OPIC
Office de la propriété intellectuelle du Canada

CIPO
Canadian Intellectual Property Office

(12) (19) (CA) **Brevet-Patent**

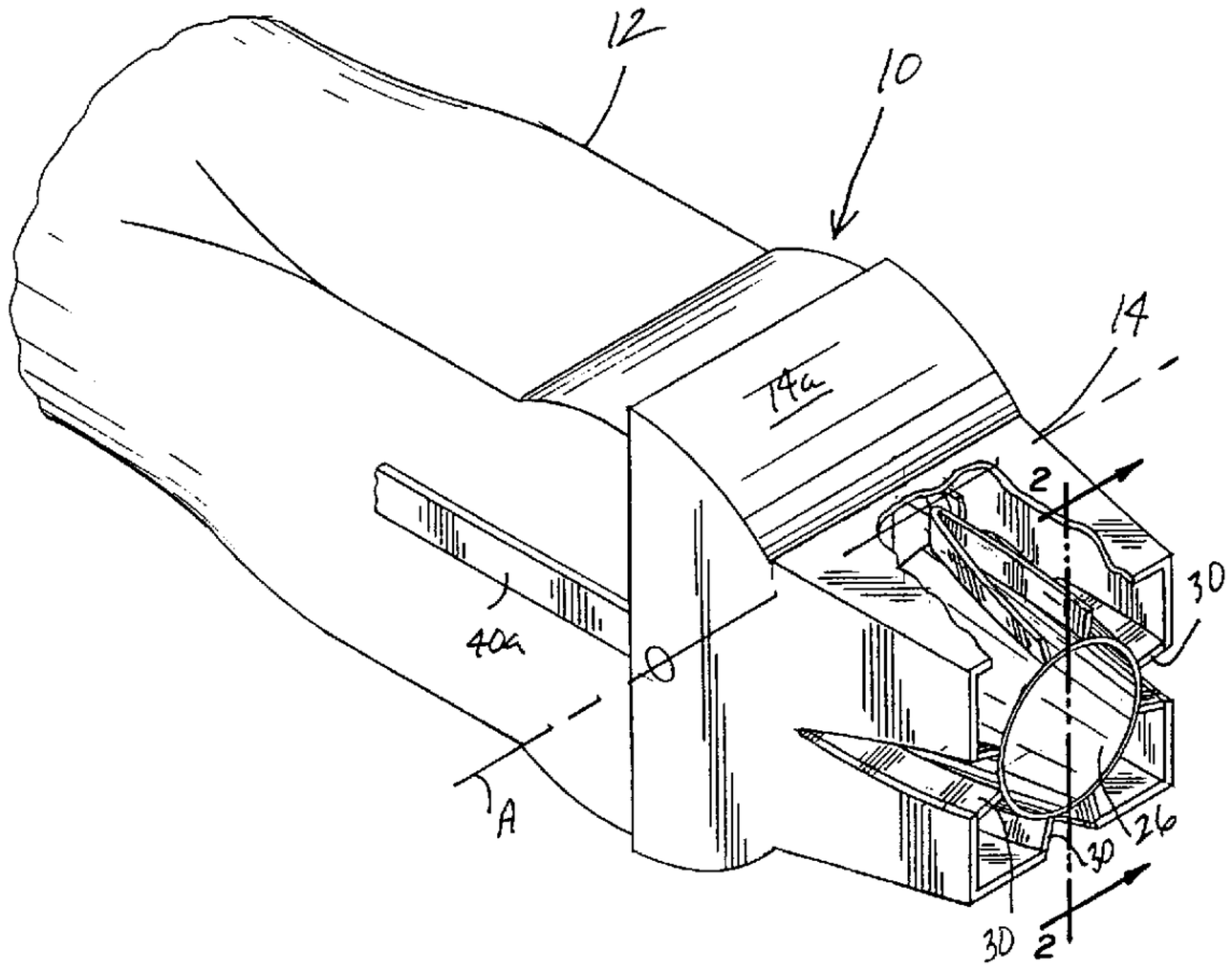
(11) (21) (C) **2,167,341**
(22) 1996/01/16
(43) 1996/07/18
(45) 2000/03/21

