United States Patent

Bagge

[15] **3,644,076**

[45] **Feb. 22, 1972**

[54] **LIQUID FUEL BURNER**

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[73] Assignee: **Shell Oil Company**, New York, N.Y.

[22] Filed: **May 1, 1970**

[21] Appl. No.: **33,572**

[30] **Foreign Application Priority Data**

May 8, 1969 Great Britain 23,443/69

[52] **U.S. Cl.**.....**431/284**, 431/350, 239/132.3, 239/424.5, 239/434, 239/434.5

[51] **Int. Cl.**.....**F23q 9/00**

[58] **Field of Search**.....431/160, 284, 350, 353, 354; 239/132.1, 132.3, 416.5, 417, 417.3, 424, 424.5, 434, 434.5

[56] **References Cited**

UNITED STATES PATENTS

3,485,452	12/1969	Sborlino	239/417
3,224,679	12/1965	Kear et al.	239/132.3
3,074,231	1/1963	Klein	239/417
2,167,183	7/1939	Naab et al.	431/284

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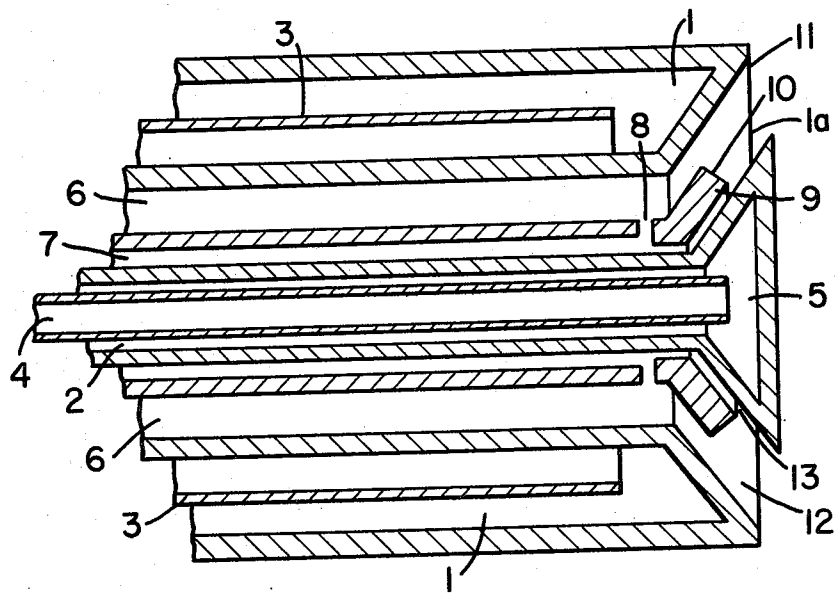
Attorney—J. H. McCarthy and T. E. Bieber

[57] **ABSTRACT**

A liquid fuel furnace comprising a hollow coolant enclosure and at least a first annular oxidant channel therein adjacent to and concentric with a second annular liquid fuel channel inwardly of the first channel. A fuel supply opening is in communication with both of the channels and a bluff body is disposed downstream of the opening and retracted with respect to the end face of the enclosure thereby forming, together with the opening, an annular fuel and oxidant discharge duct common to the first and second channels.

