line of the port.

3. A burner according to claim **1** wherein the ratio of the cross-sectional area of oxidizing fluid passage to the cross-sectional area of the fuel passage as measured at the inward end of each port is between **18** and **37.**

4. A burner according to claim **1** wherein the cooling fluid is admitted inside said housing through a central conduit to the nozzle and is conducted through a plurality of passages across the face of the nozzle to the sides thereof where it enters the housing cooling jacket and is conducted along the housing to a discharge conduit.

5. A burner according to claim **1** wherein the housing is made in fluidtight removable sections for ready replacement of the nozzle and oil ring.

6. An oxy-oil burner comprising in combination:

a generally cylindrical housing having a covered service end and a nozzle end;

a nozzle on the nozzle end of the housing containing a plurality of generally cylindrical ports extending inwardly from the outer surface of the nozzle and communicating with the interior of the housing;

a central fluid conduit extending through the covered service end to the nozzle and communicating with a plurality of passages across the face of the nozzle, the nozzle passages further communicating with a fluid cooling jacket constructed to conduct a cooling fluid down the central fluid conduit across the face of the nozzle to the fluid cooling jacket and then along a substantial length of the housing;

means for admitting cooling fluid to the central conduit and removing fluid from the housing jacket;

means for admitting an oxidizing fluid into the housing;

a generally hollow ring-shaped member affixed to the nozzle and defining a pair of open arcuate sections at the inward end of each port;

a plurality of slots in the ring so constructed and arranged to center each slot along the longitudinal axis of each port;

a fuel conduit for conducting oil from the service end of the burner to the inside of the ring and outwardly of the ring through the slots; whereby in service the oxidizing fluid surrounds the oil to atomize and mix with the oil for combustion at the outer nozzle face.

7. A burner according to claim **6** wherein the ratio of the cross-sectional area of oxidizing fluid passage to the cross-sectional area of the fuel passage as measured at the inward end of each port is between **18** and **37.**

8. A burner according to claim **6** wherein the housing is made in fluidtight removable sections and the oil conduit includes an extended flexible section for ready replacement of the nozzle and oil ring.

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