(72) Vatsky, Joel, US
(72) Sweeney, Timothy W., US
(72) Newman, Lawrence F., US
(73) FOSTER WHEELER ENERGY CORPORATION, US

(51) Int.Cl.[6] F23D 1/00
(30) 1995/01/17 (08/373,810) US

(54) **BRULEUR A JET DIVISE, INCLINABLE, AVEC JOINT D'ETANCHEITE**

(54) **TILTABLE SPLIT STREAM BURNER ASSEMBLY WITH GASKET SEAL**



(57) A burner assembly having an outer barrel formed into an inlet portion for receiving the fuel and a nozzle for discharging the fuel. An annular passage is provided in the nozzle through which fuel passes before being split up into a plurality of streams to produce a plurality of individual flame patterns upon ignition. The nozzle is tiltable relative to the inlet portion to enable the assembly to be utilized in multiple furnace configurations.

TILTABLE SPLIT STREAM BURNER ASSEMBLY WITH GASKET SEAL

Abstract of the Disclosure

A burner assembly having an outer barrel formed into an inlet portion for receiving the fuel and a nozzle for discharging the fuel. An annular passage is provided in the nozzle through which fuel passes before being split up into a plurality of streams to produce a plurality of individual flame patterns upon ignition. The nozzle is tiltable relative to the inlet portion to enable the assembly to be utilized in multiple furnace configurations.

TILTABLE SPLIT STREAM BURNER ASSEMBLY WITH GASKET SEAL

Background of the Invention

This invention relates generally to a burner assembly and, more particularly, to a burner assembly which discharges a plurality of streams of coal and air for combustion in a furnace and which has a tiltable discharge portion to vary the discharge pattern.

Considerable attention and efforts have been directed to the reduction of nitrogen oxides resulting from the combustion of fuel, and especially in connection with the use of coal, in the furnace sections of relatively large installations such as vapor generators, and the like. In a typical arrangement for burning coal in a vapor generator, several burners are disposed in communication with the interior of the furnace and operate to burn a mixture of air and pulverized coal. The burners used in these arrangements are generally of the type in which a fuel-air mixture is continuously injected through a nozzle so as to form a single relatively

large flame. As a result, the surface area of the flame is relatively small in comparison to its volume, and therefore the average flame temperature is relatively high. However, in the burning of coal, nitrogen oxides are formed by the fixation of atmospheric nitrogen available in the combustion supporting air, which is a function of the flame temperature. When the flame temperature exceeds 2800° F., the amount of fixed nitrogen removed from the combustion supporting air rises exponentially with increases in the temperature. This condition leads to the production of high levels of nitrogen oxides in the final combustion products, which cause severe air pollution problems.

In view of the foregoing, attempts have been made to suppress the flame temperatures during the combustion process and thus reduce the formation of nitrogen oxides. Attempted solutions have included techniques involving two stage combustion, flue gas recirculation, the introduction of an oxygen-deficient fuel-air mixture to the burner, and the breaking up of a single large flame into a plurality of smaller flames. However, although these attempts singularly may produce some beneficial results, they have not resulted in a reduction of nitrogen oxides to minimum levels.

In U.S. patent No. 4,348,170, assigned to the same assignee as the present invention, a burner assembly is disclosed which considerably reduces the formation of nitrogen oxides. To this end, an annular stream of fuel, preferably in the form of pulverized coal suspended or entrained within a source of primary air, is split into a plurality of streams adjacent the discharge end of the burner which

produce a corresponding number of individual flame patterns upon combustion. This results in a greater flame radiation, a lower average flame temperature and a shorter residence time of the gas components within the flame at a maximum temperature, all of which contribute to reduce the formation of nitrogen oxides.

However, the burner assembly disclosed in the above patent was designed for a particular furnace configuration, and, as such, is not suitable for other special application furnaces, such as, for example, tangentially fired furnaces.