10 Claims, 6 Drawing Figures



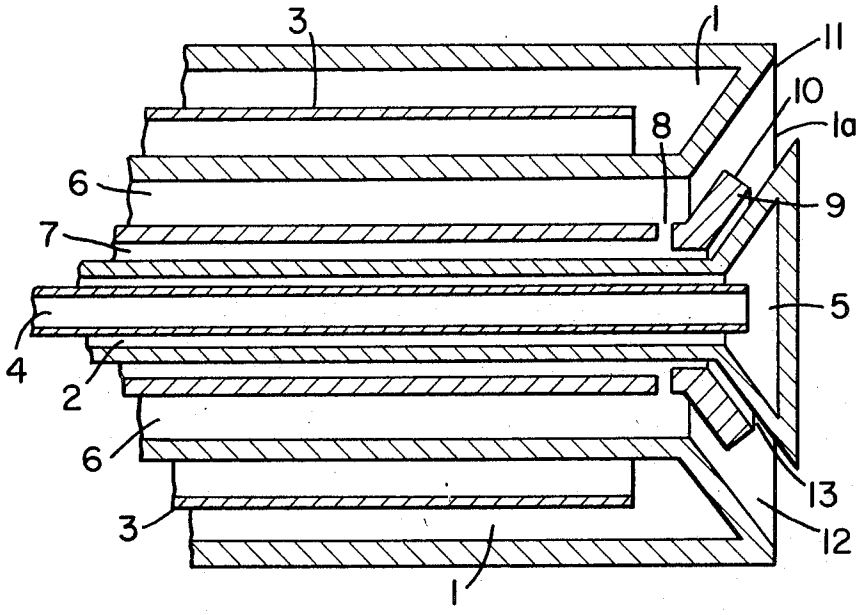


FIG_1

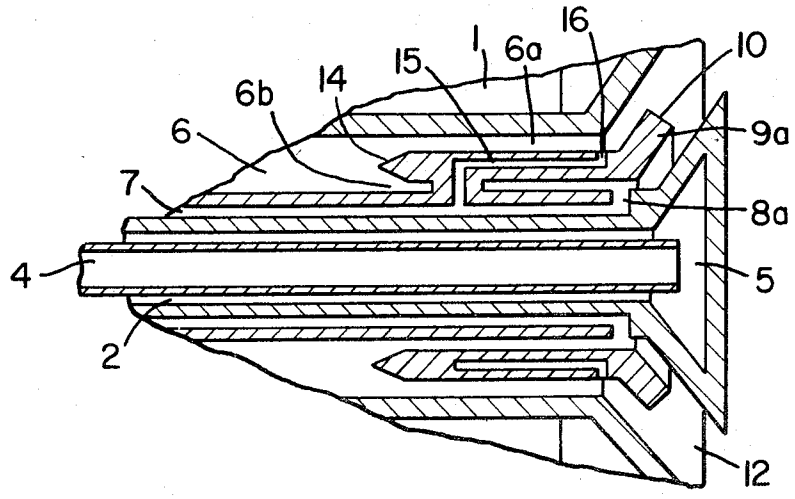


FIG_2

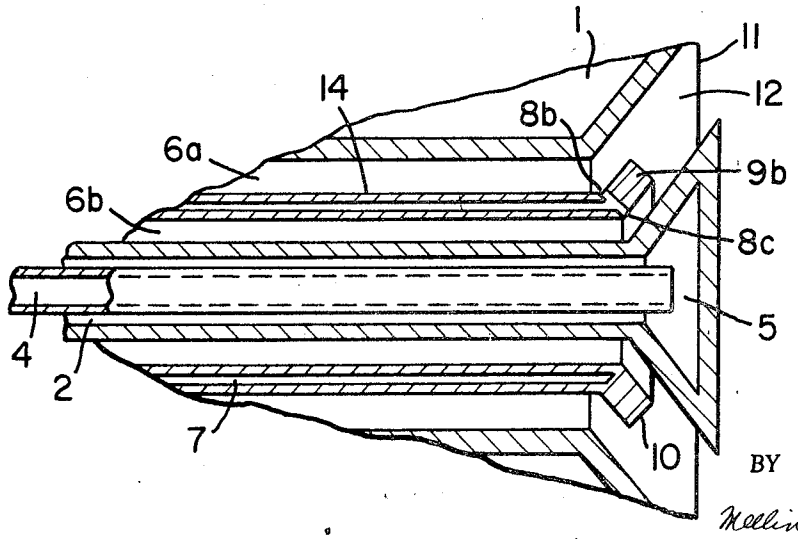


FIG_3

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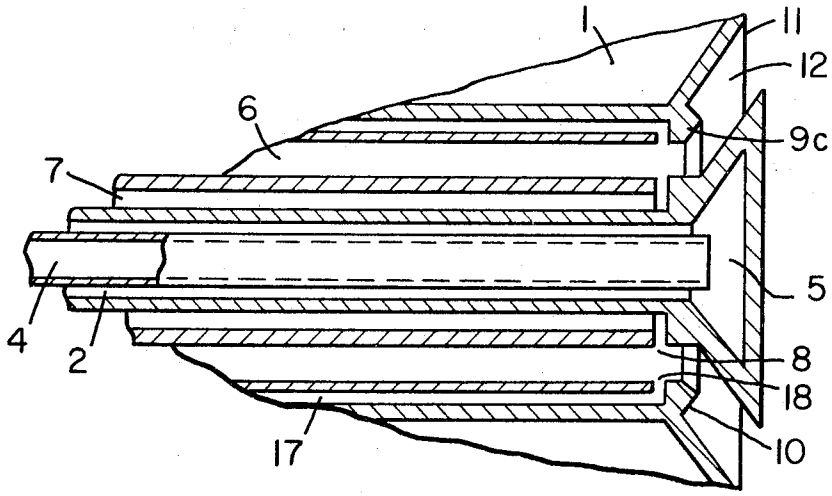