Summary of the Invention

It is therefore an objection of the present invention to provide a burner assembly which enjoys all of the advantages of the burner assembly disclosed in the above-identified patent including the reduction of nitrogen oxides in the combustion of fuel.

It is a more specific object of the present invention to provide a burner assembly of the above type which is adaptable for use in multiple furnace configurations.

Toward the fulfillment of these and other objects, the burner assembly of the present invention includes an annular passage through which fuel passes before being split up into a plurality of streams near the discharge end of the burner assembly, to produce a plurality of individual flame patterns upon ignition. The outer barrel of the assembly receives the fuel and a discharge nozzle is tiltable relative to the outer barrel to enable the assembly to be utilized in multiple furnace configurations, including tangentially fired furnaces.

Brief Description of the Drawings

The above brief description, as well as further objects, features and advantages of the present invention will be more fully appreciated by reference to the following detailed description of the presently preferred but nonetheless illustrative embodiments in accordance with the present invention when taken in conjunction with the accompanying drawings wherein:

Fig. 1 is a partial, elevational view depicting the burner assembly of the present invention;

Fig. 2 is a sectional view taken along the line 2-2 of Fig. 1; and

Fig. 3 is an enlarged, partial, sectional view of a portion of the burner assembly of Fig. 1.

Description of the Preferred Embodiments

Referring specifically to Figs. 1 and 2 of the drawings, the reference numeral 10 refers in general to the burner assembly of the present invention. The burner assembly 10 includes a tubular inlet barrel 12 and a discharge nozzle 14 connected to, and forming an extension of, the inlet barrel 12 in a manner to be described. A cap 16 (Fig. 2) extends over one end 12a of the inlet barrel and the other end 12b is enlarged for reasons to be described. The discharge nozzle 14 is connected to, and forms an extension of, the inlet barrel 12. The discharge nozzle 14 has an enlarged end portion 14a extending over the enlarged end portion 12b of the inlet barrel 12, while the other end 14b of the nozzle 14 is open and is configured in a manner to be described.

An inner tubular member 18, of a diameter less than that of the inlet member 12, extends within the inlet barrel 12 to define an annular passage 20. The inner member 18, and therefore the passage 20, extend from the end 12a of the barrel 12 for a portion of the length of the latter member, and a cover, or cap, 22 is provided on the inner end of the member 18.

A duct 24 is connected to the barrel 12 and registers with an opening 12c in the wall of the barrel. The duct extends tangentially with respect to the annular passage 20 for introducing a stream of fuel, preferably in the form of pulverized coal mixed with air into the passage, as will be explained in detail later.

As better shown in Fig. 2, that portion of the nozzle 14 extending from its enlarged portion 14a to its end 14b has a rectangular cross section which tapers in a direction towards the end 14b. A divider cone 26 is disposed within the nozzle 14 and extends from the enlarged portion 14a of the nozzle 14 to its end 14b. The cone 26 is hollow and thus defines a central passage 27 and has a taper substantially corresponding to the taper of the nozzle 14. The cone 26 has a diameter less than that of the nozzle 14 to define an annular passage 28 surrounding the central passage 27. The inlet ends of both the central passage 27 and the annular passage 28 are located immediately adjacent the enlarged portion 14a of the nozzle 14 and their discharge ends extend flush with the end 14b of the latter member.

Four splitters 30 extend within, and are circumferentially spaced around, the annular passage 28. The splitters 30 are spaced at 90° intervals and each is substantially V-shaped with its respective apex disposed adjacent the inlet end of the annular passage 28. The other ends of the splitters 30 extend flush with the end 14b of the nozzle 14 and therefore the discharge end of the annular passage 28. It is noted that, in practice, the nozzle 14 can be molded into an integral unit which would include the cone 26 and the splitters 30.

Although not shown in the drawings for the convenience of presentation, it is understood that a plurality of openings can be formed through the nozzle 14 for the purpose of admitting secondary air into the annular passage 28 as shown and described in the above-cited patent number 4,348,170.

Referring to Fig. 3, the enlarged portion 12a of the barrel 12 is connected to the enlarged end portion 14a of the nozzle 14 by a gasket seal assembly, referred to in general by the reference numeral 32. The seal assembly 32 abuts the end of the inlet member 12 as well as a corresponding inner surface portion of the discharge member 14 and is formed by an annular mesh member 34 and an annular frame member 36. The frame member 36 is U-shaped in cross-section is crimped around the inner portion of the mesh member 34 and can be secured to the barrel 12 in any known manner, such as by welding.

A

The nozzle 14 is tilted relative to the barrel 12 by means of a pair of arms 40a (Fig. 1) and 40b (Fig. 2) respectively attached to diametrically opposed outer surfaces of the nozzle 14. The arms 40a and 40b extend horizontally, as viewed in Fig. 1, and are attached to a linkage mechanism (not shown) which produces an up-and-down movement, causing the nozzle 14 to pivot about an axis A. This linkage mechanism is fully disclosed in Canadian Patent File No. 2,154,840 (attorney's docket number 10283.401), filed on July 27, 1995 and assigned to the assignee of the present invention, the disclosure of which may be referred to for further details. This pivotal, or tilting movement of the nozzle 14 about the axis A is accommodated by the gasket seal assembly 32 which also seals against any leakage of the fuel/air mixture.

Although not shown in the drawings, it is understood that, in use, the burner assembly 10 would be disposed in axial alignment with a through opening formed in a front wall of a conventional furnace having a combustion chamber immediately adjacent the opening. In most installations, similar openings would be provided in the furnace front wall for accommodating additional burner assemblies identical to the burner assembly 10. Also, a windbox and one or more air nozzles would be provided for introducing additional, or secondary, air into the furnace as disclosed in the above-identified Canadian Patent application file number 2,154,840 (attorney's docket number 10283.401). It is also understood that appropriate igniters (not shown) can be provided adjacent the outlet of the assembly 10 for igniting the coal as it discharges from the nozzle. Since the igniters are of a

conventional design they have not been shown in the drawings in the interest of clarity.

In operation of the burner assembly 10, fuel, preferably in the form of pulverized coal suspended or entrained within a source of primary air, is introduced from an external source into the duct 24, and passes through the duct into the interior of the barrel 12 where it swirls through the annular passage 20. Since the pulverized coal is heavier than the air, the pulverized coal will tend to move radially outwardly towards the inner wall of the barrel 12 under the centrifugal forces thus produced. The stream of coal and air pass from the interior of the barrel 12 to the interior of the nozzle 14 and, as a result of the above-mentioned centrifugal forces, the stream consists of a relatively large portion of coal and a relatively small portion of air. The stream then enters the outer annular passage 28 defined between the nozzle 14 and the divider cone 26 and encounter the splitters 30. The stream is thus split into four equally spaced streams which discharge from the outlet defined by the respective ends of the discharge member 14 and the cone 26.

Thus, upon ignition, four separate flame patterns are formed which extend into the interior of the above-mentioned furnace. Another stream is formed by the remaining portion of the air-coal mixture that passes through the center passage 27 of the discharge member 14 towards its center, which mixture includes primarily air. This latter stream then discharges from the end of the nozzle 14 where it is surrounded by the flame patterns discharging from the annular

passage 28. The nozzle 14 can be tilted by actuation of the arms 40a and 40b to vary the discharge angle of the flame patterns relative to the furnace opening.

The igniters are then shut off after steady state combustion has been achieved, and it is understood that secondary air can be introduced to the flame patterns in the manner described in the above-identified patent No. 4,348,170.

Several advantages result from the foregoing. For example, the provision of multiple flame patterns results in a greater flame radiation, a lower average flame temperature and a shorter residence time of the gas components within the flame at a maximum temperature, all of which, contribute to reduce the formation of nitric oxides. Also, the provision of the tangential inlet to the annular passage 20 provides excellent distribution of fuel, resulting in more complete combustion and reduction of carbon loss and making it possible to use individual burners with capacities significantly higher than otherwise could be used. Further, the nozzle 14 may be tilted, or pivoted, relative to the inlet member 12 before operation to accommodate different furnace configurations and requirements.