FIG_4

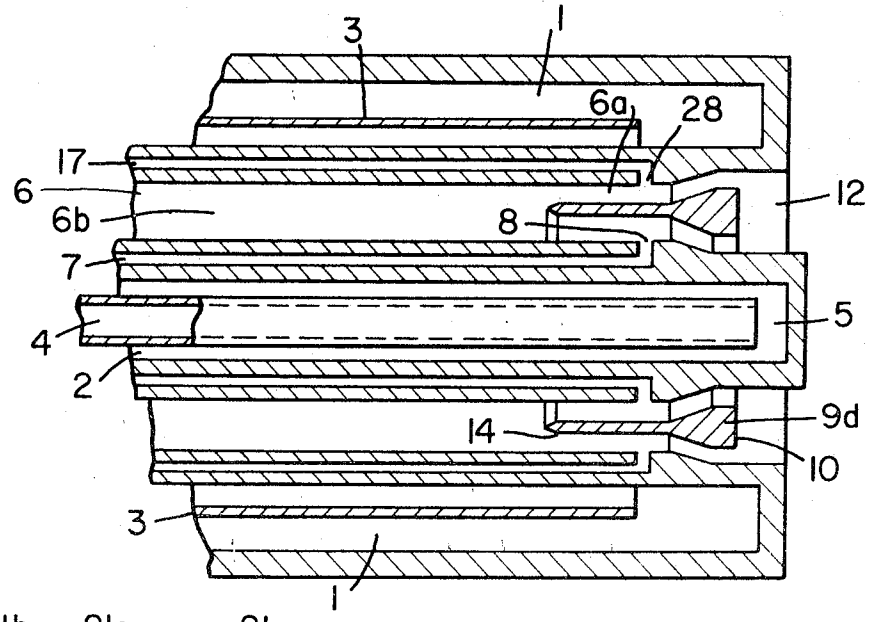

FIG_5

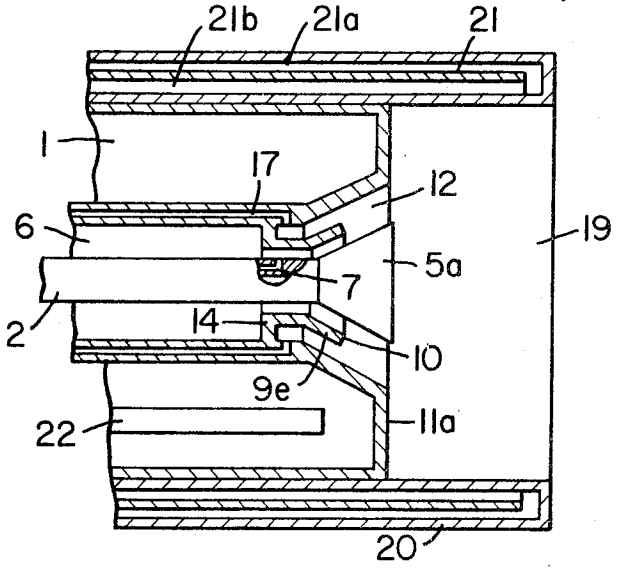

FIG_6

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LIQUID FUEL BURNER

BACKGROUND OF THE INVENTION

1. Field of the Invention

This invention relates to a burner for liquid fuel; and more particularly, to a burner which is designed for large scale use in industrial appliances, for instance in steel works, and which is able to operate with either oxygen or air, or air enriched with oxygen, as the oxidant, together with a liquid fuel, such as a liquid hydrocarbon.

2. Description of the Prior Art

In such type of burners, provisions have been made to ensure a stable combustion over a certain operating range by creating stabilizing vortices by the hot combustion gases. This is achieved in different ways by the design of the burner end face and/or by a specially adapted flame chamber or heating or reaction space to which the burner is connected.