It is understood that several variations and additions may be made to the foregoing within the scope of the invention. For example, since the arrangement of the present invention permits the admission of air at less than stoichiometric, overfire air ports, or the like, can be provided as needed to supply air to complete the combustion.

As will be apparent to those skilled in the art, various changes and modifications may be made to the embodiments of the present invention without

departing from the spirit and scope of the present invention as defined in the appended claims and the legal equivalent.

WHAT IS CLAIMED IS:

1. A burner assembly comprising an inlet member for receiving fuel, a discharge member connected to, and forming an extension of, said inlet member for receiving said fuel, a divider member disposed within said discharge member for dividing said discharge member into a central passage and an annular passage surrounding said central passage, whereby a portion of said fuel from said inlet member passes into said central passage and a portion passes into said annular passage, means associated with said annular passage for splitting the stream of fuel passing through said annular passage into a plurality of streams as it discharges from said discharge member so that, upon ignition of said fuel, a plurality of flame patterns are formed, and means for tilting said discharge member relative to said inlet member to vary the discharge angle of said flame patterns relative to said axis of said inner member.

2. The burner assembly of claim 1 wherein said splitting means comprises a plurality of V-shaped members extending in a circumferentially spaced relationship in said annular passage in a manner so that the apex of each member faces upstream and said fuel stream in said annular passage impinges against said members which direct said stream into the spaces between said members.

3. The burner assembly of claim 1 further comprising means for defining an annular passage in said inlet member for receiving said fuel.

4. The burner assembly of claim 3 wherein said fuel-supplying means comprises means for directing fuel into said annular passage of said inlet member in a tangential direction relative to said latter passage.

5. A burner assembly comprising a barrel, a tubular member disposed within the barrel and defining therewith an annular passage, an inlet conduit for directing fuel into the annular passage in a tangential direction relative to the latter passage so that the fuel flows through the annular passage in an annular flow stream, a discharge member connected to, and forming an extension of, the barrel for receiving the annular flow stream of fuel from the annular passage and discharging the fuel, a divider member disposed within the discharge member for dividing the discharge member into a central passage for receiving a first portion of the annular flow stream of fuel and an outer passage surrounding the central passage for receiving a second portion of the annular flow stream of fuel, at least one splitter disposed in the outer passage for splitting the second portion of the annular flow stream of fuel into a plurality of streams as it discharges from the discharge member so that, upon ignition of the fuel, a plurality of flame patterns are formed, the discharge member being tiltable relative to the barrel to vary the discharge angle of the streams relative to the axis of the barrel.

6. The burner assembly of claim 5 wherein each splitter comprises a V-shaped member having its apex facing upstream towards the second portion of the annular flow stream of fuel, the splitters extending in a circumferentially-spaced relationship in the outer passage so that the second portion of the annular flow stream of fuel impinges against the V-shaped members which splits the latter flow stream and directs the split streams into the spaces between the V-shaped members.