The main criticism which has been made in such industrial high-intensity burners is the very high noise level that they produce, even though this is often partly attenuated by a furnace structure.

SUMMARY OF THE INVENTION

An object of the present invention is to provide a burner which ensures a stable combustion accompanied by a considerable noise reduction while operating with a liquid fuel feed over a large range.

According to the preferred embodiment of the present invention, in a burner of the type specified, a bluff body is provided in the main channel downstream of a series of lateral fuel supply openings, but retracted with regard to the end face of the burner so as to form one common annular discharge duct for fuel and oxidant.

The bluff body serves as a means for achieving prestabilization by having a marked increase in the final width of the main channel, and a turbulence is set up which serves to increase the mixing of the oxidant and the vaporizing fuel and to anchor the flame at this point. By performing this prestabilizing action, the combustion of the mixture of fuel and oxidant proceeds in a uniform manner from the point of ignition, and so gives a flame having an overall noise level significantly less than that of the conventional flames, which are stabilized by recirculation of hot gases towards the end face of the burner, and which flames have a sudden flame front occurring a short distance from the burner mouth.

Preferably, the bluff body has a flat end face substantially perpendicular to the flow direction through the main channel.

In a particular embodiment of the invention, the bluff body may be arranged against a lateral wall of the main channel and formed by a sudden widening of the cross section of the main channel. In an alternative arrangement, according to the invention, the bluff body may originate from a partition wall in at least a part of the main channel upstream of the bluff body subdividing the main channel into an inner part and an outer part.

The invention is not only suitable for long flame burners, but also is applicable to designs for producing short, wide-angled "umbrella"-form flames. To this end, according to the invention, the annular channel at the discharge end may be conical with substantially constant cross section and diverging to the burner end face, the bluff body being present in the conical part of the annular channel.

The invention is suitable to be applied in combustion devices wherein the burner end face constitutes the bottom of a substantially cylindrical flame chamber adapted to communicate with a heating or reaction space. After prestabilization by the presence of the bluff body, the flame is subsequently further stabilized by the internal and external toroidal recirculation of hot combustion products.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a vertical cross-sectional view of the front part of a burner according to the invention;

FIG. 2 is a vertical cross-sectional view similar to FIG. 1 of an alternative embodiment of the invention.

FIG. 3 shows a vertical cross-sectional view of still another embodiment of the invention;

FIG. 4 is a vertical cross-sectional view of an embodiment of the invention comprising a provision for the supply of a pilot fuel to the burner of FIG. 1;

FIG. 5 is a vertical cross-sectional view of an embodiment of the invention adapted for operation with a longitudinal flame and comprising a provision for the supply of a pilot fuel; and

FIG. 6 is a partly cross-sectional view of a combustion device in which another embodiment of the burner according to the invention is applied.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

Referring to FIG. 1 of the drawing, a hollow body is shown comprising an annular hollow body part 1 and a hollow central barrel part 2, each of these parts being adapted for receiving a coolant. To this end, a cylindrical partition wall 3 is provided in the annular body part 1 and terminating at some distance from the front wall 11 thereof, which partition wall 3 subdivides the body part 1 into two concentric spaces for the supply and return flow of coolant respectively. In the central hollow barrel part 2, a central coolant supply tube 4 is provided debouching into the nose part 5 of the barrel part 2.

The central barrel part 2 and the hollow body part 1 are separated by an annular main channel 6. The barrel part 2 is provided with a fuel supply channel 7 debouching into the annular main channel 6 through a lateral opening 8. This opening 8 may be an annular slit or may also be formed by a series of openings (not shown in FIG. 1) equally divided over the circumference of the inner wall of the main channel 6. Downstream of the lateral opening 8 (or openings), the main channel 6 terminates at a bluff body 9 having a flat end face 10. The end face 10 of the bluff body 9 may also be slightly concave or hollow conical. Downstream of the end face 10 of the bluff body 9, which is retracted with regard to the end face or front wall 11 of the burner, the supply of the reactants (fuel and oxidant) terminates in a common discharge duct 12.