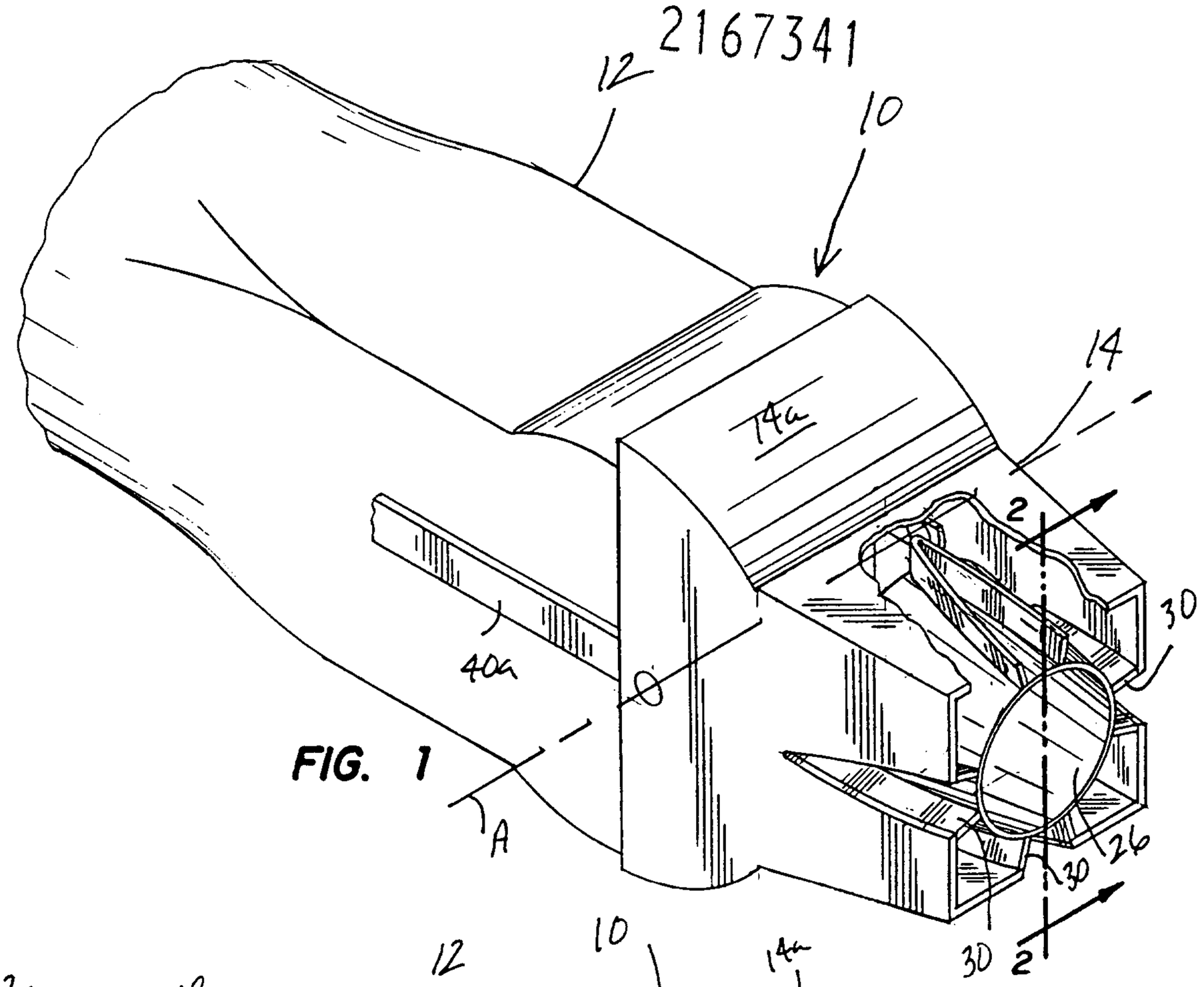


FIG. 1

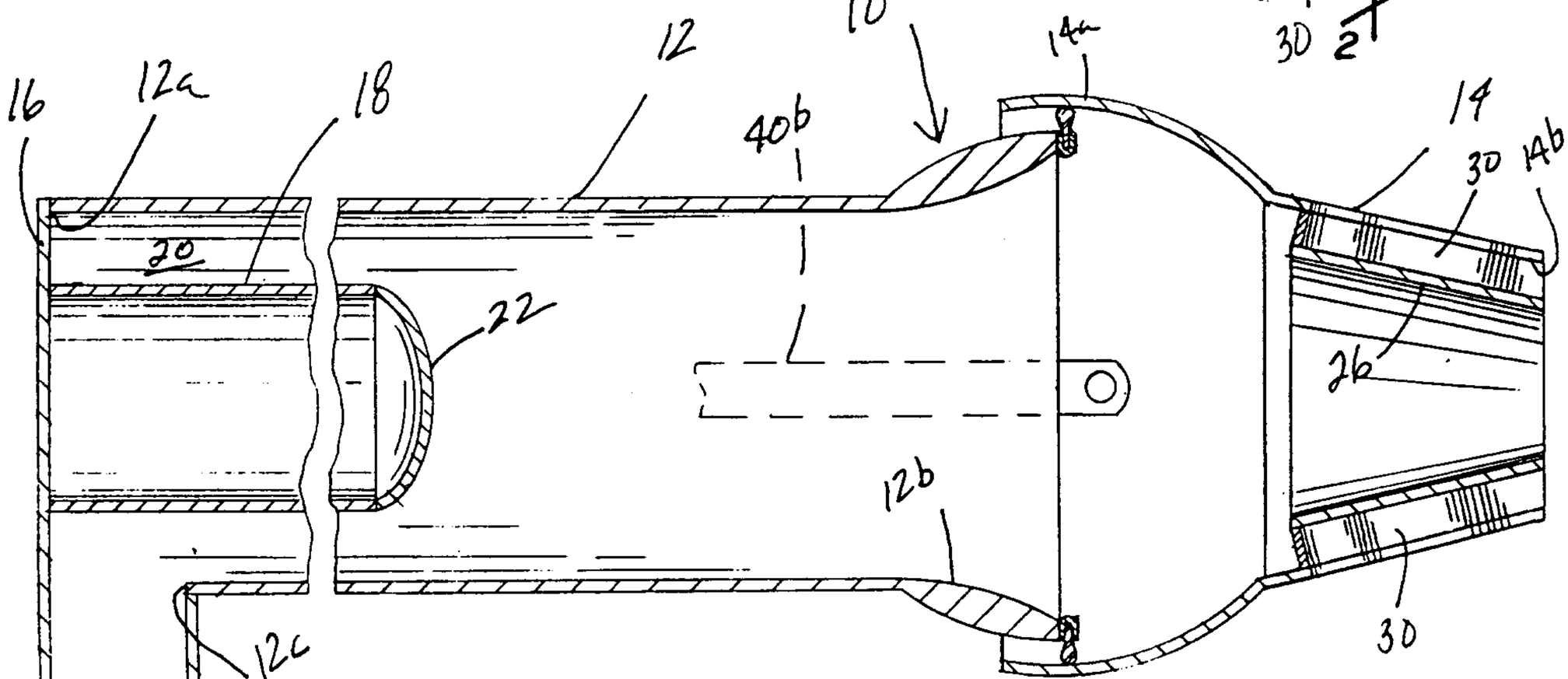


FIG. 2

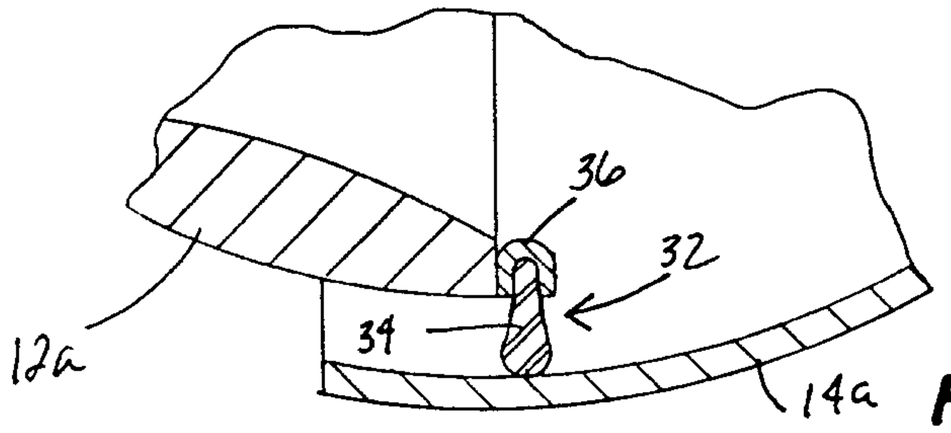


FIG. 3