In the embodiment according to FIG. 1, a design is shown adapted for "umbrella"-type flames, to which end the terminal part of the annular main channel 6 is cone shaped diverging to the downstream end. The bluff body 9 is provided in this conical part and is in this embodiment formed by a sudden widening of the cross section of the main channel. The fuel supply channel terminates in two successive series of supply openings 8, the first opening 8 (or series of openings) debouching laterally into the main channel 6 upstream of the bluff body 9 and a second opening 13 debouching into the main channel 6 at the edge of the end face 10 of the bluff body 9 adjacent to the lateral wall of the main channel 6. Consequently the fuel stream is divided to allow part to be atomized from the stabilizer edge at the lateral opening 8 (or openings) and part to be atomized at the outer edge of the bluff body 9. The opening 13 may also be ring shaped, if desired.

In the embodiment according to FIG. 2 wherein like numerals refer to like parts of FIG. 1, a bluff body 9*a*, similar to body 9 of FIG. 1, originates from a partition wall 14 in a part of the main channel 6 upstream of the bluff body 9*a*, which partition wall 14 subdivides the main channel 6 over a part of its length into an inner part 6*b* and an outer part 6*a*. The terminal part of the fuel supply channel 7 is subdivided into two channels, a first channel being the prolongation of the fuel supply channel 7 and debouching through a lateral opening 8*a* (or series of openings) upstream of the bluff body 9 into the inner part 6*b* of the main channel 6 and a second branched-off channel 15 being led axially through the partition wall 14 and debouching through a lateral opening 16 (or series of openings) into the outer part 6*a* of the main channel 6. In this embodiment, the oxidant stream is divided by the partition wall 14 and the bluff body 9*a*. Also, the fuel is subdivided into

two streams so that part thereof is atomized into each of the two oxidant streams.

In the embodiment according to FIG. 3, wherein like numerals refer to like parts of FIGS. 1 and 2, a partition wall 14 extends throughout the main channel 6 also subdividing this channel 6 into outer part 6*a* and an inner part 6*b*. The fuel supply channel is formed by a passage within the partition wall 14 terminating upstream of the bluff body 9*b* which originates from the partition wall 14 into two lateral openings 8*b* and 8*c* (or series of openings), one debouching into the inner part 6*b* of the main channel 6 and another opposite thereof debouching into the outer part 6*a* of the main channel 6.

Alternatively, the partition wall need not extend throughout the main channel 6 but also may be shaped as shown in the embodiment illustrated in FIG. 2. The passage 7 may be tubular, annular or of any other suitable shape.

FIG. 4 shows an embodiment comprising a provision for the supply of a pilot fuel where again like numerals refer to like parts of FIGS. 1 through 3. To this end, a further channel 17 is provided in the outer hollow body part 1, this further channel 17 being concentric with the main channel 6 and the fuel supply channel 7. It debouches into the main channel 6 through a lateral opening 18 (or openings) upstream of the bluff body 9*c*, which in this embodiment is formed by a sudden widening of the main channel 6 at the outer lateral wall thereof forming a flow discontinuity. Channel 17 may be tubular, annular or of any other suitable shape.

The embodiment according to FIG. 5 where again like numerals refer to like parts of FIGS. 1 through 4 represents a design adapted for operation with a longitudinal flame and also comprising a provision for the supply of a pilot fuel. The bluff body 9*d* originates from a partition wall 14 extending over a part of the length of annular main channel 6 and locally subdividing the channel 6 into an inner main channel 6*b* and an outer main channel 6*a*. In the inner main channel 6*b*, the fuel will be atomized debouching therein through a lateral opening 8 (or openings) at the terminal end of the fuel channel 7. A pilot gas supply is fed into the outer main channel through lateral port or ports 18 at the terminal end of the pilot fuel line 17. Consequently, in the outer main channel 6*a*, a premixed oxy-gas stream forms a pilot flame from the end of the bluff body 9*d*.

In the combustion device according to FIG. 6 where again like numerals refer to like parts of FIGS. 1 through 5, the end face 11*a* of the annular hollow body part 1 has an enlarged surface constituting together with the nose part 5*a* of the barrel 2, the bottom of a flame chamber 19 open at the other end and bounded by a hollow lateral wall 20, which is adapted for circulating a coolant therein to which end a partition wall 21 is provided subdividing the hollow space into two concentric annular channels 21*a* and 21*b* in communication with each other at the front end of the lateral wall 20.

At least one supply pipe 22 may be provided within part 1 for the supply of coolant thereto.

By moving the bottom of the flame chamber 19 with regard to the lateral wall 20, the flame shape can be influenced at will. The effective length of the flame chamber 19 is preferably adjustable between 0.1 and 0.8 of the diameter of the flame chamber.

A pilot gaseous fuel supply channel 17 is also included in this embodiment of the invention, the pilot fuel channel 17 debouching into an isolated terminal part of the main channel 6 through at least one lateral opening, this isolated part being formed by a partition wall 14 originating from the outer lateral wall of the annular main channel 6 at the terminal downstream end of which wall the bluff body 9*e* is provided.

The embodiments as described hereinabove are by way of example only and consequently it will be possible to apply all embodiments shown in connection with the longitudinal flame design as well as the "umbrella"-type designs, each of the last-mentioned designs being suitable to be applied in a combustion device as shown in FIG. 6.

I claim as my invention:

1. A burner for burning liquid fuel therein comprising:
a hollow enclosure, having an outer wall and an end face, adapted to receive a coolant therein;
said enclosure having a first annular channel extending therethrough spaced inwardly from said outer wall for receiving a flow of an oxidant therethrough and a second annular channel concentric with, adjacent to the inwardly of said first annular channel for receiving a flow of a liquid fuel therethrough, said second annular channel terminating before the end face of said enclosure and being in communication with said first annular channel;
said communication between said first and second channels being by means including at least a first lateral fuel supply opening leading from one of said channels to the other;
said burner including a bluff body having an end face disposed in said enclosure within said first annular channel between said fuel supply opening and said end face of said enclosure downstream of said fuel supply opening and retracted with respect to the end face of said enclosure and including downstream of said bluff body an annular discharge duct for fuel and oxidant common to said first and second annular channels; said first annular channel opening into said annular discharge duct at the end face of said bluff body.

2. The burner of claim 1 wherein the bluff body has a flat end face substantially perpendicular to the direction of flow of oxidant through said first channel.

3. The burner of claim 2 wherein said second channel terminates in at least two fuel supply openings, a first fuel supply opening debouching laterally into the first channel upstream of the bluff body and second fuel supply opening debouching into the first channel downstream of the bluff body.

4. The burner of claim 1, wherein at least part of the first annular channel is subdivided by a partition wall into an inner part and an outer part, and wherein the terminal end of the second channel is subdivided into two zones, a first zone debouching through at least one lateral fuel supply opening upstream of the bluff body into the inner part of the first channel and a second branched-off zone leading through the partition wall and debouching through at least one lateral fuel supply opening into the outer part of the first channel.

5. The burner of claim 4, wherein the bluff body forms a portion of the partition wall which subdivides said first channel, wherein said wall extends throughout the first channel upstream of the bluff body and wherein the second channel constitutes a passage within the wall terminating upstream of the bluff body into at least two lateral openings, one debouching into the inner part of the first channel and another opposite thereof debouching into the outer part of the first channel.

6. The burner of claim 1, including a third annular channel in said enclosure for providing pilot fuel thereto debouching into said first channel through at least one lateral opening.

7. The burner of claim 1, wherein the fuel supply opening is a circumferential slot in the wall dividing said first and second channels.

8. The burner of claim 1, wherein the annular discharge duct is conical with substantially constant cross section and diverging to the enclosure end face, wherein the terminal portion of the first annular channel is conical, and wherein the bluff body is disposed in the conical part of the first annular channel.

9. The burner of claim 1, including a substantially cylindrical flame chamber within said hollow enclosure downstream of said annular discharge duct.

10. The burner of claim 9, including means for axially adjusting the length of the flame chamber.

* * * * *

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UNITED STATES PATENT OFFICE
CERTIFICATE OF CORRECTION

Patent No. 3,644,076 Dated February 22, 1972

Inventor(s) Leonard P. Bagge

It is certified that error appears in the above-identified patent and that said Letters Patent are hereby corrected as shown below:

In claim 1, column 4, line 10, after "adjacent to" change "the" to -- and --.

Signed and sealed this 11th day of July 1972.

(SEAL)
Attest:

EDWARD M.FLETCHER, JR.
Attesting Officer

ROBERT GOTTSCHALK
Commissioner of Patents